

FUZZ-IEEE 2011

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Fuzzy Systems**



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Final Program and Abstracts

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A Message from the Conference Organizers

2011 IEEE International Conference on Fuzzy Systems

It is our great privilege to welcome you to the *2011 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2011)* held in Taipei, Taiwan, June 27-30, 2011. Like the previous conferences in this series, we are confident that FUZZ-IEEE 2011 will provide a forum for fruitful interaction and exchange of ideas between the participants coming from around the world. FUZZ-IEEE 2011 covers all major facets of computational intelligence, but as usual, the primary emphasis will be on fuzzy sets and systems. We are glad to note that 58 different countries from around the world are represented by the authors, thereby making it a truly international event.

The technical program covers four days of presentations including three keynote speeches, two plenary speeches, three invited talks, one Human vs. Computer Go competition, five tutorials, five workshops, two panel sessions, and forty three special sessions given by well-known world class researchers in various fuzzy related subject areas. As for the papers, a total of 358 papers were accepted for oral presentation and 82 for poster presentation out of 618 submissions. So, we expect you to have a great time during these four days. However, we would like to express our sincere gratitude to all the authors and reviewers who have made so many effects for the preparation of their latest researches and all the tutorial and invited speakers who kindly accepted sharing their expertise with the attendees.

No conference can be successful without excellent teamwork and ours is no different. Our special appreciations also go to the sacrifices and perspirations of our colleagues and organizing committee members, for example, Wei-Yen Wang (Local Arrangement Chair), I-Fang Chung (Finance Chair), Shun-Feng Su (Finance Co-Chair), Chia-Feng Juang (Publication Chair), Hani Hagrais (Special Sessions Chair), Naoyuki Kubota (Special Sessions Co-Chair), Jyh-Yeong Chang (Registration Chair), Vincenzo Loia (Workshop Chair), Shyi-Ming Chen (Publicity Chair), Mei-Hui Wang (Secretary), Ya-Wen Lin (Secretary), and Hung-Miau Chen (Secretary) in making this conference a smooth process. Most of all, thank you for attending FUZZ-IEEE 2011. We hope this conference will benefit all of us in advancing research activities and building new friendship.



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Organizers: Kiyota Hashimoto and Shingo Aoki

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Organizers: J. C. Lo and H. K. Lam

SS13: Fuzzy Multiple Criteria Decision Making

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SS14: Advances in Fuzzy Theory and their Applications

Organizers: Shyi-Ming Chen and Huey-Ming Lee

SS15: Type-2 Fuzzy Logic Theory

Organizers: Christian Wagner and Robert John

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Organizers: Qiang Shen, László Koczy, and Shyi-Ming Chen

SS17: Practical and Applications Aspects of Type-2 Fuzzy Logic Systems

Organizers: Hani Hagrass and Simon Coupland

SS18: Recent Advances in Fuzzy Logic in Image Processing

Organizers: Mike Nachtgeael and Gerald Schaefer

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SS21: Fuzzy Control in Industrial and Application

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Tomoharu Nakashima	Witold Pedrycz	Isaac Sledge
Mohammad Narimami	Wytold Pedrycz	Dominik Slezak
Costas Neocleous	David Pelta	Stephen Smith
Sing Kiong Nguang	Juan Peralta Donate	Pilar Sobrevilla
Adam Niewiadomski	Antonio Peregrin	Alejandro Sobrino
Manabu Nii	Martin Pereira-Farina	Joao Sousa
Hitoshi Nishi	Raul Perez	Dipti Srinivasan
Junji Nishino	Irina Perfilieva	Giorgos Stamou
Vesa A. Niskanen	Alfredo Petrosino	Umberto Straccia
Keiichi Niwa	Fred Petry	Maja Stula
Yusuke Nojima	Vincenzo Piuri	Chrysostomos Stylios
Akira Notsu	Hector Pomares	Juhng-Perng Su
Vilem Novak	Mihail Popescu	Ming-Yang Su
Andreas Nuernberger	Marjan Popov	Steven Su
Alessandro G. Di Nuovo	Chotipat Pornavalai	Tom Sudkamp
Hannu Nurmi	Ana Pradera	Tsung-Ying Sun
Chi-Hyon Oh	Belen Prados Suarez	Yeong-Jeu Sun
Shin-ichi Ohnishi	Girijesh Prasad	Kenji Suzuki

Kovacs Szilveszter	Albert Van Der Heide	Hongwei Wu
Seyed Mahmoud Taheri	Patricia A. Vargas	Huai-Ning Wu
Noburu Takagi	Thanos Vasilakos	Min Wu
Yasutake Takahashi	Laurentiu Vasiliu	Sebastia Xambo
Takahiro Takeda	Giovanni Velotto	Gang Xiang
Kazuhiro Takeuchi	Enrique Herrera Viedma	Fuding Xie
Woei Wan Tan	Vinicius da F. Vieira	Zong-Yi Xing
Yandong Tang	Amparo Vila	Ning Xiong
Tadanari Taniguchi	Pedro Villar	Shamshul Bahar Yaakob
Chin-Wang Tao	Karen Villaverde	Yoshiyuki Yabuuchi
Kai Meng Tay	Autilia Vitiello	Ronald R. Yager
Maguelonne Teisseire	Peter Vojtas	Naomi Yagi
Andreja Tepavcevic	Michael Wagenknecht	Yoichi Yamazaki
Settimo Termini	Christian Wagner	Hong-Tzer Yang
Vladimir Terzija	Rong-Jong Wai	Longzhi Yang
Ruck Thawonmas	Antony Waldock	Hitoshi Yano
Nipon Theera-Umpon	Igor Walter	Toshiyuki Yasuda
John B. Theocharis	Cheng-Yi Wang	Chi-Tsuen Yeh
Chuan-Kang Ting	Chun-Chieh Wang	I-Cheng Yeh
Vicenc Torra	Fei-Yue Wang	Shi-Jim Yen
Enric Trillas	Feng-Hsu Wang	Chenjiu Yin
Gracian Trivino	Jeen-Shing Wang	Tang-Kai Yin
Ching-Chih Tsai	Jen-Sheng Wang	Hao Ying
Hung-Hsu Tsai	Ling Wang	Jun Yoneyama
Kun-Lin Tsai	Mei-Hui Wang	Tomohiro Yoshikawa
Men-Shen Tsai	Shuming Wang	Ker-Wei Yu
Shun-Hung Tsai	Shyue-Liang Wang	W.S. Yu
Chung-Shi Tseng	Wei-Yen Wang	Jia Zeng
Fan-chuan Tseng	Zhenyuan Wang	Xiao-Jun Zeng
Naoki Tsuchiya	Junzo Watada	Daoyuan Zhai
Shusaku Tsumoto	Toshihiko Watanabe	Baoyong Zhang
Kuo-Yang Tu	Chih-Chin Wen	Geng Zhang
Gwo-Hshiung Tzeng	Rahmat Widianto	Hongbin Zhang
Silvia Ullo	Anna Wilbik	Xianxia Zhang
Takeshi Uno	Andy Wong	Qiangfu Zhao
Alfredo Vaccaro	Kok Wai Wong	Haibo Zhou
Gancho Vachkov	Man Leung Wong	Huiyu Zhou
Fevrier Valdez	Chih-Hung Wu	Shang-ming Zhou
Jose Valente de Oliveira	Dongrui Wu	William Zhu
Marcos Eduardo Valle	Gin-Der Wu	

Tutorials

T01: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems

Instructor: Rafael Alcala

T01-1: Monday, June 27, 2011 (9:00 AM- 10:30 AM) Room: Peacock

T01-2: Monday, June 27, 2011 (11:00 AM- 12:30 PM) Room: Peacock

T02: Interpolative Fuzzy Rule Bases

Instructor: László Koczy

T02-1: Monday, June 27, 2011 (9:00 AM- 10:30 AM) Room: Phoenix

T02-2: Monday, June 27, 2011 (11:00 AM- 12:30 PM) Room: Phoenix

T03: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 1

Instructor: Jerry Mendel

T03-1: Monday, June 27, 2011 (9:00 AM- 10:30 AM) Room: Crane

T03-2 Monday, June 27, 2011 (11:00 AM- 12:30 PM) Room: Crane

T04: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 2

Instructor: Hani Hagrass

T04-1: Monday, June 27, 2011 (01:30 PM- 03:00 PM) Room: Peacock

T04-2: Monday, June 27, 2011 (03:30 PM- 05:00 PM) Room: Peacock

T05: Towards a Unified Framework for Intelligent Robotics

Instructors: Honghai Liu and Naoyuki Kubota

T05-1: Monday, June 27, 2011 (01:30 PM- 03:00 PM) Room: Phoenix

T05-2: Monday, June 27, 2011 (03:30 PM- 05:00 PM) Room: Phoenix

Workshops

W01: Fuzzy Approaches to Ambient Intelligent Agents

Organizers: Vincenzo Loia and Hani Hagras

W01-1: Monday, June 27, 2011 (9:00 AM- 10:30 AM) Room: Egret

W01-2: Monday, June 27, 2011 (11:00 AM- 12:30 PM) Room: Egret

W02: Standards in Computational Intelligence

Organizers: Giovanni Acampora, Plamen Angelov, and Bruno Di Stefano

W02: Monday, June 27, 2011 (9:00 AM- 10:30 AM) Room: Swallow

W03: Computational Intelligence Techniques for Smart Grids

Organizers: Alfredo Vaccaro and Vladimir Terzija

W03-1: Monday, June 27, 2011 (01:30 PM- 03:00 PM) Room: Crane

W03-2: Monday, June 27, 2011 (03:30 PM- 05:00 PM) Room: Crane

W04: Computer Game and Fuzzy-based Game Applications

Organizers: Shun-Chin Hsu, I-Chen Wu, and Shi-Jim Yen

W04-1: Monday, June 27, 2011 (01:30 PM- 03:00 PM) Room: Egret

W04-2: Monday, June 27, 2011 (03:30 PM- 05:00 PM) Room: Egret

W05: Hybrid Computational Intelligence Applications

Organizers: Chuan-Kang Ting and Tzung-Pei Hong

W05-1: Monday, June 27, 2011 (01:30 PM- 03:00 PM) Room: Swallow

W05-2: Monday, June 27, 2011 (03:30 PM- 05:00 PM) Room: Swallow

Plenary Speech I

Date/Time: Tuesday, June 28, 2011 /1:30 PM- 2:30 PM

Room: Grand Ballroom I, Chair: Chang-Shing Lee

Type-2 Fuzzy Sets and Systems: Challenges and Misconceptions.



Prof. Jerry M. Mendel

University of Southern California, USA

Abstract

Type-2 fuzzy sets and systems have now moved into the mainstream of world-wide research and should no longer be viewed as an "emerging" research area. During the latter part of 2009 and the first half of 2010 a small group of type-2 researchers created a jointly-authored CI Magazine article, whose title is that of this talk. In addition, in April 2011 there were two panel sessions at the Advances in Type-2 Fuzzy Sets and Systems Symposium, that was a part of the IEEE CIS Symposium Series on CI, held in Paris, France. These panel sessions were also on the topics in the title of this talk. In this talk, I will summarize the main conclusions from the magazine article and the two panels (and ensuing discussions) about the challenges and misconceptions of type-2 fuzzy sets and systems. This should be of great interest to researchers who want to know the directions of the vectors of most promising type-2 research.

Biography

Jerry M. Mendel is Professor of Electrical Engineering and Systems Architecting Engineering at the University of Southern California in Los Angeles, where he has been since 1974. He has published over 480 technical papers and is author, co-author and/or editor of nine books, including *Uncertain Rule-based Fuzzy Logic Systems: Introduction and New Directions* and *Perceptual Computing: Aiding People in Making Subjective Judgments* (2010). His present research interests include: type-2 fuzzy logic systems and their applications to a wide range of problems, including smart oil field technology and computing with words. He is a Life Fellow of the IEEE, a Distinguished Member of the IEEE Control Systems Society, and a Fellow of the International Fuzzy Systems Association (2009). He was President of the IEEE Control Systems Society in 1986. He was a member of the Administrative Committee of the IEEE Computational Intelligence Society (2004-2009) and was Chairman of its Fuzzy Systems Technical Committee. He is presently Chair of

the Computing With Words Task Force of the IEEE Computational Intelligence Society. Among his awards are the 1983 Best Transactions Paper Award of the IEEE Geoscience and Remote Sensing Society, the 1992 Signal Processing Society Paper Award, the 2002 Transactions on Fuzzy Systems Outstanding Paper Award, a 1984 IEEE Centennial Medal, an IEEE Third Millennium Medal, and a Fuzzy Systems Pioneer Award (2008) from the IEEE Computational Intelligence Society.

Plenary Speech II

Date/Time: Wednesday, June 29, 2011 /1:30 PM- 2:30 PM

Room: Grand Ballroom I, Chair: Faa-Jeng Lin

Soft Computing in Prognostics and Health Management (PHM) Applications: A Case Study in Anomaly Detection



Dr. Piero Bonissone

GE Global Research, USA

Abstract

Soft Computing (SC) is a term that has evolved, since its inception in 1991, to represent a methodology and a set of techniques covering the aspects of data-driven models design, domain knowledge integration, model generation, and model tuning. We distinguish between offline Meta-heuristics (MH's), used for model design and tuning, and online MH's, used for models selection or aggregation. This view suggests the use of hybrid SC at each MH's level as well as at the object level. We manage model complexity by finding the best model architecture to support problem decomposition, generate local models with high-performance in focused applicability regions, provide smooth interpolations among local models, and increase robustness to imperfect data by aggregating diverse models. We illustrate this concept with a case study in anomaly detection for a fleet of physical assets (such as an aircraft engines or a gas turbines.) Anomaly detection typically uses unsupervised learning techniques to extract the underlying structural information from the data, define normal structures and regions, and identify departures from such regions. We focus on one of the most common causes for anomalies: the inadequate accuracy of the anomaly detection models, which are prone to create false alarms. To address this issue, we propose a hybrid approach based on a fuzzy supervisory system and an ensemble of locally trained auto associative neural networks (AANN's.) The design and tuning of this hierarchical model is performed using evolutionary algorithms. In our approach we interpolate among the outputs of the local models (AANN's) to assure smoothness in operating regime transition and provide continuous condition monitoring to the system. Experiments on simulated data from a high bypass, turbofan aircraft engine model demonstrated promising results.

Biography

Piero Bonissone A Chief Scientist at GE Global Research, Dr. Bonissone has been a pioneer in the field of fuzzy logic, AI, soft computing, and approximate reasoning systems applications

since 1979. He is a Coolidge Fellow at GE Global Research (1993). He is also a Fellow of the Association for the Advancement of Artificial Intelligence (1996), the IEEE (2004), and the International Fuzzy Systems Association (2005). He served as Editor in Chief of the International Journal of Approximate Reasoning for 13 years (1993-2005). He co-edited six books and co-authored 150 publications. He received 54 patents issued from the USPTO (plus 50 pending). He has co-chaired 12 scientific conferences and symposia focused on Multi-Criteria Decision-Making, Fuzzy sets, Diagnostics, Prognostics, and Uncertainty Management in AI. In 2002, he was President of the IEEE Neural Networks Society (now Computational Intelligence Society). He has been an Executive Committee member of NNC/NNS/CIS society since the past 16 years and an IEEE CIS Distinguished Lecturer since 2004. In 2008 he received the II Cajastur International Prize for Soft Computing, from CajAstur and the Foundation for the Advancement of Soft Computing. He is the Chair of the Scientific Committee of the European Centre of Soft Computing.

Keynote Speech I

Date/Time: Tuesday, June 28, 2011 /10:50 AM- 12:00 PM

Room: Grand Ballroom I, Chair: Jyh-Yeong Chang

Inferring Disease Related Gene-Gene Interactions: A Fuzzy Logic Based Approach



Prof. Nikhil Pal

Indian Statistical Institute, India

Abstract

There have been many attempts to infer gene-gene interactions from microarray data based on different approaches such as mutual information, Bayesian networks, and differential equations. The gene-gene interactions identified by such methods reveal important and interesting biological functions, but all of these may not be related to a phenotype, say, a particular cancer. In this talk we shall focus on identification of gene-gene interactions, which are related to a particular disease. Two genes individually may be related to a particular cancer but we are not interested in such pairs. The objective here is to identify pairs of genes whose cooperative behavior make them related to the disease. There have been a few attempts to address this problem based on information theoretic concepts. In this talk first we shall discuss the main philosophy behind such approaches and some associated issues/problems. Then we shall present a very simple fuzzy set theoretic method for inferring gene-gene interactions associated to a particular type of disease/cancer. Our method is based on a set of fuzzy rules. The advantages of this fuzzy approach over the existing ones will be discussed. Finally, we shall demonstrate the effectiveness of our method on a benchmark data set.

Biography

Nikhil R. Pal is a Professor in the Electronics and Communication Sciences Unit of the Indian Statistical Institute. He has also served as a Chair Professor at the National Chiao Tung University, Taiwan and as a visiting professor at other universities. He has coauthored, edited/co-edited several books. His current research interest includes bioinformatics, brain science, fuzzy logic, image and pattern analysis, neural networks, and evolutionary computation. He serves on the editorial /advisory board/ steering committee of several journals including the International Journal of Approximate Reasoning, Applied Soft Computing, Neural Information

Processing—Letters and Reviews, International Journal of Knowledge-Based Intelligent Engineering Systems, International Journal of Neural Systems, Fuzzy Sets and Systems, International Journal of Intelligent Computing in Medical Sciences and Image Processing, Fuzzy Information and Engineering : An International Journal, and the IEEE Transactions on Systems Man and Cybernetics—B. He has been serving as the Editor-in-Chief of the IEEE Transactions on Fuzzy Systems since 2005. He has given many plenary/keynote speeches in different premier international conferences in the area of computational intelligence. He was the president of the Asia Pacific Neural Net Assembly. He was the Program Chair of the 4th International Conference on Advances in Pattern recognition and Digital Techniques, December 1999, Calcutta, India and was a co-program chair of 2005 IEEE International Conference on Fuzzy Systems and 2006 IEEE International Conference on Fuzzy Systems. He was the General Chair of 2002 AFSS International Conference on Fuzzy Systems, Calcutta, 2002 and the 11th International Conference on Neural Information Processing, ICONIP 2004. He is a Fellow of the National Academy of Sciences, India, a Fellow of the Indian National Academy of Engineering, a Fellow of the International Fuzzy Systems Association (IFSA), and a Fellow of the IEEE, USA.

Keynote Speech II

Date/Time: Wednesday, June 29, 2011 /10:50 AM- 12:00 PM

Room: Grand Ballroom I, Chair: Chia-Feng Juang

Fuzzy Approaches to Information Fusion



Prof. Bernadette Bouchon-Meunier

University Paris VI, France

Abstract

Fusion is a major issue in all steps of the management of information, from data representation to data mining and decision-making, from basic granules of information to consensus of opinions or semantic interpretation of situations. The complexity of data is due to various factors : heterogeneous media, large size available data on the web or provided by all kinds of sensors, incomplete data bases, imprecise or subjective information granules, the reliability of sources, to mention a few of them. Fuzzy approaches provide interesting solutions to cope with such problems. We will address two main levels in information fusion. The first one is technical and concerns basic needs in image processing, prototype construction or classifier fusion. The second one is more abstract and deals with the interpretation of results, the recognition of high level features in images or videos, or the issue of information scoring.

Biography

Bernadette Bouchon-Meunier is a director of research at the National Center for Scientific Research, head of the department of Databases and Machine Learning in the Computer Science Laboratory of the University Paris 6. Graduate from the Ecole Normale Supérieure at Cachan, she received the degrees of B.S. in Mathematics and Computer Science, Ph.D. in Applied Mathematics and D. Sc. in Computer Science from the University of Paris. She is the Editor-in-Chief of the International Journal of Uncertainty, Fuzziness and Knowledge-based Systems (World Scientific), She is also a member of the editorial board of the International Journal of Approximate Reasoning, Fuzzy Sets and Systems, International Journal of Fuzzy Systems, International Journal of Information Technology and Intelligent Computing, Journal of Uncertain Systems. She is the (co)-editor of 21 books and the (co)-author of four books in French and one in vietnamese on Fuzzy Logic and Uncertainty Management in Artificial Intelligence. She is a co-founder and co-executive

director of the International Conference on Information Processing and Management of Uncertainty in Knowledge-based Systems (IPMU) held every other year since 1986. She is an IEEE senior member and an International Fuzzy Systems Association fellow. Her present research interests include approximate and similarity-based reasoning, as well as the application of fuzzy logic and machine learning techniques to decision-making, data mining, risk forecasting, information retrieval and user modelling.

Keynote Speech III

Date/Time: Thursday, June 30, 2011 /10:50 AM- 12:00 PM

Room: Grand Ballroom I, Chair: Jung-Hsien Chiang

Soft Computing for Hard Pattern Recognition Problems



Prof. Paul Gader

University of Florida, USA

Abstract

A survey of research and development of fuzzy set related approaches for use in difficult applications involving pattern recognition. Approaches include fuzzy clustering, fuzzy k-nearest neighbors, ordered weighted averaging operators, fuzzy integrals, and random sets. Applications will be drawn from medical image and signal analysis, landmine detection, language processing, and hyperspectral image analysis for remote sensing, face recognition, and trace material detection.

Biography

Paul Gader received his Ph.D. in Mathematics for image processing related research in 1986 from the University of Florida. He has worked as a Senior Research Scientist at Honeywell's Systems and Research Center, as a Research Engineer and Manager at the Environmental Research Institute of Michigan, and as a faculty member at the University of Wisconsin - Oshkosh, the University of Missouri - Columbia, and the University of Florida, where he is currently a Professor of Computer and Information Science and Engineering. His research has spanned a number of areas related to image analysis and pattern recognition including applied mathematics, parallel image processing, mathematical morphology, fuzzy and random sets, handwriting recognition, bio-medical image analysis, automatic target recognition, landmine detection, hyperspectral image analysis, and information fusion. He enjoys trying to devise theoretical approaches and translate them into applications and trying to understand what the important issues are in that process.

Invited Talk I

Date/Time: Wednesday, June 29, 2011 /08:00 AM- 9:00 AM

Room: Grand Ballroom I, Chair: Yau-Hwang Kuo

Casual Communication between Robots and Humans based on Robot Technology Middleware and Multimedia Recognition



Prof. Kaoru Hirota

Tokyo Institute of Technology, Japan

Abstract

The Mascot Robot System has been developed by the author's group as a part of the "Development Project for a Common Basis of Next-Generation Robots" sponsored by NEDO (New Energy and industrial technology Development Organization). The main purpose of the mascot robot system is to perform casual communication between robots and humans mainly based on the speech recognition module mounted on household robots. The system is implemented as a network of multi-robots freely connected by RT middleware (RTM). It consists of 5 robots, i.e., 4 fixed robots (placed on a TV, a darts game machine, an information terminal, and a mini-bar) and 1 mobile robot. Each of them includes an eye robot, a speech recognition module, and a notebook PC that controls the robot and the speech recognition module. These robots connect together with a server through the internet by RTM, thus constituting the Robot System. The Mascot Robot System's functioning is demonstrated in an ordinary living room, where casual communication between 5 robots and 4 human beings (1 host, 2 guests, and 1 walk-in) is conducted based on speech recognition and mentality expression of eye robots. The experimental results are shown by DVD files.

The NEDO project is extended to JSPS (Japan Society for Promotion of Science) project ongoing, where computational intelligence based gesture recognition method is proposed and embedded in the mascot robot system to realize casual communication between robots and humans. It utilized both video image data from web camera, voice information by microphone, and motion data given by a wearable 3D acceleration sensor on human wrists to identify the intentions and emotions, i.e., multi media recognition technology. To demonstrate the validity, the proposed method is now applied to a part of a mascot robot system, where a home party scenario performed

by five eye robots and four human participants. On going results show the possibility that the proposed method may be used to improve the interaction between human and robotic systems.

Biography

Kaoru HIROTA received Dr. E. degrees from Tokyo Institute of Technology in 1979. After his career at Sagami Institute of Technology and Hosei University, he has been with Tokyo Institute of Technology. His research interests include fuzzy systems, intelligent robot, and image understanding. He experienced president-elect and fellow of IFSA (International Fuzzy Systems Association), and president of SOFT (Japan Society for Fuzzy Theory and Systems.) He is a chief editor of J. of Advanced Computational Intelligence and Intelligent Informatics. Banki Donat Medal, Henri Coanda Medal, Grigore MOISIL Award, SOFT best paper award, Acoustical Society of Japan best paper award, honorary professorships from de La Salle University and Changchun Univ. of Science & Technology, and Honoris Causa from Bulacan state university, Budapest Technical University, and Szechenyi Istvan University were awarded to him. He organized more than 10 international conferences/symposiums as a founding/general/program chair. He has been publishing about 250 journal papers, 50 books, and 450 conference papers.

Invited Talk II

Date/Time: Wednesday, June 29, 2011 /05:00 PM- 06:00 PM

Room: Swan, Chair: Li-Wei Ko

Acceleration and Scalability for c-Means Clustering



Prof. James Bezdek

University of West Florida, USA

Abstract

This talk begins with characterization the three canonical problems of clustering: tendency assessment (does the data have cluster substructure?); clustering (how do we find partitions of the data?); and validation (are the partitions we find accurate and/or useful?). I identify the four types of models used in clustering: partition only (single linkage); prototype only (self-organizing maps); partition and prototypes (hard, fuzzy and possibilistic c-means); and (partition, prototype, other parameter) models (EM algorithm for Gaussian mixture decomposition). I will give a brief account of the basic models and algorithms for hard, fuzzy, possibilistic c-means. These algorithms are reliable, but can be slow, and may not scale well for very large data sets. So, the main issues when dealing with huge data sets are acceleration and scaling.

There have been many ideas for acceleration of FCM advanced over the years. I will review eight methods that can be used to speed up clustering with FCM when the entire data set is loadable. Included are AFKM, mrFCM, brFCM and a method for acceleration that depends on mounting the algorithm on a GPU instead of a conventional computer. Reported improvements in speed range from 2:1 to 100:1.

The final part of the talk covers two approaches for (approximate) FCM clustering in VL data. First I will discuss two methods that are based on incremental, distributed clustering (spFCM and oFCM). The second set of three methods considers approaches to approximating FCM clusters for VL data by a much different method – viz., sampling followed by non-iterative extension. This general technique can be used for EM and many other algorithms that are not discussed in this talk. The three algorithms are eFFCM (efficient fast FCM for image data); geFFCM (for feature vector data); and eNERF (for relational data). We will have time to look at only eFFCM here.

Biography

James Bezdek Jim received the PhD in Applied Mathematics from Cornell University in 1973. Jim is past president of NAFIPS (North American Fuzzy Information Processing Society), IFSA (International Fuzzy Systems Association) and the IEEE CIS (Computational Intelligence Society): founding editor the Int'l. Jo. Approximate Reasoning and the IEEE Transactions on Fuzzy Systems: Life fellow of the IEEE and IFSA; and a recipient of the IEEE 3rd Millennium, IEEE CIS Fuzzy Systems Pioneer, and IEEE technical field award Rosenblatt medals. Jim's interests: woodworking, optimization, motorcycles, pattern recognition, cigars, clustering in very large data, fishing, visual methods for clustering, blues music, wireless sensor networks, poker and co-clustering in rectangular relational data. Jim retired in 2007, and will be coming to a university near you soon (especially if there is fishing nearby).

Invited Talk III

Date/Time: Wednesday, June 29, 2011 /06:00 PM- 07:00 PM

Room: Swan, Chair: Li-Wei Ko

Activity Summarization from 3D Video Systems in an Eldercare Environment**Prof. Jim Keller**

University of Missouri-Columbia, USA

Abstract

This talk concerns eldercare. Older adults are living longer and more fulfilled lives, and they desire to live as independently as possible in the home of their choice. However, independent lifestyles come with risks that are complicated by chronic illness and impairments in mobility, cognition, and the senses. In response to this trend, the University of Missouri has been investigating new approaches in caring for the elderly. This research focus has resulted in TigerPlace, an apartment complex for seniors that opened in Columbia, Missouri in 2004. A joint venture between MU's Sinclair School of Nursing and Americare Systems Inc., TigerPlace is one of four projects granted state approval to operate under the "aging in place" model of care giving. Under that model, residents who would otherwise be required by state law to live in nursing homes may have health services brought to them in their apartments instead. One focus of our large multidisciplinary research team, including faculty and students from Engineering, Nursing, Health Management and Informatics, Medicine, Social Work, and Physical Therapy, is the creation of intelligent systems that use sensors to uncover patterns of activity helpful to caregivers, especially targeting mobility and cognitive impairment. Details can be found at <http://eldertech.missouri.edu>.

The larger research program fits perfectly into the concept of Recognition Technology, as defined by L. Zadeh, to be current or future systems that have the potential to provide a "quantum jump in the capabilities of today's recognition systems", and includes systems that incorporate new sensors, novel signal processing and soft computing. In this talk, I will concentrate on generating linguistic activity summarization for large amounts of multiple camera video data, depicting activities that might take place in a single person apartment. Using 2 cameras, a 3-D "voxel person" is constructed (made possible by our high speed GPU construction of silhouettes from image sequences), and sophisticated position and shape features are calculated. A hierarchical fuzzy logic system is built to determine memberships in various states, followed by another set of rules to classify activities (early focus on fall detection). Extensions to a fuzzy voxel person to model the

uncertainty of reconstruction in some areas of the field of view will be discussed. Additionally, we have recently investigated and constructed a real time multiple stereo camera system that produces true depth-based 3-D objects, providing comprehensive models of the environment and the human within it. This representation is completely insensitive to (even abrupt) lighting changes and shadows, incorporates a human detector that provides false alarm reduction for change detection regarding movement of nonhuman objects (e.g. chairs) and objects manipulated by a person, and has a natural way to address tracking and updating, i.e. not adapting stationary humans into the background while still absorbing moved objects even under significant lighting variations.

Biography

Jim Keller James M. Keller received the Ph.D. in Mathematics in 1978. He holds the University of Missouri Curators' Professorship in the Electrical and Computer Engineering and Computer Science Departments on the Columbia campus. He is also the R. L. Tatum Professor in the College of Engineering. His research interests center on computational intelligence: fuzzy set theory and fuzzy logic, neural networks, and evolutionary computation with a focus on problems in computer vision, pattern recognition, and information fusion including bioinformatics, spatial reasoning in robotics, geospatial intelligence, sensor and information analysis in technology for eldercare, and landmine detection. His industrial and government funding sources include the Electronics and Space Corporation, Union Electric, Geo-Centers, National Science Foundation, the Administration on Aging, The National Institutes of Health, NASA/JSC, the Air Force Office of Scientific Research, the Army Research Office, the Office of Naval Research, the National Geospatial Intelligence Agency, the Leonard Wood Institute, and the Army Night Vision and Electronic Sensors Directorate. Professor Keller has coauthored over 350 technical publications.

Jim is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for whom he has presented live and video tutorials on fuzzy logic in computer vision, is an International Fuzzy Systems Association (IFSA) Fellow, an IEEE Computational Intelligence Society Distinguished Lecturer, a national lecturer for the Association for Computing Machinery (ACM) from 1993 to 2007, and a past President of the North American Fuzzy Information Processing Society (NAFIPS). He received the 2007 Fuzzy Systems Pioneer Award and the 2010 Meritorious Service Award from the IEEE Computational Intelligence Society. He finished a full six year term as Editor-in-Chief of the IEEE Transactions on Fuzzy Systems, is an Associate Editor of the International Journal of Approximate Reasoning, and is on the editorial board of Pattern Analysis and Applications, Fuzzy Sets and Systems, International Journal of Fuzzy Systems, and the Journal of Intelligent and Fuzzy Systems. Jim was the Vice President for Publications of the IEEE Computational Intelligence Society from 2005-2008, and is currently an elected Adcom member. He was the conference chair of the 1991 NAFIPS Workshop, program co-chair of the 1996 NAFIPS meeting, program co-chair of the 1997 IEEE International Conference on Neural Networks, and the program chair of the 1998 IEEE International Conference on Fuzzy Systems. He was the general chair for the 2003 IEEE International Conference on Fuzzy Systems.

Panel Sessions

PASI: Interpolation and Approximation in Fuzzy Rule Bases

Organizer and Chair: Laszlo Koczy

Panelists: Kaoru Hirota, Qiang Shen, Christophe Marsala, Mathieu Serrurier,
Laszlo Koczy

Tuesday, June 28, 2011 (8:00 AM- 10:20 AM) Room: Grand Ballroom I

PASII: Computing With Words

Organizer and Chair: Nikhil Pal

Panelists: Jerry Mendel, Hani Hagrass, Jon Garibaldi,
Jim Keller, Janusz Kacprzyk, Nikhil Pal

Tuesday, June 28, 2011 (5:00 PM- 6:30 PM) Room: Grand Ballroom I

IPAS: Birth and Evolution of Fuzzy Logic

Honorary Organizer: Lotfi Zadeh

Chair: James Bezdek

Panelists: Piero Bonissone, Jim Keller, James Bezdek, Hisao Ishibuchi,
Wen-June Wang, Bernadette Bouchon-Meunier, Tan Woei Wan

Tuesday, June 28, 2011 (2:50 PM- 4:30 PM) Room: Grand Ballroom I

Human vs. Computer Go Competition

Description

The technique of Monte Carlo Tree Search (MCTS) has revolutionized the field of computer game-playing, and is starting to have an impact in other search and optimization domains as well. In past decades, the dominant paradigm in game algorithms was alpha-beta search. This technique, with many refinements and game-specific engineering, lead to breakthrough performances in classic board games such as chess, checkers and Othello. After Deep Blue's famous victory over Kasparov in 1996, some of the research focus shifted to games where alpha-beta search was not sufficient. Most prominent among these games was the ancient Asian game of Go. During the last few years, the use of MCTS techniques in Computer Go has really taken off, but the groundwork was laid much earlier. In 1990, Abramson [1] proposed to model the expected outcome of a game by averaging the results of many random games. In 1993, Bruegmann [2] proposed Monte-Carlo techniques for Go using almost random games, and developed the refinement he termed all-moves-as-first (AMAF). Ten years later, a group of French researchers working with Bruno Bouzy took up the idea [3]. Bouzy's Indigo program used Monte-Carlo simulation to decide between the top moves proposed by a classical knowledge-based Go engine [4]. RemiCoulom's Crazy Stone [5] was the first to add the crucial second element, a selective game tree search controlled by the results of the simulations. The last piece of the puzzle was the Upper-Confidence Tree (UCT) algorithm of Kocsis and Szepesvari [6], which applied ideas from the theory of multi-armed bandits to the problem of how to selectively grow a game tree. Gelly and Wang developed the first version of MoGo [7], which among other innovations combined Coulom's ideas, the UCT algorithm, and pattern-directed simulations. AMAF was revived and extended in Gelly and Silver's Rapid Action Value Estimate (RAVE), which computes AMAF statistics in all nodes of the UCT tree. Rapid progress in applying knowledge and parallelizing the search followed. Today, programs such as MoGo/MoGoTW, Crazy Stone, Fuego, Many Faces of Go, and Zen have achieved a level of play that seemed unthinkable only a decade ago. These programs are now competitive at a professional level for 9×9 Go and amateur Dan strength on 19×19 [4], [8].

One measure of success is competitions. In Go, Monte-Carlo programs now completely dominate classical programs on all board sizes (though no one has tried boards larger than 19×19). Monte-Carlo programs have achieved considerable success in play against humans. An early sign of things to come was a series of games on a 7×7 board between Crazy Stone and professional 5th Dan Guo Juan. Crazy Stone demonstrated almost perfect play. Since 2008, National University of Tainan (NUTN) in Taiwan and other academic organizations have hosted or organized several human vs. computer Go-related events, including the 2008 Computational Intelligence Forum & World 9×9 Computer Go Championship [8], and 2009 Invited Games for MoGo vs. Taiwan Professional Go Players (Taiwan Open 2009) [9]. Besides, the FUZZ-IEEE 2009: Panel, Invited Sessions, and Human vs. Computer Go Competition [10] was held at the 2009 International Conference on Fuzzy Systems in Aug. 2009. This event was the first human vs. computer Go competition hosted by the IEEE Computational Intelligence Society (CIS) at the IEEE CIS flag conference. In 2010, MoGo and Many Faces of Go achieved wins against strong amateur players on 13×13 with only two handicap stones. On the full 19×19 board, programs have racked up a number of wins (but still a lot more losses) on 6 and 7 handicap stones against top professional Go players [11], [12]. Also, computer Go Programs have won both as White and Black against top players in 9×9 game [13]. Additionally, in April 2011, MoGoTW broke a new world record by winning the first 13×13 game against the 5th Dan professional Go player with handicap 3 and reversed komi of 3.5. It also won 3 out of 4 games of Blind Go in 9×9 .

Date

June 27-June 29, 2011

Place

Magpie Room

Website

<http://fuzziieee2011.nutn.edu.tw/go/>

Human

More than 10 Taiwanese Professional Go Players will join this competition

- Chun-Hsun Chou (9P)
- Ping-Chiang Chou (5P)
- Joanne Missingham (5P)
- Other 10 professional Go players

Computer Go Program

- MoGo/MoGoTW (France / Taiwan)
- Fuego (Canada)
- Many Faces of Go (USA)
- Zen (Japan)

Organizers

- IEEE / IEEE Computational Intelligence Society (CIS)
- National University of Tainan (NUTN), Taiwan
- INRIA, France
- National Science Council (NSC), Taiwan
- Grid 5000 Project, France
- Taiwanese Association for Artificial Intelligence (TAAI), Taiwan
- Taiwan Association of Cloud Computing (TACC), Taiwan

Co-Chairs

- Chang-Shing Lee, National University of Tainan, Taiwan
- Martin Mueller, University of Alberta, Canada
- Olivier Teytaud, TAO-Inria, France
- Shun-Chin Hsu, Chang Jung Christian University, Taiwan

Potential List of Panelists: (tentative)

- Chang-Shing Lee, National University of Tainan, Taiwan
- Martin Mueller, University of Alberta, Canada

- Wen-Yang Lin, National University of Kaohsiung, Taiwan
- Olivier Teytaud, TAO-Inria, France
- Kuo-Ning Chiang, National Center for High-Performance Computing, Taiwan
- Hani Hagrais, University of Essex, UK
- Tzung-Pei Hong, National University of Kaohsiung, Taiwan
- Vincenzo Loia, University of Salerno, Italy
- Shi-Jim Yen, National Dong Hwa University, Taiwan
- Gary Yen, Oklahoma State University, USA
- Shun-Chin Hsu, Chang Jung Christian University, Taiwan
- Piero Bonissone, GE Global Research, USA
- Shang-Rong Tsai, Chang Jung Christian University, Taiwan
- Giovanni Acampora, University of Salerno, Italy
- Yeh-Ching Chung, National TsingHua University, Taiwan
- Fabien Teytaud, TAO-Inria, France
- Chun-Nan Hsu, Academia Sinica, Taiwan
- Yau-Hwang Kuo, National Cheng-Kung University, Taiwan

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- [3] B. Bouzy and T. Cazenave, "Computer Go: an AI-oriented survey," *Artificial Intelligence Journal*, vol. 132, no. 1, pp. 39-103, 2001.
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- [11] J. B. Hoock, C. S. Lee, A. Rimmel, F. Teytaud, M. H. Wang, and O. Teytaud, "Intelligent agents for the game of Go," *IEEE Computational Intelligence Magazine*, vol. 5, no. 4, pp. 28-42, Nov. 2010.
- [12] C. S. Lee, M. H. Wang, O. Teytaud, and Y. L. Wang, "The game of Go @ IEEE WCCI 2010," *IEEE Computational Intelligence Magazine*, vol. 5, no. 4, pp. 6-7, Nov. 2010.
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Fuzzy Competition

Date

11:00 AM-12:30 PM, June 27, 2011

Place

Swallow Room

Organizers

- IEEE / IEEE Computational Intelligence Society (CIS)
- Task Force on Competitions of the IEEE CIS's Fuzzy Systems Technical Committee

Co-Chairs

- Hao Ying, Wayne State University, USA
- Plamen Angelov, Lancaster University, UK
- Mohammad Biglarbegian, Ryerson University, Canada
- Asli Celikyilmaz, Microsoft Research, USA
- Xinyu Du, Wayne State University, USA
- Dimitar Filev, Ford Motor Company, USA
- Yanqing Ji, Gonzaga University, USA
- Zhao Lu, Tuskegee University, USA
- Edwin Lughofer, Johannes Kepler University of Linz, Austria
- Fazal U. Syed, Ford Motor Company, USA
- Tadanari Taniguchi, Tokai University, Japan
- Xiao-Jun Zeng, University of Manchester, UK
- Haibo Zhou, Central South University, China

General Information

Conference Location

The registration, tutorials, workshops, plenary speeches, keynotes, invited talks, competition, and technical sessions are all held at 3F, Grand Hyatt Taipei, Taipei, Taiwan.

Social Programs

- Welcome Reception: 6:00 PM- 9:00 PM, Monday, June 27, 2011
Venue: Gordon Biersch (GB) Brewery Restaurant, 2F, No.11, Songshou Rd., Xinyi District, Taipei City
- Opening Ceremony: 10:50 AM, Tuesday, June 28, 2011
Room/Venue: Grand Ballroom I, 3F, Grand Hyatt Taipei Hotel
- Banquet: 7:30 PM-10:00 PM, Wednesday, June 29, 2011
Room/Venue: Grand Ballroom II, 3F, Grand Hyatt Taipei Hotel

Internet Access

Free internet access is available at 3F, Grand Hyatt Taipei Hotel. There will be tables and chairs for delegates to relax and have discussions.

Conference Venue

- **Introduction to Taiwan**

Taiwan is a medium-sized archipelago in East Asian. It is located off the southeastern coast of China, at the western edge of the Pacific Ocean, between Japan and the Philippines. The Central Mountain Range divides the east and west coasts and stretches from north to south. A wonderful variety of geo-graphical contrasts exist: mountains, hills, plateaus, plains, basins, and coastline, all in which a diversity of unique flora and fauna thrive. Taipei is the capital of Taiwan. Fig. 1 shows basic information of Taiwan. Taiwan was first known to the West as Ilha Formosa or Beautiful Island.



Fig. 1. Taiwan geographical location.

Taiwan has many tourist attractions such as (1) Taipei 101: The world's tallest certified building; (2) Yushan National Park: the highest mountain in Northeast Asia (Yushan means Mt. Jade); (3) National Palace Museum: one of the five top museums in the world; (4) Taroko National Park: the world-class natural landscapes. We also have some of the friendliest people in the world, 24-hour bookstores and convenience shops, and hustling and bustling night markets—all of which imprint indelible memories in the minds of visitors. Taiwan also has the advantage of convenient transportation and an excellent travel environment that you will want to enjoy again and again. For example, Taiwan High Speed Rail (THSR) makes the tourists easier extend their journey from Taipei to Kaohsiung (the biggest city in southern Taiwan) and it only takes 90 minutes by THSR. For more detailed tourist attractions in Taiwan, the FUZZ-IEEE 2011 attendances can connect to Taiwan Tourism Bureau.

- **Introduction to Taipei**

Taipei is located in the valley of the Danshui River in northern Taiwan. It is Taiwan's capital, as well as Taiwan's busy center of commerce, government, and culture. Taipei itself has a population of almost 3 million and it has 12 administrative districts, listed in Fig. 2. In addition, Taipei also provides Taipei Metro with eight lines: Muzha Line, Danshui Line, Zhonghe Line, Xindian Line, Banqiao Line, Nangang Line, Tucheng Line, and Xiaonanmen Line. Fig. 3 shows the Map of Taipei Metro and also indicates some of the Taipei's most popular attraction areas' locations, including Taipei 101, National Palace Museum, Longshan Temple, ShiLin Night Market, Yangmingshan National Park, Beitou Hot Springs, Danshui Fisherman's Wharf, and Bitan Scenic Area.



Fig. 2. District Map of Taipei.



Fig. 3. Map of Taipei Metro.

- **Introduction to Grand Hyatt Taipei**

The conference venue is Grand Hyatt Taipei, which is situated in the foothills of eastern Taipei's XinYi District, an area where the modern face of Taipei shines with glass and steel skyscrapers, one of the tallest buildings in the world (Taipei 101), wide boulevards, and the Taipei World Trade Center complex. The Grand Hyatt Taipei is located in heart of the Taipei, a burgeoning business, shopping and entertainment district, and it is 45 minutes drive from the Taoyuan International Airport. As the political, economic, and cultural center of Taipei, the district houses many landmark buildings, including the Taipei City Hall, Taipei City Council, Sun Yat-Sen Memorial Hall, and Taipei 101. Additionally, the local attractions include National Palace Museum, Shihlin Night Market, Yangmingshan National Park, Lungshan Temple, and Chiang Kai-shek Memorial Hall. Taipei is the capital of Taiwan and is its largest city. Located to the north, its proximity and accessibility to Taiwan's business and production regions is just as appealing as the national parks and eco-reserves that surround and exist within the city itself. Fig. 4 shows the map near Grand Hyatt Taipei.



Fig. 4. Map near Grand Hyatt Taipei.

Transportation Information

Venue: Grand Hyatt Taipei

Address: 2, Songshou Rd., Taipei 11051, Taiwan

Tel: +886-2-2720-1234

Fax: +886-2-2720-1111

Email: taipei.grand@hyatt.com

Website: <http://taipei.grand.hyatt.com>

From Taiwan Taoyuan International Airport

TPE Airport offers you various direct connections to downtown Taipei. You may select one of the following transportation to arrive at Grand Hyatt Taipei.

Airport Bus

It offers an easy access to the Taiwan Taoyuan International Airport. Fig. 5 shows the Toward You Air Bus (East Line) transportation how to get to the Grand Hyatt Taipei from the Taiwan Taoyuan International Airport and it's about 45-minute ride.



Fig. 5. Toward You Air Bus (East Line) transportation to Grand Hyatt Taipei hotel.

Airport Taxi

Taxi queues are outside the Arrival Halls of both terminals. To ensure the safety of passengers, only the taxis approved by the Aviation Police Bureau are permitted to operate in Taoyuan Airport. The average fare (plus surcharge) to Taipei is about NT\$1,200.

Access Grand Hyatt Taipei

By Bus

1. Take bus No. 207, 537, or Blue 5 to TWTC stop, and walk toward Jilong (Keelung) Road.
2. Take bus No. 1, 284, 292, 611, or 650 to TWTC stop, and walk toward Xinyi Road.

By Metro

Take Metro Banqiao Nagang Line (Blue Line) to Taipei City Hall Station, exit at Exit 2 and take Keelung Rd., join onto Songgao Rd., and turn right to Shihfu Rd., then walk toward Xinyi Road. You will see Grand Hyatt Taipei (please refer to Fig. 6 Location Map of Grand Hyatt Taipei).

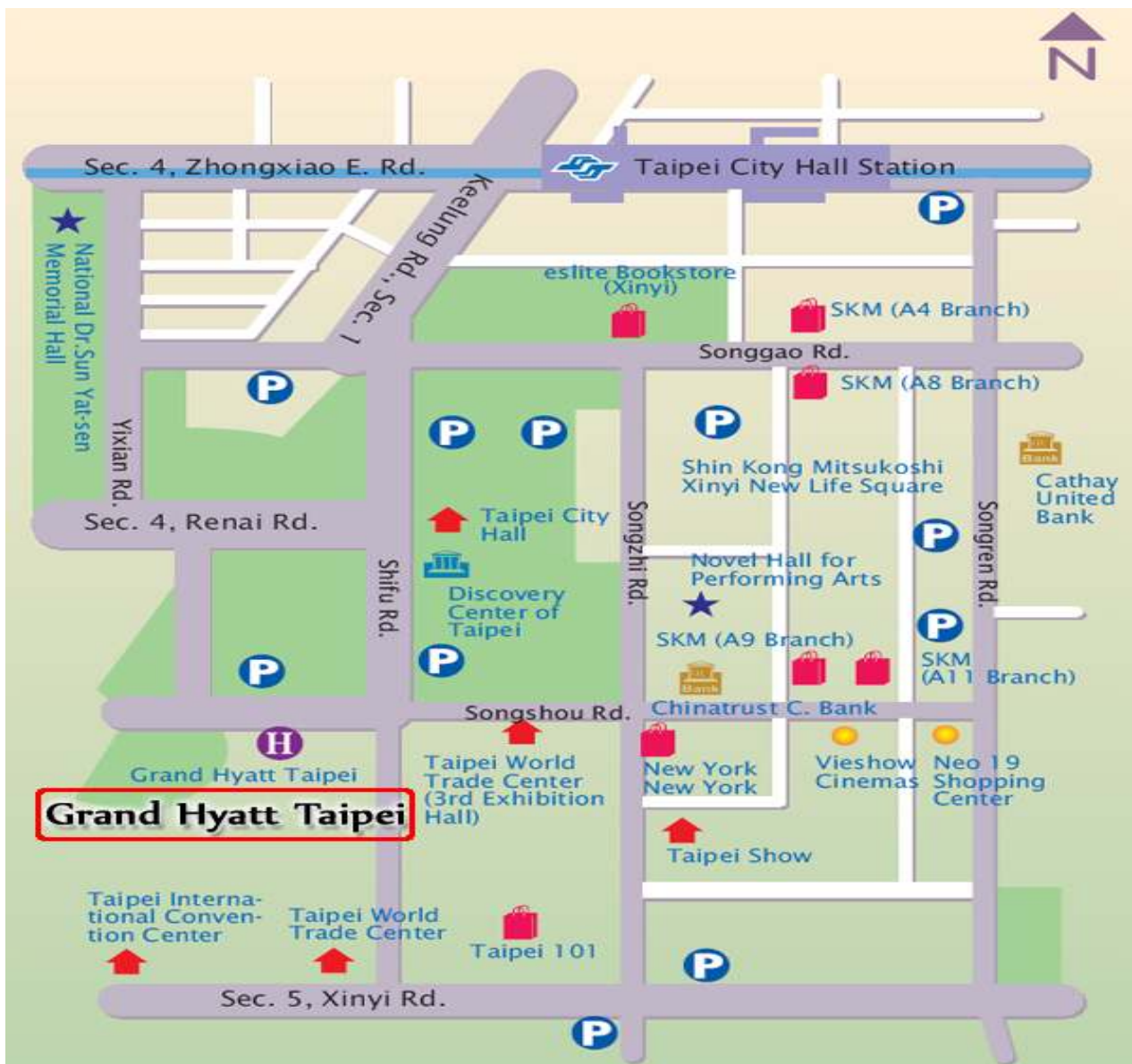


Fig. 6. Location Map of Grand Hyatt Taipei hotel.

Technical Program Schedule

DETAILED PROGRAM

Monday, June 27, 9:00AM-10:30AM

(T01-1) Tutorial: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems
Monday, June 27, 9:00AM-10:30AM, Room: Peacock, Instructor: Rafael Alcalá

(T02-1) Tutorial: Interpolative Fuzzy Rule Bases
Monday, June 27, 9:00AM-10:30AM, Room: Phoenix, Instructor: László Koczy

(T03-1) Tutorial: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 1
Monday, June 27, 9:00AM-10:30AM, Room: Crane, Instructor: Jerry Mendel

(W01-1/SS06) Workshop: Fuzzy Approaches to Ambient Intelligence/Intelligent Agents
Monday, June 27, 9:00AM-10:30AM, Room: Egret, Chair: Vincenzo Loia and Hani Hagras

9:00AM *Gesture-Based Hybrid Approach for HCI in Ambient Intelligent Environments* [#543]
Stefano Carrino, Elena Mugellini, Omar Abou Khaled and Rolf Ingold

9:40AM *A Fuzzy Agent-based Approach to Trust-based Competency Management* [#424]
Matteo Gaeta, Francesco Orciuoli, Sabrina Senatore and Vincenzo Loia

9:20AM *Understanding the Unknown: Unattested Input Processing in Natural Language* [#446]
Julia M. Taylor and Victor Raskin

10:00AM *Open discussion on current and future trends on Fuzzy Approaches to Ambient Intelligence and Intelligent Agents*

(W02) Workshop: Standards in Computational Intelligence
Monday, June 27, 9:00AM-10:30AM, Room: Swallow, Chair: Plamen Angelov, Giovanni Acampora and Bruno Di Stefano

9:00AM *New Evolution Algorithm Based On The Standard Particle Swarm Optimization* [#166]
Lipeng Wang, Yangjie Cheng and Liu Dong C

(HCGC-1) Competition: Human vs. Computer Go Competition
Monday, June 27, 9:00AM-10:30AM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Monday, June 27, 11:00AM-12:30PM**(T01-2) Tutorial: Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems**

Monday, June 27, 11:00AM-12:30PM, Room: Peacock, Instructor: Rafael Alcalá

(T02-2) Tutorial: Interpolative Fuzzy Rule Bases

Monday, June 27, 11:00AM-12:30PM, Room: Phoenix, Instructor: László Koczy

(T03-2) Tutorial: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 1

Monday, June 27, 11:00AM-12:30PM, Room: Crane, Instructor: Jerry Mendel

(W01-2/SS06) Workshop: Fuzzy Approaches to Ambient Intelligence/Intelligent Agents

Monday, June 27, 11:00AM-12:30PM, Room: Egret, Chair: Vincenzo Loia and Hani Hagras

11:00AM *Intrusion Detection Systems Adapted from Agent-based Artificial Immune Systems* [#375]
Chung-Ming Ou, Yao-Tien Wang and C.R. Ou

11:20AM *An Adaptive Multi-Agent Memetic System for Personalizing e-Learning Experiences* [#309]
Giovanni Acampora, Matteo Gaeta, Enrique Munoz and Autilia Vitiello

11:40AM *A hybrid context aware system for tourist guidance based on collaborative filtering* [#425]
Giuseppe Fenza, Enrico Fischetti, Domenico Furno and Vincenzo Loia

12:00AM *Trainable Estimators for Indirect People Counting: A Comparative Study* [#473]
Giovanni Acampora, Vincenzo Loia, Gennaro Percannella and Mario Vento

(FC) Competition: Fuzzy Competition

Monday, June 27, 11:00AM-12:30PM, Room: Swallow, Chair: Hao Ying

11:00AM *A TSK Neuro-Fuzzy Approach for Modeling Highly Dynamic Systems* [#475]
Giovanni Acampora

(HCGC-2) Competition: Human vs. Computer Go Competition

Monday, June 27, 11:00AM-12:30PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Monday, June 27, 1:30PM-3:00PM**(T04-1) Tutorial: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 2**

Monday, June 27, 1:30PM-3:00PM, Room: Peacock, Instructor: Hani Hagra

(T05-1) Tutorial: Towards a Unified Framework for Intelligent Robotics

Monday, June 27, 1:30PM-3:00PM, Room: Phoenix, Instructor: Honghai Liu and Naoyuki Kubota

(W03-1) Workshop: Computational Intelligence Techniques for Smart Grids

Monday, June 27, 1:30PM-3:00PM, Room: Crane, Chair: Alfredo Vaccaro

1:30PM *A Bacterial Foraging PSO - DE Algorithm for Solving Reserve Constrained Dynamic Economic Dispatch Problem* [#286]

Praveena Pillala, Vaisakh Kanchapogu and Rama Mohana Rao Sanchana

1:50PM *A Noisy Data Regression Model Based on General Regression Neural Networks* [#384]

Shih-Chun Shao, Wen-Hui Chen and Jun-Horng Chen

2:10PM *Estimation of Load Model Parameters from Instantaneous Voltage and Current* [#431]

Pawel Regulski, Francisco Gonzalez-Longatt and Vladimir Terzija

(W04-1) Workshop: Computer Game and Fuzzy-based Game Applications

Monday, June 27, 1:30PM-3:00PM, Room: Egret, Chair: Shun-Chin Hsu, I-Chen Wu, and Shi-Jim Yen

1:30PM *Apply Different Fuzzy Integrals in Unit Selection Problem of Real Time Strategy Game* [#170]

Y.J. Li, Peter H.F. Ng, H.B. Wang, S.C.K. Shiu and Y. Li

1:50PM *Unit Formation Planning in RTS game by using Potential Field and Fuzzy Integral* [#479]

Ng Peter, Li Y. J. and Shiu Simon

2:10PM *Elimination Search for puzzle games : An Application for Hashi Solver* [#505]

Shi-Jim Yen, Shih-Yuan Chiu, Cheng-Wei Chou and Tsan-Cheng Su

2:30PM *An efficient algorithm for solving Fillomino* [#507]

Shi-Jim Yen, Tsan-Cheng Su and Shun-Chin Hsu

(W05-1) Workshop: Hybrid Computational Intelligence Applications

Monday, June 27, 1:30PM-3:00PM, Room: Swallow, Chair: Chuan-Kang Ting and Tzung-Pei Hong

1:30PM *Symbiotic Neuron Evolution of a Neural-Network-Aided Grey Model for Time Series Prediction* [#302]

Shih-Hung Yang and Yon-Ping Chen

1:50PM *A Hybrid Computational Intelligence Approach for Automatic Music Composition* [#315]

Giovanni Acampora, Jose Manuel Cadenas, Roberto De Prisco, Vincenzo Loia, Enrique Munoz and Rocco Zaccagnino

2:10PM *A Study of a Hybrid Evolutionary Fuzzy Model for Stock Selection* [#503]

Chien-Feng Huang, Chih-Hsiang Chang, Bao Rong Chang and Dun-Wei Cheng

2:30PM *Upper-Bound Multiple Fuzzy Frequent-Pattern Trees* [#526]

Tzung-Pei Hong, Chun-Wei Lin, Tsung-Ching Lin and Shing-Tai Pan

(HCGC-3) Competition: Human vs. Computer Go Competition

Monday, June 27, 1:30PM-3:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Monday, June 27, 3:30PM-5:00PM**(T04-2) Tutorial: Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 2**

Monday, June 27, 3:30PM-5:00PM, Room: Peacock, Instructor: Hani Hagra

(T05-2) Tutorial: Towards a Unified Framework for Intelligent Robotics

Monday, June 27, 3:30PM-5:00PM, Room: Phoenix, Instructor: Honghai Liu and Naoyuki Kubota

(W03-2) Workshop: Computational Intelligence Techniques for Smart Grids

Monday, June 27, 3:30PM-5:00PM, Room: Crane, Chair: Alfredo Vaccaro

3:30PM *Exploiting Timed Automata Based Fuzzy Controllers for Voltage regulation in Smart Grids* [#441]

Giovanni Acampora, Vincenzo Loia and Autilia Vitiello

4:10PM *Terminal Sliding Mode Controlled CVCF Inverters* [#282]

En-Chih Chang, Li-Peng Yin, Rong-Ching Wu and Lung-Sheng Yang

3:50PM *A Novel Fuzzy System for Wind Turbines Reactive Power Control* [#411]

Geev Mokryani, Pierluigi Siano, Antonio Piccolo, Vito Calderaro and Carlo Cecati

(W04-2) Workshop: Computer Game and Fuzzy-based Game Applications

Monday, June 27, 3:30PM-5:00PM, Room: Egret, Chair: Shun-Chin Hsu, I-Chen Wu, and Shi-Jim Yen

(W05-2) Workshop: Hybrid Computational Intelligence Applications

Monday, June 27, 3:30PM-5:00PM, Room: Swallow, Chair: Chuan-Kang Ting and Tzung-Pei Hong

3:30PM *Differential Evolution to Enhance Localization of Mobile Robots* [#584]

Michael Lisowski, Zhun Fan and Ravn Ole

3:50PM *Fuzzy C-Means Clustering Based Construction And Training For Second Order RBF Network* [#571]

Kanishka Tyagi, Xun Cai and Michael Manry

(HCGC-4) Competition: Human vs. Computer Go Competition

Monday, June 27, 3:30PM-5:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Tuesday, June 28, 8:00AM-10:20AM**(SS02-1) Special Session: Evolutionary Fuzzy Systems**

Tuesday, June 28, 8:00AM-10:20AM, Room: Swan, Chair: Rafael Alcalá

8:00AM Evolutionary Learning of a Laser Pointer Detection Fuzzy System for an Environment Control System [#320]

Chavez de la O Francisco, Fernandez de Vega Francisco, Alcalá Fernandez Rafael, Alcalá Fernandez Jesus and Herrera Trigeros Francisco

8:20AM A Meta-Fuzzy Classifier for Specifying Appropriate Fuzzy Partitions by Genetic Fuzzy Rule Selection with Data Complexity Measures [#606]

Yusuke Nojima, Shinya Nishikawa and Hisao Ishibuchi

8:40AM Assessing The Effects Of Zero Abundance Data On Habitat Preference Modelling Using A Genetic Takagi-Sugeno Fuzzy Model [#586]

Shinji Fukuda

9:00AM A Multiple-Level Genetic-Fuzzy Mining Algorithm [#512]

Chun-Hao Chen, Tzung-Pei Hong and Yeong-Chyi Lee

9:20AM An Architecture for Constructing Fuzzy Regression Tree Forests Using Opt-aiNet [#314]

Fathi Gasir, Zuhair Bandar and Keeley Crockett

9:40AM Fuzzy C-Means Clustering and Partition Entropy for Species-Best Strategy and Search Mode Selection in Nonlinear Optimization by Differential Evolution [#456]

Tetsuyuki Takahama and Setsuko Takahama

(SS12-1) Special Session: Recent Advances in Fuzzy-Model-Based Control Systems

Tuesday, June 28, 8:00AM-10:20AM, Room: Peacock, Chair: H. K. Lam

8:00AM LMI-Based Stability Conditions for Interval Type-2 Fuzzy-Model-Based Control Systems [#228]

H.K. Lam, Mohammad Narimani and L.D. Seneviratne

8:20AM Robust H-infinite Fuzzy Observer for A Class of Time-Delay Discrete Fuzzy Bilinear Systems with Parameter Uncertainties [#54]

Shun-Hung Tsai, Ta-Tau Chen, Ming-Ying Hsiao and Chin-Sheng Chen

8:40AM Sum of Squares Solutions Assuring Non-quadratic Discrete Stability [#39]

Ji-Chang Lo and Jhen-Shun Kao

9:00AM Output Feedback Control for Discrete-Time Takagi-Sugeno Fuzzy Systems [#122]

Nao Ueno, Yuzu Uchida and Jun Yoneyama

9:20AM Decentralized control of large scale switched Takagi-Sugeno systems [#156]

Dalel Jabri, Kevin Guelton and Noureddine Manamanni

9:40AM Some Refinements for Non quadratic Stabilization of continuous TS Models [#381]

Thierry Marie Guerra, Abdelhafidh Jaadari, Juntao Pan and Antonio Sala

10:00AM Adaptive fault estimation design for T-S fuzzy systems with interval time varying delay [#496]

Hamdi Gassara, Ahmed EL Hajjaji and Mohamed Chaabane

(SS14) Special Session: Advances in Fuzzy Theory and their Applications

Tuesday, June 28, 8:00AM-10:20AM, Room: Phoenix, Chair: Shyi-Ming Chen

8:00AM Fast Extracting of Change Area from Remote Sensing Image by Fuzzy Theory and Case Base Reasoning [#399]

Ting-shiuan Wang and Teng-to Yu

8:20AM Weights-Learning for Weighted Fuzzy Rule Interpolation in Sparse Fuzzy Rule-Based Systems [#253]

Shyi-Ming Chen and Yu-Chuan Chang

8:40AM On The Type-2 Fuzzy Thresholding Protocol For Event-Driven Wireless Sensor Networks [#458]

Chung-Ming Own

9:00AM A Theoretical Approach to Liu's Generalized Lambda-Fuzzy Measure [#350]

Hsiang-Chuan Liu and Tung-Sheng Liu

9:20AM *A Fuzzy Intelligent Decision Support System for Typhoon Disaster Management* [#387]
Wang-Kun Chen, GuangJun Sui and DangLing Tang

9:40AM *A Robust Fuzzy Trajectory Estimation Design of High Speed Reentry Vehicles* [#190]
Yung-Yue Chen and Chung-Shi Tseng

10:00AM *Data-driven Based 3-D Fuzzy Logic Controller Design Using Nearest Neighborhood Clustering and Linear Support Vector Regression* [#535]

Zhang Xianxia, Jiang Ye, Zou Tao, Qi Chenkun and Cao Guitao

(SS28-1) Special Session: Current Development in Pattern Classification-Kernelization, Pairwise Constraints, and Classifiers

Tuesday, June 28, 8:00AM-10:20AM, Room: Crane, Chair: Yasunori Endo

8:00AM *A Method of Explicit Mappings for Kernel Data Analysis and Applications* [#276]

Sadaaki Miyamoto and Keisuke Sawazaki

8:20AM *Comparison of Scaling Behavior Between Fuzzy c-Means Based Classifier with Many Parameters and LibSVM* [#77]

Hidetomo Ichihashi, Katsuhiko Honda and Akira Notsu

8:40AM *Ellipse Detection with Hard c-Regression Models and Random Initializations* [#106]

Hidetomo Ichihashi, Li Chieu Lam, Katsuhiko Honda and Akira Notsu

9:00AM *Trajectory Anonymization From a Time Series Perspective* [#141]

Sergi Martinez-Bea and Vicenc Torra

9:20AM *On Some Clustering Approaches For Graphs* [#205]

Klara Stokes and Vicenc Torra

9:40AM *A Study on Regularization Effects of Fuzzified Memberships in FCM Clustering* [#57]

Katsuhiko Honda, Yui Matsumoto, Akira Notsu and Hidetomo Ichihashi

10:00AM *Constrained Agglomerative Hierarchical Clustering Algorithms with Penalties* [#75]

Sadaaki Miyamoto and Akihisa Teram

(SS16 & SS11) Special Session: Fuzzy Interpolation & Large-Scale Clustering

Tuesday, June 28, 8:00AM-10:20AM, Room: Egret, Chair: Qiang Shen and Timothy Havens

8:00AM *Adaptive Fuzzy Interpolation with Prioritized Component Candidates* [#226]

Longzhi Yang and Qiang Shen

8:20AM *Fuzzy Rule Interpolation in Embedded Behaviour-based Control* [#558]

Szilveszter Kovacs

8:40AM *An Evolutionary-Based Similarity Reasoning Scheme for Monotonic Multi-Input Fuzzy Inference Systems* [#119]

Tay Kai Meng and Lim Chee Peng

9:00AM *Fuzzy Rule Interpolation Based on Interval Type-2 Gaussian Fuzzy Sets and Genetic Algorithms* [#326]

Shyi-Ming Chen and Yu-Chuan Chang

9:20AM *Double-Linear Fuzzy Interpolation Method* [#546]

Marcin Detyniecki, Christophe Marsala and Maria Rifqi

9:40AM *Speedup of Fuzzy and Possibilistic Kernel c-Means for Large-Scale Clustering* [#443]

Timothy Havens, Radha Chitta, Anil Jain and Rong Jin

10:00AM *Adaptive Fuzzy Interpolation with Uncertain Observations and Rule Base* [#397]

Longzhi Yang and Qiang Shen

(T2FL & FPR) Type-2 Fuzzy Logic and Fuzzy Pattern Recognition

Tuesday, June 28, 8:00AM-10:20AM, Room: Swallow, Chair: Frank Chung-Hoon Rhee

8:00AM *General Type-2 Fuzzy Membership Function Design and its Application to Neural Networks* [#590]

Eun-A Shim and Frank Chung-Hoon Rhee

8:20AM *Human Action Recognition via Sum-Rule Fusion of Fuzzy K-Nearest Neighbor Classifiers* [#510]

Teck Wee Chua, Karianto Leman and Nam Trung Pham

8:40AM Fuzzy Clustering with Multiple Kernels
[#150]

Naouel Baili and Hichem Frigui

9:00AM Kernel-Based Fuzzy Clustering of Interval Data [#52]

Bruno Pimentel, Anderson Costa and Renata Souza

9:20AM Short Term Load Forecasting Using Interval Type-2 Fuzzy Logic Systems [#208]

Abbas Khosravi, Saeid Nahavandi and Doug Creighton

9:20AM An Adaptive Type-2 Input Based Non-Singleton Type-2 Fuzzy Logic System for Real World Applications [#528]

Nazanin Sahab and Hani Hagraas

9:40AM Hospital Service Quality Evaluation: A Fuzzy Preference Relation Approach [#72]

Tsung-Han Chang

(HCGC-1) Competition: Human vs. Computer Go Competition

Tuesday, June 28, 8:00AM-10:20AM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Panel Session I: Interpolation and Approximation in Fuzzy Rule Bases

Tuesday, June 28, 8:00AM-10:20AM, Room: Grand Ballroom I, Chair: László Koczy

(FA-1) Fuzzy Applications

Tuesday, June 28, 8:00AM-10:20AM, Room: Grand Ballroom II, Chair: Hisao Ishibuchi

8:00AM Structural Analysis on Team Internal Soft Factors to Project Success [#49]

Jyh-Fu (Don) Jeng

8:20AM A Robust Portfolio Selection Problem based on a Confidence Interval with Investor's Subjectivity [#100]

Takashi Hasuike and Hideki Katagir

8:40AM On Some Fuzzy Relations for Color Information [#412]

Daniel Sanchez, Jose Manuel Soto-Hidalgo, Jesus Chamorro-Martinez and Pedro Martinez-Jimenez

9:00AM The Positioning control of an Electro-Hydraulic Variable Rotational Speed Pump-Controlled System Using Adaptive Fuzzy Controller with Self-tuning Fuzzy Sliding Mode Compensation [#463]

Lian-Wang Lee, I-Hsum Li, Chung-Chieh Chen and Jun-Yi Huang

9:20AM Toward Quantitative Definition of Explanation Ability of Fuzzy Rule-based Classifiers [#605]

Hisao Ishibuchi and Yusuke Nojima

9:40AM Multi-level Multi-Objective Decision Problem through Fuzzy Random Regression based Objective Function [#81]

Nureize Arbaiy and Junzo Watada

10:00AM A Fuzzy Toolbox for the R Programming Language [#612]

Christian Wagner, Simon Miller and Jonathan M. Garibaldi

Tuesday, June 28, 10:50AM-12:00PM**(HCGC-2) Competition: Human vs. Computer Go Competition**

Tuesday, June 28, 10:50AM-12:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Keynote Speech I: Inferring Disease Related Gene-Gene Interactions: A Fuzzy Logic Based Approach

Tuesday, June 28, 10:50AM-12:00PM, Room: Grand Ballroom I, Speaker: Nikhil Pal

Tuesday, June 28, 1:30PM-2:30PM**(HCGC-3) Competition: Human vs. Computer Go Competition**

Tuesday, June 28, 1:30PM-2:30PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Plenary Speech I: Type-2 Fuzzy Sets and Systems: Challenges and Misconceptions

Tuesday, June 28, 1:30PM-2:30PM, Room: Grand Ballroom I, Speaker: Jerry M. Mendel

Tuesday, June 28, 2:30PM-4:30PM**(PS01) Poster Session I**

Tuesday, June 28, 2:30PM-4:30PM, Room: Grand Ballroom II

P101 *A fuzzy hypothesis test based model for customer satisfaction measurement (Case study in PARS KHODRO CO.)* [#22]

Naimeh Borjalilu, Mahdi Zowghi and Abdolhamid Eshraghniaie Jahromi

P102 *Permutation Flow Shop Scheduling: Fuzzy Particle Swarm Optimization Approach* [#29]

S. H. Ling, F. Jiang, H. T. Nguyen and K. Y. Chan

P103 *Patent Valuation with a Fuzzy Binomial Model* [#67]

Xiaolu Wang

P104 *Natural Topology via Fuzzy Metric* [#70]

Fagner Santana and Regivan Santiago

P105 *Fault diagnosis of turbine using an improved intuitionistic fuzzy cross entropy approach* [#79]

Hung Kuo-Chen, Lin Kuo-Ping and Weng Chia-Chun

P106 *Fuzzy delta separation axioms* [#91]

Seok Jong Lee and Sang Min Yun

P107 *Clustering Data and Imprecise Concepts* [#101]

Zengchang Qin and Weifeng Zhang

P108 *Fuzzy Variable Structure Control for PWM Inverters* [#102]

En-Chih Chang and Josep M. Guerrero

P109 *An Adaptive Fuzzy Logic Controller based on Real Coded Quantum-Inspired Evolutionary Algorithm* [#103]

Pintu Shill, Amjad Hossain, Faijul Amin and Kazuyuki Murase

P110 *An Efficient Hybrid Particle Swarm Optimization for the Job Shop Scheduling Problem* [#116]

Xue-Feng Zhang, Miyuki Koshimura, Hiroshi Fujita and Ryuzo Hasegawa

P111 *A Framework of Multi-characteristics Fuzzy Dynamic Scheduling for Parallel Video Processing on MPSoC Architecture* [#117]

Da Li, Yibin Hou, Zhangqin Huang and Chunhua Xiao

P112 *The Derivation of the Analytical Structure of a class of Interval Type-2 fuzzy PD and PI controllers* [#127]

Maowen Nie and Woei Wan Tan

P113 *Estimation of the Asymptotic Stability Region of Uncertain Fuzzy Systems with Bounded Controllers Using Variable Structure System Design Approach* [#138]

Chung-Chun Kung, Ti-Hung Chen, Shuo-Chieh Chang and Chih-Chieh Chen

P114 *A Study on Atanassov's Intuitionistic Fuzzy Graphs* [#157]

Karunambigai M.G., Parvathi R. and Kalaivani O.K.

P115 *Fuzzy Controller Based Output Power Leveling Enhancement for a Permanent Magnet Synchronous Generator* [#159]

Abdul Motin Howlader, Naomitsu Urasaki, Shantanu Chakraborty, Atsushi Yona, Tomonobu Senjyu and Ahmed Y. Saber

P116 *Important Issues To Be Considered In Developing Fuzzy Cognitive Maps* [#548]

Costas Neocleous, Christos Schizas and Maria Papaioannou

P117 *A Fall Detection Study on the Sensors Placement Location and a Rule-Based Multi-Thresholds Algorithm Using Both Accelerometer and Gyroscopes* [#613]

Donald Lie, Jerene Jacob and Nguyen Tam

P118 *A Fuzzy Representation for Non-additive Weights of AHP* [#196]

Shin-ichi Ohnishi, Takahiro Yamanoi and Hideyuki Imai

P119 *A social cognitive framework of knowledge contribution in the online community* [#192]

Fan-Chuan Tseng and Feng-Yuan Kuo

P120 *Fuzzy Clustering of Large-Scale Data Sets Using Principal Component Analysis* [#188]

Sassi Minyar and Arfaoui Olfa

P121 *Soft Subspace Clustering with Competitive Agglomeration* [#168]

Lin Zhu, Longbing Cao and Jie Yang

Tuesday, June 28, 2:50PM-4:30PM**(SS05) Special Session: Fuzzy Robotics**

Tuesday, June 28, 2:50PM-4:30PM, Room: Swan, Chair: Honghai Liu

2:50PM *Hand Motion Recognition via Fuzzy Active Curve Axis Gaussian Mixture Models: A Comparative Study* [#96]

Ju Zhaojie and Liu Honghai

3:10PM *Trajectory-based Control under ZMP Constraint for the 3D Biped Walking via Fuzzy Control* [#294]

Hsiu-Ming Wu and Chih-Lyang Hwang

3:30PM *Formation Behavior of Multiple Robots based on Tele-operation* [#565]

Yuki Wagatsuma, Yuichiro Toda and Naoyuki Kubota

3:50PM *Evaluation of Pointing Navigation Interface for Mobile Robot with Spherical Vision System* [#521]

Kyohei Yoshida, Fuminori Hibino, Yasutake Takahashi and Yoichiro Maeda

4:10PM *Fuzzy PID Controller Design for Artificial Finger based SMA Actuators* [#341]

Alireza Khodayari, Mohammad Mahdi Kheirikhah and Maryam Talari

(SS18) Special Session: Recent Advances in Fuzzy Logic in Image Processing

Tuesday, June 28, 2:50PM-4:30PM, Room: Peacock, Chair: Mike Nachtgeael

2:50PM Fuzzy shape Classification exploiting Geometrical and Moments Descriptors [#557]

Ugo Erra and Sabrina Senatore

3:10PM Piece-wise Convex Spatial-Spectral Unmixing of Hyperspectral Imagery using Possibilistic and Fuzzy Clustering [#452]

Alina Zare and Paul Gader

3:30PM Detection of Hyperintense Regions on MR Brain Images using a Mamdani Type Fuzzy Rule-Based System [#603]

F. Xavier Aymerich, Eduard Montseny, Pilar Sobrevilla and Alex Rovira

3:50PM On Fuzzy Partitions for Visual Texture Modelling [#360]

Jesus Chamorro-Martinez, Pedro Manuel Martinez-Jimenez and Jose Manuel Soto-Hidalgo

(SS27) Special Session: Communication Robotics and Computational Intelligence Co-creation

Tuesday, June 28, 2:50PM-4:30PM, Room: Phoenix, Chair: Yoichi Yamazaki

2:50PM Educational System with the Android Robot SAYA and Field Trial [#176]

Takuya Hashimoto, Naoki Kato and Hiroshi Kobayashi

3:10PM Multimodal Gesture Recognition Based on Choquet Integral [#113]

Kaoru Hirota, Hai An Vu, Phuc Quang Le, Chastine Fatichah and Zhentao Liu

3:30PM Emotional States Based 3-D Fuzzy Atmosfield for Casual Communication between Humans and Robots [#172]

Zhentao Liu, Min Wu, Danyun Li, Fangyan Dong, Yoichi Yamazaki and Kaoru Hirota

3:50PM Presence Expression Using Eye Robot for Computer Go System [#455]

Yoichi Yamazaki, Masaya Hanada, Chang-Shing Lee, Takuya Hashimoto, Fangyan Dong, Makoto Motoki and Kaoru Hirota

4:10PM Emotion Recognition based on Human Gesture and Speech Information using RT Middleware [#367]

Hai An Vu, Yoichi Yamazaki, Fangyan Dong and Kaoru Hirota

(SS28-2) Special Session: Current Development in Pattern Classification-Kernelization, Pairwise Constraints, and Classifiers

Tuesday, June 28, 2:50PM-4:30PM, Room: Crane, Chair: Yasunori Endo

2:50PM FCMdd-type Linear Fuzzy Clustering for Incomplete Non-Euclidean Relational Data [#108]

Takeshi Yamamoto, Katsuhiko Honda, Akira Notsu and Hidetomo Ichihashi

3:10PM Hybrid Objective Function of Fuzzy c-Varieties and Cross-shape Fuzzy Cluster Extraction [#295]

Daisuke Yoshida, Katsuhiko Honda, Akira Notsu and Hidetomo Ichihashi

3:30PM Kernelized Fuzzy c-Means Clustering for Uncertain Data using Quadratic Penalty-Vector Regularization with Explicit Mappings [#114]

Yasunori Endo, Isao Takayama, Yukihiko Hamasuna and Sadaaki Miyamoto

3:50PM On Mahalanobis Distance Based Fuzzy c-Means Clustering for Uncertain Data Using Penalty Vector Regularization [#125]

Yukihiko Hamasuna, Yasunori Endo and Sadaaki Miyamoto

4:10PM On Hard and Fuzzy c-Means Clustering with Conditionally Positive Definite Kernel [#177]

Yuchi Kanzawa, Yasunori Endo and Sadaaki Miyamoto

(SS42-1) Special Session: Fuzzy Cognitive Maps-Theory and Applications

Tuesday, June 28, 2:50PM-4:30PM, Room: Egret, Chair: Chair: Elpiniki I. Papageorgiou and Sebastian Lozano

2:50PM Intuitionistic Fuzzy Reasoning with Cognitive Maps [#477]

Dimitris Iakovidis and Elpiniki Papageorgiou

3:10PM Review study on Fuzzy Cognitive Maps and their applications during the last decade [#516]

Elpiniki Papageorgiou

3:30PM Nonlinear Cause-Effect Relationships In Fuzzy Cognitive Maps [#361]

Maria Ketipi, Dimitrios Koulouriotis, Evangelos Karakasis, George Papakostas and Vassilios Tourassis

3:50PM Case Based Fuzzy Cognitive Maps (CBFCM) : New method for medical reasoning [#567]

Nassim Douali, Elpiniki Papageorgiou, Jos De Roo and Marie-Christine Jaulent

4:10PM Training Fuzzy Cognitive Maps by Using Hebbian Learning Algorithms: A Comparative Study [#343]

George Papakostas, Athanasios Polydoros, Koulouriotis Dimitrios and Tourassis Vasileios

(SS21-1) Special Session: Fuzzy Control in Industrial and Application

Tuesday, June 28, 2:50PM-4:30PM, Room: Swallow, Chair: Shun-Hung Tsai

2:50PM Applications of Fuzzy Classification with Fuzzy C-Means Clustering and Optimization Strategies for Load Identification in NILM Systems [#126]

Yu-Hsiu Lin, Men-Shen Tsai and Chin-Sheng Chen

3:10PM Knowledge-Based Fuzzy Imbalanced Force Compensator Design for a Single Active Magnetic Bearing Suspended Rotor System [#347]

Yi Hua Fan and Ying Tsun Lee

3:30PM DSP-Based Cross-Coupled Synchronous Control for Dual Linear Motors via Functional Link Radial Basis Function Network [#129]

Chin-Sheng Chen, Po-Huan Chou and Faa-Jeng Lin

3:50PM An Interactive Fuzzy Satisficing Method for Multiobjective Stochastic Defensive Location Problems [#284]

Takeshi Uno and Kosuke Kato

4:10PM A Comparison of Non-stationary, Interval Type-2 and Dual-Surface Interval Type-2 Fuzzy Control [#423]

Naisan Benatar, Uwe Aickelin and Jonathan M. Garibaldi

(HCGC-4) Competition: Human vs. Computer Go Competition

Tuesday, June 28, 2:50PM-4:30PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Tuesday, June 28, 4:30PM-7:00PM**(PS02) Poster Session II**

Tuesday, June 28, 4:30PM-7:00PM, Room: Grand Ballroom II

P301 Robust Speed-Controlled Permanent Magnet Synchronous Motor Drive using Fuzzy Logic Controller [#162]

Gunawan Dewantoro and Yong-Lin Kuo

P302 Possibilistic Regression Analysis by Support Vector Machine [#183]

Pei-Yi Hao

P303 Cognitive Simulation-Based on Knowledge Evolution in Fuzzy Discrete Event Systems [#199]

Paul-Antoine Bisgambiglia, Paul Antoine Bisgambiglia and Jean-Sebastien Gaultieri

P304 A Fuzzy Tool for the Validation of Individual Risk Premia in High-Technology Venture Valuation [#202]

Lars Krueger, Peter Heydebreck and Ralf Salomon

P305 Soft-Core Implementation for Centre of Slice Area Average Defuzzifier [#206]

Antonio Hernandez Zavala, Oscar Camacho Nieto and Cornelio Yanez Marquez

P306 Fuzzy Integral-based Composite Facial Expression Generation for a Robotic Head [#234]

Bum-Soo Yoo, Se-Hyoung Cho and Jong-Hwan Kim

P307 Comparing soft clusters and partitions [#243]

Derek Anderson, James Keller, Ozy Sjahputera, James Bezdek and Mihail Popescu

P308 *An Adaptive Hybrid Data Fusion Based Identification of Skeletal Muscle Force with ANFIS and Smoothing Spline Curve Fitting* [#245]

Parmod Kumar, Cheng-Hung Chen, Anish Sebastian, Madhavi Anugolu, Chandrasekhar Potluri, Amir Fassih, Yimesker Yihun, Alex Jensen, Yi Tang, Steve Chiu, Ken Bosworth, D. S. Naidu, Marco P. Schoen, Jim Creelman and Alex Urfer

P309 *A Functional-Link based Interval Type-2 Compensatory Fuzzy Neural Network for Nonlinear System modeling* [#249]

Jyh-Yeong Chang, Yang-Yin Lin, Ming-Feng Han and Chin-Teng Lin

P310 *Infrared Image Segmentation using Enhanced Fuzzy C-Means clustering for Automatic Detection Systems* [#251]

Sitanshu Gupta and Asim Mukherjee

P311 *Image-Correlation Data Association with Global Uncertainty Techniques* [#274]

Stephen Stubberud and Kathleen Kramer

P312 *A Non-Singleton Interval Type-2 Fuzzy Logic System for Universal Image Noise Removal using Quantum-Behaved Particle Swarm Optimization* [#291]

Daoyuan Zhai, Minshen Hao and Jerry Mendel

P313 *Fuzzy Folksonomy-based Index Creation for e-Learning Content Retrieval on Cloud Computing Environments* [#306]

Wen-Chung Shih, Chao-Tung Yang and Shian-Shyong Tseng

P314 *Relationship between Intuitionistic Fuzzy Similarity Measures* [#308]

Leila Baccour, Adel M. Alimi and Robert I. John

P315 *Decomposition of Term-Document Matrix Representation for Clustering Analysis* [#316]

Jianxiong Yang and Junzo Watada

P316 *Visual-Based Guiding Method for Unmanned Helicopter Approaching to Landmark* [#171]

Kuo-Hsien Hsia, Shao-Fan Lien and Juhng-Perng Su

P317 *On the Type-1 and Type-2 Fuzziness Measures for Thresholding MRI Brain Images* [#200]

Rajesh R., Senthilkumaran N., Satheesh Kumar J., Shanmuga Priya B., Thilagavathy C. and Priya K

P318 *A Fast Algorithm for Mining Frequent Closed Itemsets over Stream Sliding Window* [#587]

Show-Jane Yen, Cheng-Wei Wu, Yue-Shi Lee, Vincent S. Tseng and Chaur-Heh Hsieh

P319 *Neuro-Fuzzy System Design using Differential Evolution with Local Information* [#313]

Lin Chin-Teng, Han Ming-Feng, Lin Yang-Yin, Liao Shih-Hui and Chang Jyh-Yeong

P320 *Stability Analysis and Synthesis of Markovian Jump Nonlinear Systems with Incomplete Transition Descriptions via Fuzzy Control* [#325]

Min Kook Song, Jin Bae Park and Young Hoon Joo

P321 *Bio-inspired computing of vision - fuzzy and neuromorphic processing* [#426]

Woo Joon Han and Il Song Han

Tuesday, June 28, 5:00PM-7:00PM**(SS10-1) Special Session: Medical and Wellness Engineering**

Tuesday, June 28, 5:00PM-7:00PM, Room: Swan, Chair: Yutaka Hata

5:00PM *A Testicular Tubule Evaluation Method by Ultrasonic Array Probe* [#89]

Yuya Takashima, Kei Kuramoto, Kobashi Syoji, Hata Yutaka and Ishikawa Tomomoto

5:20PM *Fuzzy RASP Determination by 1kHz Ultrasonic Probe for Total Hip Arthroplasty* [#98]

Naomi Yagi, Yoshitetsu Oshiro, Osamu Ishikawa, Yutaka Hata and Nao Shibanuma

5:40PM *A Fuzzy Logic Approach to Predict Human Body Weight Based on AR Model* [#88]

Hideaki Tanii, Hiroshi Nakajima, Tsuchiya Naoki, Kei Kuramoto, Syoji Kobashi and Yutaka Hata

6:00PM *Consideration of Invasion, Intrusion, and Consciousness in Biomedical Sensing with Uncertainty* [#209]

Hiroshi Nakajima, Naoki Tsuchiya and Yutaka Hata

6:20PM *Load Forecasting using Fuzzy Wavelet Neural Networks* [#273]

Mahdi Amina and Vassilis Kodogiannis

6:40PM *Fuzzy Modelling Using a New Compact Fuzzy System: A Special Application to the Prediction of the Mechanical Properties of Alloy Steels* [#593]

Qian Zhang and Mahdi Mahfouf

(SS09) Special Session: Applications of Fuzzy Logic to Awareness Promotion

Tuesday, June 28, 5:00PM-7:00PM, Room: Peacock, Chair: Kiyota Hashimoto

5:00PM *Agent Simulation for Contents Evaluation with User Models for Hierarchical Knowledge Relations* [#356]

Kiyota Hashimoto and Kazuhiro Takeuchi

5:20PM *Giving Awareness of Maturity by Capability Assessment* [#607]

Yi-Ling Kuo, Yu Nakamura, Masayuki Sakoda, Hiroshi Tsuji and Chang-Shing Lee

5:40PM *Medical Care System Evaluation Based on DEA Of Prefectures In Japan* [#335]

Kenji Fukuoka, Shingo Aoki and Yukie Majima

6:00PM *Structured DEA Model Considering Relation among Input and Output Elements* [#331]

Yamasaki Shingo and Aoki Shingo

6:20PM *Component-Based Search Engine for Blogs* [#490]

Sachio Hirokawa, Chengjiu Yin and Tetsuya Nakatoh

6:40PM *Influence of the Space Segmentation and its Adaptive Automation for Reinforcement Learning* [#290]

Akira Notsu, Yuki Komori, Katsuhiko Honda and Hidetomo Ichihashi

(SS08) Special Session: Innovative Fuzzy Approaches to Management Engineering

Tuesday, June 28, 5:00PM-7:00PM, Room: Phoenix, Chair: Junzo Watada

5:00PM *Learning with Imbalanced Datasets using Fuzzy ARTMAP-based Neural Network Models* [#43]

Shing Chiang Tan, Junzo Watada, Zuwarie Ibrahim, Marzuki Khalid and Wen Jau Lee

5:20PM *Re-Scheduling the Unit Commitment Problem in Fuzzy Environment* [#18]

Bo Wang, You Li and Junzo Watada

5:40PM *Building a Fuzzy Multi-objective Portfolio Selection model with Distinct Risk Measurements* [#19]

You Li, Bo Wang and Junzo Watada

6:00PM *Statistic Test on Fuzzy Portfolio Selection Model* [#65]

Pei-Chun Lin, Junzo Watada and Berlin Wu

6:20PM *An Approach Based on Takagi-Sugeno Fuzzy Inference System Applied to the Operation Planning of Hydrothermal Systems* [#279]

Ricardo Rabelo, Ricardo Fernandes, Adriano Carneiro and Rosana Braga

6:40PM *Fuzzy Cognitive Maps in estimating the repercussions of oil/gas exploration on politico-economic issues in Cyprus* [#495]

Costas Neocleous, Maria Papaioannou and Christos Schizas

(SS37) Special Session: Fuzzy Logic Based Computer Vision and Its Applications to Guidance and Control

Tuesday, June 28, 5:00PM-7:00PM, Room: Crane, Chair: Kuo-Hsien Hsia

5:00PM *The Picked and Placed Control of the Objects for a Pneumatic X-Y Servo Platform by Integrating Image Processing Techniques and a Fuzzy Sliding Mode Controller Design* [#390]

Hong-Ming Chen, Yi-Ping Shyu, Chun-Sheng Shen and Hong-Jia Yang

5:20PM *The Dynamic Measurement System Design for Stewart Platform by Using Digital Image Processing Method* [#161]

Yu Ker-Wei and Zhou Yu-Quan

5:40PM *Orientation control of hovercraft systems via an SMFLC and Image-Guided Techniques* [#318]

Chun-Chieh Wang

6:00PM *PSO-based Estimation for Gaussian Blur in Blind Image Deconvolution Problem* [#529]

Yang-Chih Lai, Chih-Li Huo, Yu-Hsiang Yu and Tsung-Ying Sun

6:20PM *Fuzzy integrals for the aggregation of confidence measures in speech recognition* [#494]

Julie Mauclair, Laurent Wendling and David Janiszek

6:40PM *Active Tracking Using Intelligent Fuzzy Controller and Kernel-Based Algorithm* [#400]

Moteaal Asadi Shirzi and M.R. Hairi-Yazdi

(SS17-1) Special Session: Practical and Applications Aspects of Type-2 Fuzzy Logic Systems

Tuesday, June 28, 5:00PM-7:00PM, Room: Egret, Chair: Woei Wan Tan

5:00PM *An Interval Type 2 Fuzzy Approach to Multilevel Image Segmentation* [#591]

Debanga Raj Neog, Muhammad Amjad Raza and Frank Chung-Hoon Rhee

5:20PM *Navigation System of Mobile Robot in an Uncertain Environment Using Type-2 Fuzzy Modelling* [#585]

Sittichok Junratanasiri, Sansanee Auephanwiriyakul and Nipon Theera-Umpon

5:40PM *Multi-attribute Decision Making Models under Interval Type-2 Fuzzy Environment* [#95]

Weize Wang and Xinwang Liu

6:00PM *A Perceptual Computer Based Method for Supplier Selection Problem* [#186]

Han Shilian and Liu Xinwang

(SS19) Special Session: Fuzzy Inference Systems-Theory and Applications

Tuesday, June 28, 5:00PM-7:00PM, Room: Swallow, Chair: Hirosato Seki

5:00PM *Type-2 Fuzzy Functional Inference Method* [#573]

Hirosato Seki and Masaharu Mizumoto

5:20PM *On Extension of Consequent Parts of T-S Inference Model* [#553]

Hirosato Seki and Masaharu Mizumoto

5:40PM *Optimization of Gaussian Fuzzy Membership Functions and Evaluation of the Monotonicity Property of Fuzzy Inference Systems* [#118]

Tay Kai Meng and Lim Chee Peng

6:00PM *Refinement CTIN for General Type-2 Fuzzy Logic Systems* [#417]

Thanh Long Ngo

6:20PM *On a Strengthening Connective for Flexible Database Querying* [#7]

Patrick Bosc and Olivier Pivert

(HCGC-5) Competition: Human vs. Computer Go Competition

Tuesday, June 28, 5:00PM-7:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Panel Session II: Computing With Words

Tuesday, June 28, 5:00PM-6:30PM, Room: Grand Ballroom I, Chair: Nikhil R. Pal

Wednesday, June 29, 8:00AM-10:20AM**(SS02-2) Special Session: Evolutionary Fuzzy Systems**

Wednesday, June 29, 8:00AM-10:20AM, Room: Swan, Chair: Rafael Alcalá

8:00AM *Studying the Behavior of a Multiobjective Genetic Algorithm to design Fuzzy Rule-Based Classification Systems for Imbalanced Data-Sets* [#189]

Pedro Villar, Alberto Fernandez and Francisco Herrera

8:20AM *On the Cooperation of Interval-Valued Fuzzy Sets and Genetic Tuning to Improve the Performance of Fuzzy Decision Trees* [#258]

Jose Antonio Sanz, Alberto Fernandez, Humberto Bustince and Francisco Herrera

8:40AM *A Two-Step Approach of Feature Construction for a Genetic Learning Algorithm* [#388]

David Garcia, Antonio Gonzalez and Raul Perez

9:00AM *Using the Adaboost algorithm for extracting fuzzy rules from low quality data: some preliminary results* [#487]

Ana Palacios, Luciano Sanchez and Ines Couso

9:20AM *Checking Orthogonal Transformations and Genetic Algorithms for Selection of Fuzzy Rules based on Interpretability-Accuracy Concepts* [#324]

M.Isabel Rey, Marta Galende, Gregorio I. Sainz and MariaJ. Fuente

9:40AM *A Hierarchical Genetic Fuzzy Rule-Based Classifier for High-Dimensional Classification Problems* [#395]

Dimitris Stavrakoudis, Ioannis Gitas and John Theocharis

10:00AM *A New Approach to Handle High Dimensional and Large Datasets in Multi-objective Evolutionary Fuzzy Systems* [#432]

Michela Antonelli, Pietro Ducange and Francesco Marcelloni

(SS12-2) Special Session: Recent Advances in Fuzzy-Model-Based Control Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Peacock, Chair: H. K. Lam

8:00AM *Generalized Stabilizing Controllers for Fuzzy Systems via Circle Criterion -- LMI and SOS* [#40]

Ji-Chang Lo and Wei-Cheng Liao

8:20AM *T-S Fuzzy Systems Approach to Approximation and Robust Controller Design for General Nonlinear Systems* [#216]

Qing Gao, Xiao-Jun Zeng, Gang Feng and Yong Wang

8:40AM *A Polynomial Observer Design for a Wider Class of Polynomial Fuzzy Systems* [#62]

Toshiaki Seo, Hiroshi Ohtake, Kazuo Tanaka, Ying-Jen Chen and Hua O. Wang

9:00AM *A SVD Approach to \mathcal{H}_∞ Decentralized Static Output Feedback Fuzzy Control Design for Nonlinear Interconnected Systems* [#45]

Chung-Shi Tseng and Yung-Yue Chen

9:20AM *Adaptive Fuzzy Sliding-Mode Control for a Class of Nonlinear Systems with Uncertainties* [#111]

Hugang Han

9:40AM *Mixed H_2/H_∞ Optimization with Discrete Smith Predictor for Fuzzy Decentralized Control of Nonlinear Interconnected Discrete Dynamic Systems with Large Delay* [#44]

Chih-Lyang Hwang

10:00AM *A Hybrid Fuzzy Sliding-Mode Control for a Class of Generalized, Under-Actuated and Uncertain Nonlinear Dynamic Systems* [#120]

Chih-Lyang Hwang and Hsiu-Ming Wu

(SS31) Special Session: Human Symbiotic Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Phoenix, Chair: Daisuke Katagami

8:00AM *Visualization and Analytical Support of Questionnaire Free-Texts Data based on HK Graph with Concepts of Words* [#365]

Daisuke Kobayashi, Tomohiro Yoshikawa and Takeshi Furuhashi

8:20AM *Development of Body Mapping from Human Demonstrator to Inverted-Pendulum Mobile Robot for Imitation* [#353]

Takahashi Sataya, Takahashi Yasutake, Maeda Yoichiro and Nakamura Takayauki

8:40AM *Social Interaction of Cooperative Communication and Group Generation in Multi-Agent Reinforcement Learning Systems* [#389]

Kun Zhang, Yoichiro Maeda and Yasutake Takahashi

9:00AM *Estimation Of Subjective Stress Via Finger Plethysmogram* [#255]

Yusuke Kobashi, Genma Sano, Tsuyoshi Nakamura and Masayoshi Kanoh

9:20AM *Human Preference Learning by Robot Partners Based on Multi-objective Behavior Coordination* [#560]

Naoyuki Kubota, Aiko Yaguchi and Utaki Ishikawa

9:40AM *A Report The Difference Features Of A Multi-agent Using An Overlay Knowledge In The Fire Panic Problem* [#554]

Yukinobu Hoshino

10:00AM *Group Pressure Generation of Multi-Agents on Cross-cultural Simulation Game* [#377]

Daisuke Katagami and Tam Huynh van

(FC& IS) Fuzzy Control and Intelligent Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Crane, Chair: Li-Wei Ko

8:00AM *H2 Guaranteed Cost of Uncertain Continuous T-S Fuzzy Systems by Multiple Lyapunov Function Approach* [#87]

Wen-Ren Horng, Chun-Hsiung Fang, Ching-Hsiang Lee and Jyh-Horng Chou

8:20AM *Higher Order Sliding Fuzzy Type-2 Interval Control for SISO Uncertain Nonlinear Systems* [#508]

Malik Manceur, Essounbouli Najib and Hamzaoui Abdelaziz

8:40AM *Output Regulation Using Integral Fuzzy Predictive Control with Piecewise Lyapunov Functions* [#248]

Chien-Hung Liu and Kuang-Yow Lian

9:00AM *Power Management of a Variable Speed Wind Turbine for Stand-Alone System using Fuzzy Logic* [#580]

Minh Huynh Quang, Frederic Nollet, Najib Essounbouli and Abdelaziz Hamzaoui

9:20AM *Robust stabilization for continuous fuzzy systems with time varying delay* [#550]

Chedia Latrach, Mourad Kchaou, Ahmed Hajjaji and Ahmed Toumi

9:40AM *Splitting K-means Generated Neural Fuzzy System with Support Vector Regression* [#406]

Cheng-Da Hsieh and Chia-Feng Juang

10:00AM *Fuzzy Reinforcement Learning Control for Decentralized Partially Observable Markov Decision Processes* [#523]

Rajneesh Sharma and Matthijs T. J. Spaan

(SS10-2) Special Session: Medical and Wellness Engineering

Wednesday, June 29, 8:00AM-10:20AM, Room: Egret, Chair: Yutaka Hata

8:00AM *A challenge to biometrics by sole pressure while walking* [#338]

Takahiro Takeda, Kei Kuramoto, Syoji Kobashi and Yutaka Hata

8:20AM *Six Degree of Freedom Calculation Based on Principal Component Analysis for the Knee Joint in MDCT Image* [#433]

Yosuke Uozumi, Kouki Nagamune, Daisuke Araki, Tomoyuki Matsumoto and Takehiko Matsushita

8:40AM Nursing-care Text Classification using Additional Term Information from Web [#336]

Manabu Nii, Takafumi Yamaguchi, Yusuke Mori, Yutaka Takahashi and Atsuko Uchinuno

9:00AM A Development of Navigation System for MOSAIC PLASTY using Electromagnetic Sensor [#413]

Takayasu Toyoshima, Kouki Nagamune, Daisuke Araki, Tomoyuki Matsumoto and Seiji Kubo

9:20AM A Quantitative Measurement System of Endpoint during Lachman tTest with Force Sensor [#379]

Shogo Kawaguchi, Kouki Nagamune, Daisuke Araki, Tomoyuki Matsumoto and Seiji Kubo

9:40AM Human Motion Tracking for Cognitive Rehabilitation in Informationally Structured Space Based on Sensor Networks [#569]

Yuichiro Toda, Kodai Yuki, Eriko Hiwada and Naoyuki Kubota

10:00AM A Pervasive Multi-sensor Data Fusion for Smart Home Healthcare Monitoring [#472]

Hamid Medjahed, Dan Istrate, Jerome Boudy, Jean-Louis Baldinger and Bernadette Dorizzi

(SS13-1) Special Session: Fuzzy Multiple Criteria Decision Making

Wednesday, June 29, 8:00AM-10:20AM, Room: Swallow, Chair: Gwo-Hshiung Tzeng

8:00AM Value Driver Derivations for Embedded Memories by Fuzzy DEMATEL based Hybrid MCDM Methods [#530]

Chi-Yo Huang and Gwo-Hshiung Tzeng

8:20AM Fuzzy Multiple Attribute Decision Making Theory With The Balanced Scorecard Application In Mobile Industry [#369]

Chiu-Hung Su, Ying-Hsun Hung and Gwo-Hshiung Tzeng

8:40AM Fuzzy MCDM Application for Strategy Evaluation [#383]

Mei-Chen Lo and Gwo-Hshiung Tzeng

9:00AM Exploring the SPM System Structure Model by Using Fuzzy DEMATEL for NPD [#342]

Chang Yu-Yun, Kuan Meng-Jong, Chuang Yen-Ching and Tzeng Gwo-Hshiung

9:20AM Interdependent Multiple Objective Programming- A Monte Carlo Method [#398]

Jih-Jeng Huang and Chin-Yi Chen

9:40AM Handling Fuzzy Decision Making Problem based on Linguistic Information and Intersection Concept [#93]

Chen-Tung Chen, Ping-Feng Pai and Wei-Zhan Hung

10:00AM Evaluate and Identify Optimal Weapon Systems Using Fuzzy Multiple Criteria Decision Making [#14]

Ying Bai and Dali Wang

(HCGC-1) Competition: Human vs. Computer Go Competition

Wednesday, June 29, 8:00AM-10:20AM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Wednesday, June 29, 8:00AM-9:00AM**Invited Talk I: Casual Communication between Robots and Humans based on Robot Technology Middleware and Multimedia Recognition**

Wednesday, June 29, 8:00AM-9:00AM, Room: Grand Ballroom I, Speaker: Kaoru Hirota

Wednesday, June 29, 8:00AM-10:20AM**(FA-2) Fuzzy Applications**

Wednesday, June 29, 8:00AM-10:20AM, Room: Grand Ballroom II, Chair: Qiang Shen

8:00AM *Fuzzy-rough Classifier Ensemble Selection* [#134]

Ren Diao and Qiang Shen

8:20AM *Kernel-Based Fuzzy-Rough Nearest Neighbour Classification* [#135]

Yanpeng Qu, Changjing Shang, Qiang Shen, Neil MacParthalain and Wei Wu

8:40AM *FAPOP: Feature Analysis Enhanced Pseudo Outer-Product Fuzzy Rule Identification System* [#240]

Sau Wai Tung, Chai Quek and Cuntai Guan

9:00AM *Tracking Control of Surface Vessels via Adaptive Type-2 Fuzzy Logic Control* [#256]

Xue Tao Chen and Woei Wan Tan

9:20AM *Relaxed Fuzzy Lyapunov Approach for Dynamic Local Model Networks* [#263]

Christian Mayr, Christoph Hametner, Martin Kozek and Stefan Jakubek

9:40AM *Vehicle Warning System for Land Departure and Collision Avoidance: Using Adaptive Fuzzy Decision Making* [#484]

Chih-Li Huo, Yu-Hsiang Yu, Jih-Cheng Syu and Tsung-Ying Sun

10:00AM *Centroid Density of Interval Type-2 Fuzzy Sets: Comparing Stochastic and Deterministic Defuzzification* [#444]

Ondrej Linda and Milos Manic

Wednesday, June 29, 10:50AM-12:00PM**(HCGC-2) Competition: Human vs. Computer Go Competition**

Wednesday, June 29, 10:50AM-12:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Keynote Speech II: Fuzzy Approaches to Information Fusion

Wednesday, June 29, 10:50AM-12:00PM, Room: Grand Ballroom I, Speaker: Bernadette Bouchon-Meunier

Wednesday, June 29, 1:30PM-2:30PM**(HCGC-3) Competition: Human vs. Computer Go Competition**

Wednesday, June 29, 1:30PM-2:30PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Plenary Speech II: Soft Computing in Prognostics and Health Management (PHM) Applications: A Case Study in Anomaly Detection

Wednesday, June 29, 1:30PM-2:30PM, Room: Grand Ballroom I, Speaker: Piero Bonissone

Wednesday, June 29, 2:30PM-4:30PM**(PS03) Poster Session III**

Wednesday, June 29, 2:30PM-4:30PM, Room: Grand Ballroom II

P501 Statistical Scheme via AIC for Evaluating the Optimal Cut Off Level in Fuzzy Clustering [#370]

Shuya Kanagawa, Kimiaki Shinkai, Hsunhsun Chung and Kenichi Nagashima

P502 Genetic Algorithm Based Fully Automated and Adaptive Fuzzy Logic Controller [#371]

Pintu Shill, Kishore Pal, Faijul Amin and Kazuyuki Murase

P503 A Comparison of Distance-based Semi-Supervised Fuzzy c-Means Clustering Algorithms [#373]

Daphne Teck Ching Lai and Jonathan M. Garibaldi

P504 Applying MDL in PSO for Learning Bayesian Networks [#382]

Shu-Ching Kuo, Hung-Jen Wang, Hsiao-Yi Wei, Chih-Chuan Chen and Sheng-Tun Li

P505 Relational Structure Analysis of Fuzzy Node Fuzzy Graph and its Application [#385]

Hiroaki Uesu, Kenichi Nagashima, Hsunhsun Chung and Ei Tsuda

P506 On another approach to the definition of an L-fuzzy valued integral [#419]

Vecislavs Ruza and Svetlana Asmuss

P507 Evolving Fuzzy Image Segmentation [#422]

Ahmed Othman and Hamid Tizhoosh

P508 On spline methods of approximation under L-fuzzy information [#430]

Svetlana Asmuss and Alexander Sostak

P509 Local Non-Quadratic H-infinity Control For Continuous-Time Takagi-Sugeno Models [#440]

Miguel Bernal, Adolfo Soto-Cota, Joaquin Cortez, Jose Luis Pitarch and Abdelhafidh Jaadari

P510 Fuzzy Active Contour Models [#451]

Cesar Pereira, Carlos Bastos, Ren Tsang and George Cavalcanti

P511 Discretization of fuzzy transitive relations [#470]

D. Boixader and J. Recasens

P512 Tridimensional Fuzzy Pain Assessment [#476]

Ernesto Araujo and Suzana Miyahira

P513 Integrate Variable Precision Rough Sets and Modified PBMF Index Function for Partitioning and Classifying Complex Datasets [#478]

Kuang Yu Huang and Yu-Hsin Cheng

P514 Anti-Swing Control of A New Container Crane With Fuzzy Uncertainties Compensation [#486]

Weimin Xu, Wei Gu, Aidi Shen, Jianxin Chu and Wangqiang Niu

P515 A Robust Method for Image Segmentation of Noisy Digital Images [#492]

Prabhjot Kaur, I. M. S. Lamba and Anjana Gosain

P516 The Fuzzy DEMATEL based Job Accommodation Strategy Definitions for Operators with Hearing Impairments [#534]

Chi-Yo Huang and Gwo-Hshiung Tzeng

P517 A Fuzzy MCDM method to select the best company based on Financial Report Analysis [#527]

Jung-Yuan Kung, Tzung-Nan Chuang and Minh Ky Chau

P518 Improve Observation-Based Discrete Hidden Markov Model by Fuzzy Vector Quantization -- An example on electroencephalogram (EEG) signal recognition [#572]

Shing-Tai Pan, Sheng-Fu Liang, Tzung-Pei Hong and Jian-Hong Zeng

P519 Design of Interval Type-2 Fuzzy Logic Systems Using Prior Knowledge via Optimization Algorithms [#92]

Tiechao Wang and Jianqiang Yi

P520 Fuzzy Reinforcement Learning for System of Systems (SOS) [#34]

Hamid Berenji and Mo Jamshidi

Wednesday, June 29, 2:50PM-4:30PM**(SS20) Special Session: Universal Contents Creation/Distribution and Intelligent System**

Wednesday, June 29, 2:50PM-4:30PM, Room: Swan, Chair: Katsuhiko Honda

2:50PM Partially Exclusive Condition for Sequential Fuzzy Co-cluster Extraction [#48]

Katsuhiro Honda, Akira Notsu and Hidetomo Ichihashi

3:10PM DEA based Hierarchical Structure Evaluation and Visualization Method [#323]

Kazushige Inoue, Takeo Ichinotsubo and Shingo Aoki

3:30PM Group Decision Focusing on Outliers [#115]

Tomoe Entani

3:50PM PCA-guided k-Means Clustering With Incomplete Data [#15]

Katsuhiro Honda, Ryoichi Nonoguchi, Akira Notsu and Hidetomo Ichihashi

4:10PM Proposed Particle-Filtering Method for Reinforcement Learning [#53]

Akira Notsu, Katsuhiro Honda and Hidetomo Ichihashi

(SS03) Special Session: Uncertainty and the Semantic Web

Wednesday, June 29, 2:50PM-4:30PM, Room: Peacock, Chair: Fernando Bobillo

2:50PM Formalizing Object Membership in Fuzzy Ontology with Property Importance and Property Priority [#298]

Yi Cai and Ho-fung Leung

3:10PM Aggregation Operators and Fuzzy OWL 2 [#142]

Fernando Bobillo and Umberto Straccia

3:30PM Are Fuzzy Description Logics with General Concept Inclusion Axioms Decidable? [#310]

Franz Baader and Rafael Penaloza

3:50PM Fuzzy Concept Lattice Construction: A Basis for Building Fuzzy Ontologies [#454]

Valerie Cross and Meenaskhi Kandasamy

4:10PM Fuzziness, OWA and Linguistic Quantifiers for Web Selection Processes [#420]

Ronald R. Yager, Marek Z. Reformat and Giray Gumrah

(SS04) Special Session: Soft Computing for Operations Research and Optimization

Wednesday, June 29, 2:50PM-4:30PM, Room: Phoenix, Chair: Takashi Hasuike

2:50PM Visual Stability Improvement of SOM's Feature Map by Initial Value Assignment [#502]

Shinji Momoi and Tsutomu Miyoshi

3:10PM Study of morphogenesis of a large-span roof that satisfies its form design requirements [#61]

Yuya Takeda and Kazutoshi Tsutsumi

3:30PM Multiobjective Two-Level 0-1 Programming through Distributed Genetic Algorithms [#86]

Keiichi Niwa, Tomohiro Hayashida and Masatoshi Sakawa

3:50PM Optimal Static Output Feedback Control of Fuzzy-Model-Based Control Systems [#12]

Wen-Hsien Ho, Chen Shinn-Horng, Chou Jyh-Horng and Shu Chun-Chin

4:10PM An Interactive Satisficing Method for Multiobjective Random Fuzzy Programming Problems through the Possibility-Based Probability Model [#197]

Hideki Katagiri, Masatoshi Sakawa and Takeshi Matsui

(SS01) Special Session: Fuzzy Ontologies and FML Applications

Wednesday, June 29, 2:50PM-4:30PM, Room: Crane, Chair: Giovanni Acampora

2:50PM Improving Ontology Alignment through Memetic Algorithms [#307]

Giovanni Acampora, Pasquale Avella, Vincenzo Loia, Salerno Saverio and Autilia Vitiello

3:10PM Genetic Fuzzy Markup Language for Diet Application [#468]

Chang-Shing Lee, Mei-Hui Wang, Zhi-Wei Chen, Chin-Yuan Hsu, Su-E Kuo, Hui-Ching Kuo, Hui-Hua Cheng and Akio Naito

3:30PM *A Hierarchical Approach to Assess Keyword Dependencies in Fuzzy Keyword Ontologies* [#124]

Christer Carlsson, Robert Fuller and Mario Fedrizzi

3:50PM *Improving Disease Prediction Using ICD-9 Ontological Features* [#148]

Mihail Popescu and Mohammed Khalilia

(SS42-2) Special Session: Fuzzy Cognitive Maps-Theory and Applications

Wednesday, June 29, 2:50PM-4:30PM, Room: Egret, Chair: Chair: Elpiniki I. Papageorgiou and Sebastian Lozano

2:50PM *Software Maintenance Scenarios Simulation with Fuzzy Cognitive Maps* [#514]

Cristina Lopez, Jose L. Salmeron and Sebastian Lozano

3:10PM *Train Fuzzy Cognitive Maps by Gradient Residual Algorithm* [#262]

Huiliang Zhang, Zhiqi Shen and Chunyan Miao

3:30PM *Causal Modeling Approximations In The Medical Domain* [#556]

Lawrence Mazlack

3:50PM *Interactive fuzzy programming through possibility measures and probability maximization for two-level linear programming problems involving fuzzy random variable coefficients* [#163]

Masatoshi Sakawa, Hideki Katagiri and Takeshi Matsui

(SS21-2) Special Session: Fuzzy Control in Industrial and Application

Wednesday, June 29, 2:50PM-4:30PM, Room: Swallow, Chair: Shun-Hung Tsai, Chin-Sheng Chen and Ming-Ying Hsiao

2:50PM *Decentralized Fuzzy Fault Tolerant Control for Multiple Satellites Attitude Synchronization* [#265]

Junquan Li and K. D. Kumar

3:10PM *T-S Fuzzy Tracking and Synchronous Control in a Gantry Stage* [#128]

Chin-Sheng Chen, Chao-Feng Lee, Po-Huan Chou, Faa-Jeng Lin and Shun-Hung Tsai

3:30PM *Observer-Based Adaptive FNN Control of Robot Manipulators: PSO-SA Self Adjust Membership Approach* [#181]

Kai-Shiuan Shih, Tzue-Hseng S. Li and Shun-Hung Tsai

3:50PM *Design of Digital Battery Charger System Based on PV-Module* [#137]

Ta-Tau Chen, Ming-Ying Hsiao, Shun-Hung Tsai and Che-Nan Lin

4:10PM *Fuzzy Approaches for Multiobjective Stochastic Linear Programming Problems Considering Both Probability Maximization and Fractile Optimization* [#217]

Hitoshi Yano

(HCGC-4) Competition: Human vs. Computer Go Competition

Wednesday, June 29, 2:50PM-4:30PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Wednesday, June 29, 4:30PM-7:00PM

(PS04) Poster Session IV

Wednesday, June 29, 4:30PM-7:00PM, Room: Grand Ballroom II

P701 *Performance Enhancement of Hierarchical Document Signature: A Comprehensive Study* [#497]

Sukanya Manna and Tom Gedeon

P702 *Sliding Adaptive Fuzzy Control for a Class of Time-Delayed Chaotic Systems* [#509]

Negin Farzbod, Hassan Zarabadipour, Mahdi Aliyari Shoorehdeli and Faezeh Farivar

P703 Estimating Missing Value in Microarray Gene Expression Data [#515]

Amit Paul and Jaya Sil

P704 Interval Fuzzy Modeling Applied to Model Based Fault Detection of an Active Suspension System [#537]

Tayebe Sadat Ghiasi, Hassan Zarabadipour and Mahdi Aliyari Shoorehdeli

P705 Uncertainty Management in Type-2 Fuzzy Face-Space for Emotion Recognition [#541]

Rajshree Mandal, Anisha Halder, Pavel Bhowmik, Aruna Chakraborty, Amit Konar and Atulya K. Nagar

P706 Generation of Takagi-Sugeno Fuzzy Systems with Minimum Rules in Modeling and Identification [#549]

Feng Wan and Chenglin Hu

P707 Maximum Power Point Tracker for a PV Cell using a Fuzzy Agent adapted by the Fractional Open Circuit Voltage Technique [#551]

Moustafa Adly, Hisham El-Sherif and Mohamed Ibrahim

P708 Improvement of Digital Image Motion Compensation by Fuzzy Inference [#597]

Sheng-Che Hsu

P709 A Semisupervised Feature Extraction Method Based on Fuzzy-type Linear Discriminant Analysis [#598]

Hui-Shan Chu, Cheng-Hsuan Li, Bor-Chen Kuo and Chin-Teng Lin

P710 The Emotion Recognition System with Heart Rate Variability and Facial Image Features [#599]

Pei-Yang Hsieh and Chiun-Li Chin

P711 Fuzzy Control of a Bi-directional Inverter with Nonlinear Inductance for DC Microgrids [#610]

Gwo-Ruey Yu

P712 The Development of the Automatic Lane Following Navigation System for the Intelligent Robotic Wheelchair [#611]

Wen-Chang Cheng and Chia-Ching Chiang

P713 The Prediction of Trust Rating Based on the Quality of Services Using Fuzzy Linear Regression [#614]

M. Hadi Mashinchi, Lei Li, Mehmet Orgun and Yan Wang

P714 Observer-based Hybrid Fuzzy CMAC Controller for a Class of Uncertain Chaotic Systems [#616]

Chun-Sheng Chen

P715 Automated Boundary Extraction and Visualization System for Coronary Plaque in IVUS Image by Using Fuzzy Inference-based Method [#271]

Takanori Koga, Eiji Uchino and Noriaki Suetake

P716 Multi-source Knowledge Based Unnormalized Interval Type-2 Fuzzy Logic Systems Design [#154]

Tiechao Wang, Jianqiang Yi and Chengdong Li

P717 On the Properties of SIRMs Connected Type-1 and Type-2 Fuzzy Inference Systems [#264]

Chengdong Li, Guiqing Zhang, Jianqiang Yi and Tiechao Wang

P718 Digital controller design for fuzzy systems with packet loss: intelligent digital redesign approach [#333]

Geun Bum Koo, Jin Bae Park, Young Hoon Joo and Hyoung Seok Jeon

P719 Mixed-Time T-S Fuzzy Optimal Estimator for Target Tracking [#517]

Sun Young Noh, Jin Bae Park and Young Hoon Joo

P720 Generalized Projective Synchronization of Time-Delayed Chaotic Systems via Sliding Adaptive Fuzzy Control [#540]

Negin Farzbod, Hassan Zarabadipour, Mahdi Aliyari Shoorehdeli and Faezeh Farivar

Wednesday, June 29, 5:00PM-6:00PM**Invited Talk II: Acceleration and Scalability for c-Means Clustering**

Wednesday, June 29, 5:00PM-6:00PM, Room: Swan, Speaker: James Bezdek

Wednesday, June 29, 5:00PM-7:00PM**(SS40) Special Session: Fuzzy Approach for Information Security Management**

Wednesday, June 29, 5:00PM-7:00PM, Room: Peacock, Chair: Che-Hung Liu

5:00PM Knowledge Management, Education and Firm's Performance [#416]

Yen-Tzu Chen, Yun-Chia Yan, Hsiao-Wen Huang and Hua-Wei Huang

5:20PM Expert decision making method based on uncertain linguistic variables [#525]

Tzung-Nan Chuang, Jung-Yuan Kung, Yin-Fang Lin and Hsiang-Chun Ku

5:40PM Applying FML and Fuzzy Ontologies to Malware Behavioural Analysis [#575]

Hsien-De Huang, Giovanni Acampora, Vincenzo Loia, Chang-Shing Lee and Hung-Yu Kao

6:00PM Applying Fuzzy AHP to Study the KSFs of Information Security Management [#401]

Jen-Sheng Wang, Che-Hung Liu, Joseph Z. Shyu and Hsiao-Wen Huang

6:20PM An Extension of a Fuzzy Ontology for Flexible Querying [#6]

Nouredine Tamani, Ludovic Lietard and Daniel Rocacher

6:40PM A Computational Linguistic Approach for the Identification of Translator Stylometry using Arabic-English Text [#329]

Heba El-Fiqi, Eleni Petraki and Hussein A. Abbass

(SS38) Special Session: Fuzzy Knowledge Discovery and Its Applications

Wednesday, June 29, 5:00PM-7:00PM, Room: Phoenix, Chair: Rung-Ching Chen

5:00PM Genetic-Fuzzy Association Rules for Network Intrusion Detection Systems [#364]

Ming-Yang Su, Chun-Yuen Lin, Sheng-Wei Chien and Han-Chung Hsu

5:20PM Personalized Recommendation for Web-based Learning Based on Ant Colony Optimization with Segmented-goal and Meta-Control Strategies [#459]

Feng-Hsu Wang

5:40PM A novel fuzzy recommendation system integrated the experts' opinion [#461]

Li Chen Cheng and Hua An Wang

6:00PM Fuzzy Rule-Based Stock Trading System [#464]

I-Cheng Yeh and Che-hui Lien

6:20PM Towards Application of FML in Suspicion of Non-Common Diseases [#582]

Giovanni Acampora, Tatiana Kiseliova, Karaman Pagava and Autilia Vitiello

6:40PM Linguistic summarization of long-term trends for understanding change in human behavior [#296]

Maria Ros, Derek Anderson, James Keller, Manuel Pegalajar, Miguel Delgado, Amparo Vila and Mihail Popescu

(SS39) Special Session: Fuzzy Based Computation on Biomedical Systems

Wednesday, June 29, 5:00PM-7:00PM, Room: Crane, Chair: Shing-Tai Pan

5:00PM Fuzzy Knowledge Approach to Automatic Disease Diagnosis [#281]

Giuseppe Fenza, Vincenzo Loia, Carmen De Maio, Mariacristina Gallo, Roberto Linciano and Aldo Morrone

5:20PM Predicting Laboratory Testing in Intensive Care using Fuzzy and Neural Modeling [#349]

Federico Cisoni, Andre Fialho, Susana Vieira, Joao Sousa and Shane Reti

5:40PM A fuzzy inference system for sleep staging [#109]

Liang Sheng-Fu, Chen Ying-Huang, Kuo Chih-En, Chen Jyun-Yu and Hsu Sheng-Che

6:00PM Fusion of Fuzzy Logic and PD Control for a Five-Fingered Smart Prosthetic Hand [#485]

Cheng-Hung Chen and D. Subbaram Naidu

6:20PM Hierarchical-interpolative Fuzzy System Construction by Genetic and Bacterial Programming Algorithms [#414]

Krisztian Balazs and Laszlo T. Koczy

6:40PM Study on Various Defuzzification Methods for Fuzzy Clustering Algorithms to Improve ROIs Detection in Lung CTs [#140]

Alberto Rey, Bernardino Arcay and Alfonso Castro

(SS17-2 & SS15) Special Session: Practical and Applications Aspects of Type-2 Fuzzy Logic Systems & Type-2 Fuzzy Logic Theory

Wednesday, June 29, 5:00PM-7:00PM, Room: Egret, Chair: Hani Hagrass and Christian Wagner

5:00PM *Comparison and Practical Implementation of Type-Reduction Algorithms for Type-2 Fuzzy Sets and Systems* [#24]

Dongrui Wu and Maowen Nie

5:20PM *Interpreting Fuzzy Set Operations and Multi Level Agreement in a Computing with Words Context* [#602]

Christian Wagner and Hani Hagrass

5:40PM *An Adaptive Type-2 Fuzzy Logic Controller for Dynamic Positioning* [#211]

Xue Tao Chen and Woei Wan Tan

6:00PM *Interval Type-2 Recurrent Fuzzy Neural System Desing via Stable Simultaneous Perturbation Stochastic Approximation Algorithm* [#269]

Feng-Yu Chang and Ching-Hung Lee

6:20PM *Efficient centroid computation of general type-2 fuzzy sets with linear secondary membership function* [#145]

Liu Xinwang

6:40PM *Type-2 Fuzzy Airplane Altitude Control: A Comparative Study* [#283]

Sheir Afgen Zaheer and Jong-Hwan Kim

(SS30 & SS43) Special Session: Fuzzy Inference Systems-Theory and Applications & Fuzzy Systems of Unknown Nonlinear Complex Systems

Wednesday, June 29, 5:00PM-7:00PM, Room: Swallow, Chair: Chi-Hsu Wan and Shih-Yu Li

5:00PM *Solving Zadeh's Magnus Challenge Problem on Linguistic Probabilities via Linguistic Weighted Averages* [#436]

Mohammad Reza Rajati, Jerry Mendel and Dongrui Wu

5:20PM *Linguistic Weighted Power Means: Comparison with the Linguistic Weighted Average* [#68]

John T. Rickard, Janet Aisbett, Ronald R. Yager and Greg Gibbon

5:40PM *Finding the Capacity of Fuzzy Neural Networks (FNNs) via Its Equivalent Fully Connected Neural Networks (FFNNs)* [#241]

Jing Wang, Chi-Hsu Wang and C. L. Philip Chen

6:00PM *On the Classification of Cancer Cell Gene via Expressive Value Distance (EVD) Algorithm and Its Comparison to the Optimally Trained ANN Method* [#589]

Tong Zhang, Sik Chung Tam, Chi-Hsu Wang and C.L. Philip Chen

6:20PM *Adaptive Neural-Fuzzy Inference System for Classification of Rail Quality Data with Bootstrapping-Based Over-Sampling* [#592]

Yong Yao Yang, Mahdi Mahfouf, George Panoutsos, Steve Thornton and Qian Zhang

6:40PM *Passive Fuzzy Control for Uncertain Nonlinear Stochastic Inverted Pendulum Robot System* [#219]

Wen-Jer Chang, Sin-Sian Jheng and Cheung-Chieh Ku

(HCGC-5) Competition: Human vs. Computer Go Competition

Wednesday, June 29, 5:00PM-7:00PM, Room: Magpie, Chair: Chang-Shing Lee, Martin Muller, Olivier Teytaud, and Shun-Chin Hsu

Wednesday, June 29, 6:00PM-7:00PM**Invited Talk III: Activity Summarization from 3D Video Systems in an Eldercare Environment**

Wednesday, June 29, 6:00PM-7:00PM, Room: Swan, Speaker: Jim Keller

Thursday, June 30, 8:00AM-10:20AM**(SS23) Special Session: Industrial Applications of Evolving Fuzzy Systems**

Thursday, June 30, 8:00AM-10:20AM, Room: Swan, Chair: Kit Yan Chan

8:00AM Economic Load Dispatch using Intelligent Optimization with Fuzzy Control [#105]

Johnny C.Y. Lai, Frank H. Leung, S. H. Ling and Edwin C. Shi

8:20AM Hypoglycemia Detection using Fuzzy Inference System with Genetic Algorithm [#28]

Sai Ho Ling, Hung Nguyen and F.H.F Leung

8:40AM An Approach for Stability Analysis of Polynomial Fuzzy Model-Based Control Systems [#280]

Mohammad Narimani, Hak-Keung Lam, Kaspar Althoefer, Reza Shams Dilmaghani, Charles Wolfe and Christian Deters

9:00AM A Distributed Smart Routing Scheme for Terrestrial Sensor Networks with Hybrid Neural Rough Sets [#588]

Frank Jiang and Steve Ling

9:20AM P2P Traffic Identification and Optimization Using Fuzzy C-means Clustering [#435]

Duo Liu and Chung-Horng Lung

9:40AM Determination Of Process Conditions Of Epoxy Dispensing Processes Using A Genetic Algorithm Based Neural Fuzzy Networks [#30]

K. Y. Chan, T.S. Dillon, S. H. Ling and C.K. Kwong

10:00AM Manufacturing Modeling Using An Evolutionary Fuzzy Regression [#31]

K.Y. Chan, T.S. Dillon, S.H. Ling and C.K. Kwong

(MFI & RWA) Medical, Financial, Industrial and Other Real World Applications

Thursday, June 30, 8:00AM-10:20AM, Room: Peacock, Chair: James Keller

8:00AM A Heuristic Search and its Roughness [#153]

Chun-Hung Tzeng and Fu-Shing Sun

8:20AM Linguistic description of adult skeletal age-at-death estimations from fuzzy integral acquired fuzzy sets [#164]

Derek Anderson, Melissa Anderson, James Keller and Daniel Wescott

8:40AM Moving Pattern-based Approach to Modeling of a Class of Complex Production Processes [#491]

Zhengguang Xu and Changping Sun

9:00AM Multiple Characterisation Modelling of Friction Stir Welding Using a Genetic Multi-objective Data-driven Fuzzy Modelling Approach [#596]

Qian Zhang, Mahdi Mahfouf, George Panoutsos, Kathryn Beamish and Ian Norris

9:20AM Fuzzy Modeling to Predict Administration of Vasopressors in Intensive Care Unit Patients [#429]

Andre Fialho, Federico Cismondi, Susana Vieira, Joao Sousa, Shane Reti, Leo Celi, Michael Howell and Stan Finkelstein

9:40AM Probing Performance Evaluation for NPD Process by Using MCDM Approach [#354]

Chia-Chun Hsiang, Meng-Jong Kuan and Gwo-Hshiong Tzeng

10:00AM Application of Adaptive Self-Organizing CMAC_GBF to Aircraft Landing System [#221]

Jih-Gau Juang

(FSM & IS) Fuzzy Systems Modeling and Intelligent Systems

Thursday, June 30, 8:00AM-10:20AM, Room: Phoenix, Chair: Honghai Liu

8:00AM Optimal Necessary Conditions for General SISO Mamdani Fuzzy Systems as Function Approximators within a Given Accuracy [#522]

Fuchun Sun, Jin Yang, Minnan Luo and Huaping Liu

8:20AM A fuzzy stochastic programming approach to solve the capacitated lot size problem under uncertainty [#493]

Navid Sahebjamnia and S.Ali Torabi

8:40AM *Look-ahead intelligent energy management of a parallel hybrid electric vehicle* [#278]

Behnam Ganji, Abbas Z. Kouzani and Hamid Khayyam

9:00AM *Dynamic Window with Fuzzy Controller in Wireless Sensor Networks for Elliptic Curve Cryptography* [#38]

Xu Huang, Dharmendra Sharma and Pritam Gajkumar Shah

9:20AM *Regulation for Wind Generation System Using Ant System Based Takagi Sugeno Fuzzy PID* [#260]

Ahmad Besheer and Abdo Tamer

9:40AM *Actuator Delayed Active Vehicle Suspension Control: A T-S Fuzzy Approach* [#396]

Hongyi Li, Honghai Liu and Huijun Gao

10:00AM *Hinf Disturbance Attenuation of Fuzzy Large-Scale Systems* [#66]

Mehdi Hosseinzadeh, Nasser Sadati and Iman Zamani

(FST & GC) Fuzzy Set Theory and Granular Computing

Thursday, June 30, 8:00AM-10:20AM, Room: Crane, Chair: Gwo-Hshiung Tzeng

8:00AM *Dualities between Indistinguishabilities and Related Concepts* [#518]

Gabriel Mattioli and Jordi Recasens

8:20AM *Graded equipollence and fuzzy c-measures of finite fuzzy sets* [#559]

Michal Holcapek

8:40AM *On monotonicity of type $\langle 1,1 \rangle$ fuzzy quantifiers determined by fuzzy measures* [#437]

Antonin Dvorak and Michal Holcapek

9:00AM *Generalized Fuzzy Imaginary Ideals of Rings* [#104]

Zuhua Liao, Shu Cao, Qinghe Tian, Miaohan Hu and Yang Zhang

9:20AM *Cellular Fuzzy Networks* [#59]

Koosha Sadeghi Oskooyee, Mohammad Mansour Riahi Kashani and Mehrdad Jangjou

9:40AM *Expatriate Manager Selection for an Overseas Manufacturing Site by Using FMCDM Methods* [#568]

Chi-Yo Huang, Chih-Wei Wan and Gwo-Hshiung Tzeng

10:00AM *On the Geometry of Join and Meet Calculations for General Type-2 Fuzzy Sets* [#8]

Jerry Mendel

(SS36-1) Special Session: Fuzzy Systems on Renewable Energy

Thursday, June 30, 8:00AM-10:20AM, Room: Egret, Chair: Faa-Jeng Lin

8:00AM *A Fuzzy-Based Output Power Smoothing of WECS using Short-Term Ahead Prediction of Wind Speed* [#97]

Yuya Izumi, Alok Pratap, Yoshihisa Kinjyo, Akie Uehara and Endusa Billy Muhando

8:20AM *Frequency and Voltage Control by Decentralized Controllable Loads with Fuzzy Control* [#332]

Yoshihisa Kinjyo, Tomonobu Senjyu, Atsushi Yona, Nomitsu Urasaki and Toshihisa Funabashi

8:40AM *Short-Term Load Forecasting Via Fuzzy Neural Network With Varied Learning Rates* [#27]

Rong-Jong Wai, Yi-Chang Chen and Yung-Ruei Chang

9:00AM *A Fuzzy Control Maximum Power Point Tracking Photovoltaic System* [#133]

Irwan Purnama, Lo Yu-Kang and Chiu Huang-Jen

9:20AM *Fuzzy Control of MW-class PV Generation to Reduce Frequency and Tie-line Power Fluctuations in Three Control Area Power System* [#391]

Manoj Datta, Tomonobu Senjyu, Atsushi Yona and Toshihisa Funabashi

9:40AM *A Fuzzy-Rule Based Power Restoration Approach for a Distribution System with Renewable Energies* [#327]

Hong-Tzer Yang, Jian-Tang Liao and Xiang-He Su

10:00AM *Neuro-Fuzzy Predictive Model for PV Energy Production based on Weather Forecast* [#539]

Francesco Grimaccia, Marco Mussetta and Riccardo E. Zich

(FS & FDM) Fuzzy Clustering and Fuzzy Data Mining

Thursday, June 30, 8:00AM-10:20AM, Room: Swallow, Chair: Tzung-Pei Hong

8:00AM *Fuzzy Clustering Approach for Star-Structured Multi-Type Relational Data* [#165]
Jian-Ping Mei and Lihui Chen

8:20AM *Predicting Septic Shock Outcomes in a Database with Missing Data using Fuzzy Modeling* [#427]

Ruben Pereira, Andre Fialho, Federico Cismondi, Susana Vieira, Joao Sousa, Rui Almeida, Uzay Kaymak, Shane Reti, Michael Howell and Stan Finkelstein

8:40AM *A normalized soft window-based similarity measure to extend the Rand index* [#405]
Romain Quere and Carl Frelicot

9:00AM *Fuzzy Clustering With Learnable Cluster Dependent Kernels* [#149]
Ouiem Bchir and Hichem Frigui

9:20AM *The Interval Autoregressive Time Series Model* [#236]

Xun Wang and Shoumei Li

9:40AM *Feature Evaluation Based Fuzzy C-Mean Classification* [#229]

Mostafa A. Salama, Aboul Ella Hassanien and Aly A. Fahmy

10:00AM *A Clustering Method for Geometric Data based on Approximation using Conformal Geometric Algebra* [#386]

Minh Tuan Pham, Kanta Tachibana, Tomohiro Yoshikawa and Takeshi Furuhashi

(HA) Hybrids and Other Applications

Thursday, June 30, 8:00AM-10:20AM, Room: Magpie, Chair: Bor-Sen Chen

8:00AM *Improving Estimation Accuracy of the COCOMO II Using an Adaptive Fuzzy Logic Model* [#237]

Iman Attarzadeh and Siew Hock Ow

8:20AM *Fuzzy-Rough Set based Semi-Supervised Learning* [#259]

Neil Mac Parthalain and Richard Jensen

8:40AM *An Application of Genetic Fuzzy Systems for Wireless Sensor Networks* [#418]

Liliam Leal, Marcus Lemos, Raimir Holanda, Ricardo Rabelo and Fabbio Borges

9:00AM *On Predicting Learning Styles in Conversational Intelligent Tutoring Systems using Fuzzy Classification Trees* [#304]

Keeley Crockett, Annabel Latham, Zuhair Bandar, James O'Shea and David Mclean

9:20AM *Signal Transduction Ability Measurement of Signaling Pathways in Intracellular Communication via Fuzzy Method* [#501]

Chia-Chou Wu and Bor-Sen Chen

9:40AM *Long-term business cycle forecasting using intuitionistic fuzzy least-squares support vector regression* [#348]

Kuo-Ping Lin, Kuo-Chen Hung and Ming-Chang Wu

Thursday, June 30, 10:50AM-12:00PM

Keynote Speech III: Soft Computing for Hard Pattern Recognition Problems

Thursday, June 30, 10:50AM-12:00PM, Room: Grand Ballroom I, Speaker: Paul Gader

Thursday, June 30, 1:30PM-2:30PM**(FOD) Fuzzy Optimization and Design**

Thursday, June 30, 1:30PM-2:30PM, Room: Swan, Chair: Chia-Feng Juang

1:30PM *Production Planning with Uncertain Demands* [#35]

Guillaume Romain, Kobylanski Przemyslaw and Zielinski Pawel

1:50PM *Min-Max and Two-Stage Possibilistic Combinatorial Optimization Problems* [#69]

Kasperski Adam and Zielinski Pawel

2:10PM *A Fuzzy Concept for Climate Management in Preventive Conservation* [#146]

Christian Arnold, Steven Lambeck and Christoph Ament

(FO & FEC) Fuzzy Optimization and Fuzzy Emotional Computing

Thursday, June 30, 1:30PM-2:30PM, Room: Peacock, Chair: Chuan-Yu Chang

1:30PM *Fuzzy Bipolar Conditions of Type "or else"* [#33]

Ludovic Lietard, Nouredine Tamani and Daniel Rocacher

1:50PM *Fuzzy Optimization Model Based Tolerance Approach to Timetable Rescheduling for High Speed Railway in China* [#130]

Yong Qin, Li Wang, Huan Lian, Xuelei Meng, Xuewen Li, Fugui Shi and Limin Jia

2:10PM *Online Neuro-Fuzzy CANFIS Hidden-Node Teaching* [#402]

Eiji Mizutani and Jing-Yun Fan

(RS & RDA) Rough Sets and Rough Data Analysis

Thursday, June 30, 1:30PM-2:30PM, Room: Phoenix, Chair: Yo-Ping Huang

1:30PM *Fuzzy Fusion Fairness Relations for the Evaluation of User Preference* [#358]

Mario Koeppen, Jun Okamoto and Aoi Honda

2:10PM *Noise Control in Document Classification Based On Fuzzy Formal Concept Analysis* [#207]

Sheng-Tun Li and Fu-Ching Tsai

1:50PM *Multiple Criteria Group Decision Making with Triangular Interval Type-2 Fuzzy Sets* [#409]

Kuo-Ping Chiao

(T2FL) Type-2 Fuzzy Logic

Thursday, June 30, 1:30PM-2:30PM, Room: Crane, Chair: Hao Ying

1:30PM *Deriving the Input-Output Mathematical Relationship for a Class of Interval Type-2 Mamdani Fuzzy Controllers* [#193]

Haibo Zhou and Hao Ying

1:50PM *Design of Interval of Type-2 Fuzzy Logic Controllers for Flocking Algorithm* [#231]

Seung-Mok Lee, Jong-Hwan Kim and Hyun Myung

2:10PM *Is it rational to partition a data set using Kernel-clustering?* [#536]

Kaushik Sarkar and Nikhil R Pal

(SS36-2) Special Session: Fuzzy Systems on Renewable Energy

Thursday, June 30, 1:30PM-2:30PM, Room: Egret, Chair: Faa-Jeng Lin

1:30PM *Fuzzy Quantum Computation Based Thermal Unit Commitment Strategy with Solar-battery System Injection* [#312]

Shantanu Chakraborty, Tomonobu Senjyu, Atsushi Yona and Toshihisa Funabashi

1:50PM *Control of Doubly-Fed Induction Generator System Using PFNN* [#46]

Faa-Jeng Lin, Kuang-Hsiung Tan, Zong-Han Lu and Yung-Ruei Chang

(FDM & DSS-1) Fuzzy Decision Making and Decision Support Systems

Thursday, June 30, 1:30PM-2:30PM, Room: Swallow, Chair: Bao-Rong Chang

1:30PM *Web User Identification with Fuzzy Fingerprints* [#203]

Nuno Homem and Joao Carvalho

1:50PM *Fuzzy Multiattribute Evaluation of Airport Performance* [#500]

Chung-Hsing Yeh, Yu-Hern Chang and Yu-Liang Kuo

2:10PM *An Intelligent Decision Support Tool Based on Belief Rule-Based Inference Methodology* [#305]

Alberto Calzada, Jun Liu, Hui Wang, Luis Martinez and Kashyap Anil

(HFS) Hybrid Fuzzy Systems

Thursday, June 30, 1:30PM-2:30PM, Room: Magpie, Chair: I-Fang Chung

1:30PM *Fuzzy Controller Design Using Group-Crossover Particle Swarm Optimization for Truck Reversing Control* [#225]

Chia-Feng Juang, Yu-Cheng Chang, Chia-Hung Hsu and I-Fang Chung

1:50PM *Evolving Ensemble of Fuzzy Models* [#85]

Eng Yeow Cheu, Chai Quek and See Kiong Ng

2:10PM *Long Term Bank Failure Prediction using Fuzzy Refinement-based Transductive Transfer Learning* [#467]

Vahid Behbood, Jie Lu and Guangquan Zhang

Thursday, June 30, 2:50PM-4:30PM**(SS29) Special Session: Software Engineering with Computational Intelligence**

Thursday, June 30, 2:50PM-4:30PM, Room: Swan, Chair: Nien-Lin Hsueh

2:50PM *Developing a Fuzzy Search Engine Based on Fuzzy Ontology and Semantic Search* [#107]

Lien-Fu Lai, Chao-Chin Wu, Pei-Ying Lin and Liang-Tsung Huang

3:10PM *Multi-Agent Automatic Negotiation and Argumentation for Courses Scheduling* [#213]

Jong Yih Kuo, Hsuan-Kueil Cheng, Yong-Yi FanJiang and Shang-Pin Ma

3:30PM *Investment Decision Making by Using Fuzzy Candlestick Pattern and Genetic Algorithm* [#563]

Chiung-Hon Lee, Lindroos Hsu and Yi-Ching Liaw

3:50PM *Fuzzy Logic as a Basic for Use Case Point Estimation* [#577]

Jonathan Lee, Wen-Tin Lee and Jong-Yih Kuo

4:10PM *Fuzzy Lymphedema Assessment based on Clinical and Functional Criteria* [#524]

Ernesto Araujo, Patricia Vicentini and Maria C. J. Perez

(SS34) Special Session: Brain and Learning

Thursday, June 30, 2:50PM-4:30PM, Room: Peacock, Chair: Toshihiko Watanabe

2:50PM *Decision Making Based on Reinforcement Learning and Emotion Learning for Social Behavior* [#293]

Atsushi Matsuda, Hideaki Misawa and Keiichi Horio

3:10PM *Analysis of Relationship between Characteristics of Driver's Eye Movements and Visual Scene in Driving Events* [#561]

Tetsuya Miyoshi and Hidetoshi Nakayasu

3:30PM Directional Control of an Omni-Directional Walker for Walking Support with Forearm Pressures [#233]
Yinlai Jiang, Shuoyu Wang, Kenji Ishida, Takeshi Ando and Masakatsu G. Fujie

3:50PM Construction of Collision Avoidance Behavior Model Induced by Visual Motion [#457]
Norifumi Watanabe, Hiroaki Mikado and Takashi Omori

4:10PM Instruction Knowledge Acquisition for Reinforcement Learning Scheme by PSO Algorithm [#564]
Toru Sawa and Toshihiko Watanabe

(SS35) Special Session: Fuzzy Regression Analysis and Its Applications

Thursday, June 30, 2:50PM-4:30PM, Room: Phoenix, Chair: M. Hadi Mashinchi

2:50PM A formula for fuzzy linear regression analysis [#374]
Chi-Tsuen Yeh

3:30PM An Interval-Based Approach to Fuzzy Regression for Fuzzy Input-Output Data [#215]
Jalal Chachi, Taheri Seyed Mahmoud and Hojat Rezaei Pazhand

3:10PM Real-Time Analysis of Granular Information: Some Initial Thoughts on a Convex Hull-based Fuzzy Regression Approach [#175]
Azizul Azhar Ramli, Witold Pedrycz, Junzo Watada and Nureize Arbaiy

3:50PM Study of Dependency between the Input Noise and the Parameter in Fuzzy Linear Regression Model [#372]
Hongwei Ge, Shitong Wang and Wei Song

(SS41) Special Session: Neuro Fuzzy Systems and Their Real World Application

Thursday, June 30, 2:50PM-4:30PM, Room: Crane, Chair: Sungshin Kim

2:50PM Daily Reservoir Inflow Forecasting Using Fuzzy Inference Systems [#542]
Ivette Raymunda Luna Huamani, Rosangela Ballini, Ieda Geriberto Hidalgo, Paulo Sergio Franco Barbosa and Alberto Luiz Francato

3:30PM Optimal Input Selection for Neural Fuzzy Modelling With Application to Charpy Energy Prediction [#601]
Yong Yao Yang, Mahdi Mahfouf and Qian Zhang

3:10PM A Study on Hybrid Model of HMMs and GMMs for Mirror Neuron System Modeling using EEG Signals [#289]
Seung-Min Park, Junheong Park, Kwang-Eun Ko and Kwee-Bo Sim

3:50PM Stereo Vision-Based Self-Localization System for RoboCup [#555]
Jen-Shiun Chiang, Chih-Hsien Hsia, Hung-Wei Hsu and Chun-I Li

4:10PM Training Multilayer Perceptron By Using Optimal Input Normalization [#488]
Xun Cai, Kanishka Tyagi and Michael Manry

(SS25) Special Session: Evolving and Adaptive Fuzzy Systems

Thursday, June 30, 2:50PM-4:30PM, Room: Egret, Chair: Plamen Angelov

2:50PM Automatic Scene Recognition for Low-Resource Devices using Evolving Classifiers [#583]
Andreu Javier, Dutta Baruah Rashmi and Angelov Plamen

3:30PM Fuzzy Granular Evolving Modeling for Time Series Prediction [#210]
Daniel Leite, Fernando Gomide, Rosangela Ballini and Pyramo Costa

3:10PM Real Time Recognition of Human Activities from Wearable Sensors by Evolving Classifiers [#415]
Javier Andreu, Rashmi Dutta Baruah and Plamen Angelov

3:50PM Combustion Engine Modelling using an Evolving Local Model Network [#84]
Christoph Hametner and Stefan Jakubek

4:10PM Rough Set Approach to User Modeling [#71]
Binghui Helen Wu

(SS24) Special Session: Hybrid Learning for Fuzzy Systems

Thursday, June 30, 2:50PM-4:30PM, Room: Swallow, Chair: Jin-Tsong Jeng

2:50PM *A Rough-based Robust Support Vector Regression Network for Function Approximation* [#212]

Chih-Ching Hsiao, Shun-Feng Su and Chen-Chia Chuang

3:10PM *An Immune Symbiotic Evolution Learning for Compensatory Neural Fuzzy Networks and Its Applications* [#32]

Cheng-Hung Chen, Cheng-Jian Lin and Chin-Teng Lin

3:30PM *Identification of Time-Delay Chaotic System with Outliers: Fuzzy Neural Networks Using Hybrid Learning Algorithm* [#214]

Chia-Nan Ko, Yu-Yi Fu, Guan-Yu Liu and Cheng-Ming Lee

3:50PM *A New Framework of Fuzzy Clustering Algorithm* [#99]

Horng-Lin Shieh

4:10PM *Modeling of Fuzzy Integral Based Nonlinear Multi-regressions Systems with QPSO-GS* [#270]

You-Min Jau and Jin-Tsong Jeng

(SS32) Special Session: Adaptive Fuzzy Logic Control

Thursday, June 30, 2:50PM-4:30PM, Room: Magpie, Chair: Tsung-Chih Lin

2:50PM *Direct Adaptive Fuzzy Control for Nonaffine Nonlinear Systems with Unknown Control direction* [#20]

Salim Labiod and Thierry Marie Guerra

3:10PM *An Observer Based Adaptive Iterative Learning Control for Robotic Systems* [#169]

Ying-Chung Wang and Chiang-Ju Chien

3:30PM *Synchronization of uncertain fractional order chaotic systems via adaptive interval type-2 fuzzy sliding mode control* [#80]

Tsung-Chih Lin, Tun-Yuan Lee and Emilia Balas Valentina

3:50PM *Fractional order chaotic system tracking design based on adaptive hybrid intelligent control* [#83]

Tsung-Chih Lin, Chia-Hao Kuo and Emilia Balas Valentina

Thursday, June 30, 5:00PM-6:00PM**(SS22) Special Session: Fuzzy Methods in Machine Learning and Data Mining**

Thursday, June 30, 5:00PM-6:00PM, Room: Swan, Chair: Shi-An Chen and Enrique Munoz

5:00PM *Towards the Learning from Low Quality Data in a Fuzzy Random Forest ensemble* [#299]

Jose M. Cadenas, M. Carmen Garrido, Raquel Martinez and Piero P. Bonissone

5:40PM *Linguistic Local Change Comparison Of Time Series* [#147]

Rita Castillo-Ortega, Nicolas Marin and Daniel Sanchez

5:20PM *Non-monotone averaging aggregation* [#480]

Gleb Beliakov, Shui Yu and Daniel Paternain

(FCW & PT) Fuzzy Computing with Words and Possibility Theory

Thursday, June 30, 5:00PM-6:00PM, Room: Peacock, Chair: Chin-Wang Tao

5:00PM *Indirect Adaptive Model Predictive Control Supervised by Fuzzy Logic* [#434]

Jerry Mamboundou and Nicolas Langlois

5:20PM *Maximum likelihood principle for possibility distributions viewed as families of probabilities* [#319]

Mathieu Serrurier and Henri Prade

(SS07 & SS33) Special Session: Metaheuristics and Its Applications & Fuzzy and Paraconsistent Intelligent Systems

Thursday, June 30, 5:00PM-6:00PM, Room: Phoenix, Chair: Chun-Wei Tsai and Shih-Yu Li

5:00PM *Ant Colony Optimization with Dual Pheromone Tables for Clustering* [#378]

Chun-Wei Tsai, Kai-Cheng Hu, Ming-Chao Chiang and Chu-Sing Yang

5:40PM *The Sensing System for the Autonomous Mobile Robot Emmy III* [#321]

Claudio Torres, Jair Abe, Germano Lambert-Torres and Joao da Silva Filho

5:20PM *Job Shop Scheduling Based on ACO with a Hybrid Solution Construction Strategy* [#376]

Shih-Pang Tseng, Chun-Wei Tsai, Jui-Le Chen, Ming-Chao Chiang and Chu-Sing Yang

(IA) Informatics & Analytics

Thursday, June 30, 5:00PM-6:00PM, Room: Crane, Chair: Janusz Kacprzyk and Lawrence Mazlack

5:00PM *On a benchmark related assessment of the performance of mutual (investment) funds* [#297]

Anna Wilbik and Janusz Kacprzyk

5:20PM *Discerning Suicide Notes Causality Using Fuzzy Cognitive Maps* [#545]

Ethan White and Lawrence Mazlack

(SS13-2) Special Session: Fuzzy Multiple Criteria Decision Making

Thursday, June 30, 5:00PM-6:00PM, Room: Egret, Chair: Gwo-Hshiung Tzeng

5:00PM *Constant Penalty Functions to Simplify Optimization of the Choquet Integral under Constraints* [#235]

Tanja Magoc

5:20PM *Design of a reliable hub-and-spoke network using an interactive fuzzy goal programming* [#489]

Mohammad Hossein Fazel Zarandi, Soheil Davari and Ali Haddad Sisakht

(FDM & DSS-2) Fuzzy Decision Making and Decision Support Systems

Thursday, June 30, 5:00PM-6:00PM, Room: Swallow, Chair: Kuang-Yow Lian

5:00PM *Connection Manager : A FAHP-based System for Classifier and Decision-Making* [#198]

Chih-Wei Hsu and Sheng-Tzong Cheng

5:40PM *Generalized Intuitionistic Fuzzy Soft Set and its Application in Practical Medical Diagnosis Problem* [#131]

Manish Agarwal, Madasu Hanmandlu and Kanad K. Biswas

5:20PM *Approximate Confidence Interval for Generalized Taguchi Process Capability Index* [#460]

Abbas Parchami, Mashaallah Mashinchi and M. Hadi Mashinchi

Abstracts of Contributed Papers

Monday, June 27

(W01-1/SS06) Workshop: Fuzzy Approaches to Ambient Intelligence/Intelligent Agents

Monday, June 27, 9:00AM-10:30AM, Room: Egret, Chair: Vincenzo Loia and Hani Haggas

9:00AM *Gesture-Based Hybrid Approach for HCI in Ambient Intelligent Environments* [#543]

Stefano Carrino	College of Engineering and Architecture of Fribourg, Switzerland
Elena Mugellini	College of Engineering and Architecture of Fribourg, Switzerland
Omar Abou Khaled	College of Engineering and Architecture of Fribourg, Switzerland
Rolf Ingold	University of Fribourg, Switzerland

In this paper we propose a novel interaction approach, based on gestures, aiming to recognize and enhance interactions between augmented human beings and augmented environments. We explain how this model, we called ARAMIS, allows interaction designers to fill the gap between real and virtual worlds augmenting the human itself. An enhanced interaction is achieved exploiting a hybrid approach. This approach is defined hybrid since it is the combination of several complementary techniques: wearable and pervasive computing paradigms, brute force, fuzzy and ML methods, virtual and real worlds, optical and non-optical sensing technologies. A framework implementing this concept has been developed. Finally, in order to validate our approach, we present a first prototype implemented according to the ARAMIS concept.

9:20AM *Understanding the Unknown: Unattested Input Processing in Natural Language* [#446]

Julia M. Taylor	RiverGlass Inc and Purdue University, United States
Victor Raskin	Purdue University, United States

This paper describes the process of deriving the meaning of an unknown word within the framework of meaning based natural language processing. It uses the clues supplied by the rest of the sentence, taking into account various degrees of possibilities of what the unknown word can mean, according to the previously acquired knowledge resources. The process of finding the meaning is incremental, and thus the derived meaning can evolve as more knowledge is gathered. The paper describes the fuzzy approach to the problem within this framework with regard to the semantic and syntactic acceptability of a sentence.

9:40AM *A Fuzzy Agent-based Approach to Trust-based Competency Management* [#424]

Matteo Gaeta	University of Salerno, Italy
Francesco Orciuoli	University of Salerno, Italy
Sabrina Senatore	University of Salerno, Italy
Vincenzo Loia	University of Salerno, Italy

In an era in which organizations increasingly consider the competencies of their employees as a crucial resource, human management becomes a key activity for improving staff and business performances. Important is also knowing who knows what inside the organization, so that project teams are assembled as the right mix of skill, knowledge and workforce abilities. At the same time, trust, an essential component, related to understanding interpersonal and group behavior, is an indisputable prerequisite for organizational effectiveness, in terms of social-cognitive capital, global competency as well as economic exchange and social and political stability. This paper defines an approach to support competency-based management by providing recommendations about the reliability of a worker in terms of trust information and own competencies. The approach lies on an agent-based architecture which supervises the Human Resources Management (HRM). Task-oriented agents monitor the employees' profiles and capabilities by maintaining update the competencies and the trusts in the organizational social network. Particularly, an agent endowed by fuzzy reasoning capabilities provides recommendations about workers' competencies in HRM decision-making processes.

10:00AM *Open discussion on current and future trends on Fuzzy Approaches to Ambient Intelligence and Intelligent Agents*

(W02) Workshop: Standards in Computational Intelligence

Monday, June 27, 9:00AM-10:30AM, Room: Swallow, Chair: Plamen Angelov, Giovanni Acampora and Bruno Di Stefano

9:00AM *New Evolution Algorithm Based On The Standard Particle Swarm Optimization* [#166]

Lipeng Wang	Sichuan University, China
Yangjie Cheng	Sichuan University, China
Liu Dong C	Sichuan University, China

The particle swarm optimization (PSO) is an alternative for global optimization. A standard for PSO (SPSO) was defined which took into the latest developments, and was used as a baseline for performance testing of improvements. In SPSO, however, particles need to search the optimal solution in the constraint space, and the

item velocity in PSO makes particles difficult to adjust themselves to meet those complicated constraints. A new PSO without the item velocity based on SPSO is proposed in this article. The new algorithm inherits the capability of SPSO with fast convergence and high accuracy. This research proves that the convergence process of PSO has nothing to do with the velocity and the proposed method modified simple PSO (msPSO) can converge. The experiments show that msPSO is able to achieve a good result.

(W01-2/SS06) Workshop: Fuzzy Approaches to Ambient Intelligence/Intelligent Agents

Monday, June 27, 11:00AM-12:30PM, Room: Egret, Chair: Vincenzo Loia and Hani Hagraas

11:00AM *Intrusion Detection Systems Adapted from Agent-based Artificial Immune Systems* [#375]

Chung-Ming Ou
Yao-Tien Wang
C.R. Ou

Kainan University, Taiwan
Hungkuang University, Taiwan
Hsiuping Institute of Technology, Taiwan

Agent-based artificial immune system (ABAIS) is applied to intrusion detection systems (IDS). A multiagent-based IDS (ABIDS) inspired by the danger theory of human immune system is proposed. The intelligence behind ABIDS is based on the functionality of dendritic cells in human immune systems and the danger theory, while dendritic cells agents (DC agent) are emulated for innate immune subsystem and artificial T-cell agents (TC agent) are for adaptive immune subsystem. Antigens are profiles of system calls while corresponding behaviors are regarded as signals. This ABIDS is based on the dual detections of DC agent for signals and TC agent for antigen, where each agent coordinates with other to calculate danger value (DV). ABAIS is an intelligent system with learning and memory capabilities. According to DVs, immune response for malicious behaviors is activated by either computer host or Security Operating Center (SOC). Multiple agents are "embedded" to ABIDS, where agents coordinate one another to calculate mature context antigen value (MCAV) and update activation threshold for security responses. Accordingly, computer hosts met with malicious intrusions can be effectively detected via input signals and temporary output signals such as PAMP, danger and safe signals.

11:20AM *An Adaptive Multi-Agent Memetic System for Personalizing e-Learning Experiences* [#309]

Giovanni Acampora
Matteo Gaeta
Enrique Munoz
Autilia Vitiello

University of Salerno, Italy
University of Salerno, Italy
University of Murcia, Spain
University of Salerno, Italy

The rapid changes in modern knowledge, due to exponential growth of information sources, is complicating learners' activity. For this reason, novel approaches are necessary to obtain suitable learning solutions able to generate efficient, personalized and flexible learning experiences. From this point of view, the use of different cooperative intelligent agents can be exploited to analyze learner's preferences and generate high quality learning presentations which provide attractive learning solutions. In particular, to achieve this goal this paper exploits an ontological representation of the learning environment and an adaptive memetic algorithm based on a cooperative multiagent framework. In this framework different agents analyze the e-learning instance and solve it in a parallel way, cooperating between them. This cooperation is performed by jointly exploiting data mining, via fuzzy decision trees, together with a decision making framework exploiting fuzzy methodologies. As will be shown in the experimental results section, this multi-agent strategy is capable of speeding up the convergence to high-quality personalized e-learning experiences.

11:40AM *A hybrid context aware system for tourist guidance based on collaborative filtering* [#425]

Giuseppe Fenza
Enrico Fischetti
Domenico Furno
Vincenzo Loia

Ricerca Sistemi ad Agenti, Italy
Ricerca Sistemi ad Agenti, Italy
Ricerca Sistemi ad Agenti, Italy
Ricerca Sistemi ad Agenti, Italy

In the area of ambient intelligence there is a need to address user needs according with context features. Recently, the synergy between context aware computing and collaborative filtering is leading to enhance recommender systems with capabilities always nearer to user needs. Specifically, in the domain of tourism it is useful to proactively suggest right sets of attractive locations, events and so on. This work defines a context aware recommender system aimed at suggesting pertinent points of interest (POIs) to tourists. In particular, the approach is strongly based on the synergy between soft computing and data mining techniques. The general framework integrates user profiles, history of social networking and POIs data. Then by defining collaborative filtering approach on the history meaningful POIs are extracted. Indeed, soft computing techniques are mainly applied in order to support activity of unsupervised users and POIs classification. On the other hand, data mining techniques are exploited in order to extract rules able to associate user profile and context features with an eligible set of recommendable POIs. Experimental results show performance in terms of recommendations accuracy.

12:00AM *Trainable Estimators for Indirect People Counting: A Comparative Study* [#473]

Giovanni Acampora
Vincenzo Loia

University of Salerno, Italy
University of Salerno, Italy

Gennaro Percannella
Mario Vento

University of Salerno, Italy
University of Salerno, Italy

Estimating the number of people in a scene is a very relevant issue due to the possibility of using it in a large number of contexts where it is necessary to automatically monitor an area for security/safety reasons, for economic purposes, etc. The large number of people counting approaches available in the literature can be roughly ascribed to two categories: direct approaches and indirect ones. In the first category there are methods that first detect people and then count them; differently, the indirect methods face the counting problem by establishing a relation between some scene features and the estimated number of people. Some recent comparative evaluations carried out in the framework of the PETS initiative have demonstrated that the indirect methods tends to be more robust than direct ones, above all when they are used in very crowded conditions. In this paper, we analyze the behavior of an indirect approach that is based on a trainable estimator that does not require an explicit formulation of a priori knowledge about the perspective and density effects present in the scene at hand. In particular, we investigate on the way the counting accuracy in different crowding conditions is affected by the choice of the trainable estimator.

(FC) Competition: Fuzzy

Monday, June 27, 11:00AM-12:30PM, Room: Swallow, Chair: Hao Ying

11:00AM *A TSK Neuro-Fuzzy Approach for Modeling Highly Dynamic Systems* [#475]

Giovanni Acampora

University of Salerno, Italy

This paper introduces a new type of TSK-based neuro-fuzzy approach and its application to modeling highly dynamic systems. In details, our proposal performs an adaptive supervised learning on a collection of time series in order to create a so-called Timed Automata Based Fuzzy Controller, i.e. an evolvable fuzzy controller whose dynamic features yield high performances in variable structure systems representation. The adaptive learning is accomplished by merging together theories from the area of times series analysis such as the Adaptive Piecewise Constant Approximation method, with a well-known neuro-fuzzy framework, the Adaptive Neuro Fuzzy Inference System. As will be shown in our experiments, where our proposal has been tested on a Fuzz-IEEE 2011 Fuzzy Competition dataset, this approach reduces the output error measure and achieves a better performance than a standard application of the ANFIS algorithm when applied to highly dynamic systems.

(W03-1) Workshop: Computational Intelligence Techniques for Smart Grids

Monday, June 27, 1:30PM-3:00PM, Room: Crane, Chair: Alfredo Vaccaro

1:30PM *A Bacterial Foraging PSO - DE Algorithm for Solving Reserve Constrained Dynamic Economic Dispatch Problem* [#286]

Praveena Pillala

Andhra University, AP, India

Vaisakh Kanchapogu

Andhra University, AP, India

Rama Mohana Rao Sanchana

Andhra University, AP, India

This paper introduces a solution to Dynamic Economic Dispatch (DED) problem using a hybrid optimization methodology bacterial foraging and PSO-DE (BPSO- DE) by integrating Bacterial foraging optimization Algorithm (BFOA), Particle Swarm Optimization (PSO) and Differential Evolution (DE). In the proposed method BFOA performs local search and global search for entire search space is accomplished through PSO-DE operators in this way they move to reach the global optimization. The BFOA also takes care of the constraints such as ramp-rate limits, valve-point loading effects, system load demand, prohibited operating zones, power losses and spinning reserve capacity. A ten unit test system is considered to show the effectiveness of the proposed method over other existing methods

1:50PM *A Noisy Data Regression Model Based on General Regression Neural Networks* [#384]

Shih-Chun Shao

National Taipei University of Technology, Taiwan

Wen-Hui Chen

National Taipei University of Technology, Taiwan

Jun-Horng Chen

Oriental Institute of Technology, Taiwan

Supervisory control and data acquisition (SCADA) systems are indispensable in the operation of modern power systems. In power SCADA systems, all the field data are collected by remote terminal units (RTU), and transmit to the host computer in the control center based on some protocol through communication networks. In the data transmission process, there are different data processing stages between field sites and the control center, including raw data acquisition, transformation, conversion, and transmission in various devices. Spikes or power surges can cause data corruption in the data transmission process, which makes the acquired data become unreliable. Analysis of noisy data gathered from measurement devices is challenging in the power grid. In this study, a computational approach based on general regression neural networks (GRNN) was proposed to construct a systematic fitting model for RTU noisy data processing in power SCADA systems. The optimal spread constant of the GRNN model is determined according to the mean square error (MSE) criterion using GA searching technique. The proposed approach is employed to examine the analogue data collected by RTUs as a data preprocessing step to reduce errors existing in the conversion process before running the required data

analysis. The main merits of the proposed method include its simple computational framework, precision in nonlinear approximation, and fast learning speed. The performance of the proposed GRNN model was evaluated by a set of RTU data, and compared with the existing method. Experimental results show the proposed model is able to handle noisy data for practical applications, and has good performance in removing the unintended changes to the original data.

2:10PM Estimation of Load Model Parameters from Instantaneous Voltage and Current [#431]

Pawel Regulski

Francisco Gonzalez-Longatt

Vladimir Terzija

University of Manchester, UK

University of Manchester, UK

University of Manchester, UK

Load modeling is a very important aspect of voltage stability analysis as load characteristics governs voltage behavior. In this paper a compact solution to extract parameters of a load model is presented, which includes estimation of power components based on Improved Recursive Newton Type Algorithm and estimation of parameters of a dynamic Load Model using Genetic Algorithms. The paper demonstrates the influence of the preprocessing of the instantaneous values on the final estimation of load parameters. All tests were carried out using 9-buses P.M.Anderson system built in DlgSILENT.

(W04-1) Workshop: Computer Game and Fuzzy-based Game Applications

Monday, June 27, 1:30PM-3:00PM, Room: Egret, Chair: Shun-Chin Hsu, I-Chen Wu, and Shi-Jim Yen

1:30PM Apply Different Fuzzy Integrals in Unit Selection Problem of Real Time Strategy Game [#170]

Y.J. Li

Peter H.F. Ng

H.B. Wang

S.C.K. Shiu

Y. Li

Hong Kong Polytechnic University, Hong Kong

Hong Kong Polytechnic University, Hong Kong

Hong Kong Polytechnic University, Hong Kong

Hong Kong Polytechnic University, Hong Kong

Hebei University, China

Choquet Integral (CI), which is known as a fuzzy measure-based technique, has been a general aggregation tool for multi-criteria decision making problem. In this paper, we apply Choquet Integral to unit selection problem in Real Time Strategy (RTS) game. In addition, three new fuzzy integrals named Mean-based Fuzzy Integral (Me-based FI), Max-based Fuzzy Integral (Ma-based FI), and Order-based Fuzzy Integral (Or-based FI) are developed, which relax the monotonicity requirement of the traditional fuzzy measures and consider different properties of game play. We compare the performance of Choquet Integral and the new proposed ones on this practical application with highly non-monotonic data. Experiments show that the proposed new fuzzy integrals achieved better learning performance and testing result.

1:50PM Unit Formation Planning in RTS game by using Potential Field and Fuzzy Integral [#479]

Ng Peter

Li Y. J.

Shiu Simon

The Hong Kong Polytechnic University, Hong Kong

The Hong Kong Polytechnic University, Hong Kong

The Hong Kong Polytechnic University, Hong Kong

Unit formation planning and target of attack is the core of micro management in real time strategy (RTS) game. It is more complicated than macro management, such as building and unit production sequence. It consists of a great quantity of possibility. Multiple targets and the non-additive property of unit formation leads the micro-management remains a problem. Traditional tree searching or A* searching is unable to handle these two properties. They are time consuming in runtime and difficult to manage in the AI programming development as there are too many weightings and each of them will interact with the others. In this paper, we applied potential field, fuzzy measure and integral to solve the micro- management. Potential field is suitable for complicated and various environment with multiple targets. However, it does not consider non-additive property. We integrated it with fuzzy measure and integral to extend simple additive property to non-additive property and provide the ability to handle interaction among different targets.

2:10PM Elimination Search for puzzle games : An Application for Hashi Solver [#505]

Shi-Jim Yen

Shih-Yuan Chiu

Cheng-Wei Chou

Tsan-Cheng Su

National Dong Hwa University, Taiwan

National Dong Hwa University, Taiwan

National Dong Hwa University, Taiwan

National Dong Hwa University, Taiwan

This paper proposes an efficient method to solve Hashi, a logical-type puzzle game with N by M grid. By using two methods, intersection method and elimination search, we can solve Hashi quickly and efficiency. The solver is authenticated by solving problems taken from Internet.

2:30PM An efficient algorithm for solving Fillomino [#507]

Shi-Jim Yen

Tsan-Cheng Su

Shun-Chin Hsu

National Dong Hwa University, Taiwan

National Dong Hwa University, Taiwan

Chang Jung Christian University, Taiwan

Fillomino is a logical puzzle game invented by Nikoli Company in Japan. Fillomino is played on a rectangular cell with no standard size; the internal cell lines are often dotted. Some cells of the cell start containing numbers, referred to as "givens". In this paper, we propose a puzzle solving algorithm to treat these problems. Based on the fact the Fillomino are compact and contiguous, some logical rules are deduced to paint some cells. Experimental results show that our algorithm can solve Fillominos successfully and efficient, and the processing speed is significantly faster than that of depth first search algorithm.

(W05-1) Workshop: Hybrid Computational Intelligence Applications

Monday, June 27, 1:30PM-3:00PM, Room: Swallow, Chair: Chuan-Kang Ting and Tzung-Pei Hong

1:30PM *Symbiotic Neuron Evolution of a Neural-Network-Aided Grey Model for Time Series Prediction* [#302]

Shih-Hung Yang
Yon-Ping Chen

National Chiao Tung University, Taiwan
National Chiao Tung University, Taiwan

This paper introduces a symbiotic neuron evolution algorithm (SNEA) to determine the topology of a neural-network-aided grey model (NNAGM) for time series prediction problem. The SNEA uses an evolutionary approach to evolve partially connected neural networks (NNs) and determine the number of hidden neurons. To achieve symbiotic evolution, SNEA first establishes a neuron population where each neuron is randomly created, and evaluates the neurons by constructing NNs with different numbers of neurons. Each neuron shares fitness from participating NNs. This algorithm then performs evolution on the neuron population by crossover and mutation based on neuron fitness. An NNAGM designed by SNEA is applied to the prediction problems and compared with other methods. The experimental results show that SNEA can produce an NNAGM with appropriate topology and higher prediction performance than other methods.

1:50PM *A Hybrid Computational Intelligence Approach for Automatic Music Composition* [#315]

Giovanni Acampora
Jose Manuel Cadenas
Roberto De Prisco
Vincenzo Loia
Enrique Munoz
Rocco Zaccagnino

University of Salerno, Italy
University of Murcia, Spain
University of Salerno, Italy
University of Salerno, Italy
University of Murcia, Spain
University of Salerno, Italy

The use of computers in the production of artifacts has drawn the attention of both artists and computer scientists. Among the different art disciplines, music is one of the arts that most benefited from the use of computers. There are many works which demonstrate the great synergy between these two fields. In this paper we will focus on a specific music composition problem: the figured bass problem, in which we have to automatically generate a 4 voice piece of music, starting from an input the bass line. To solve this problem we use a hybrid strategy, in which different metaheuristics cooperate to find high quality solutions. The cooperation is controlled by means of the combination of fuzzy control and knowledge obtained through Data Mining. As will be shown in the experimental results section, this hybrid strategy is capable of finding musical solutions with an acceptable quality and never discordant which, according to experts, are sound and adhere to scholastic rule.

2:10PM *A Study of a Hybrid Evolutionary Fuzzy Model for Stock Selection* [#503]

Chien-Feng Huang
Chih-Hsiang Chang
Bao Rong Chang
Dun-Wei Cheng

National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan

Stock selection has long been a challenging and important task in finance. Recent advances in machine learning and data mining are leading to significant opportunities to solve these problems more effectively. In this study, we aim at developing a methodology for effective stock selection using fuzzy models as well as genetic algorithms (GA). We first devise a stock scoring mechanism using fundamental variables and apply fuzzy membership functions to re-scale the scores properly. The scores are then used to obtain the relative rankings of stocks. Top-ranked stocks can thus be selected to form a portfolio. Furthermore, we employ GA for optimization of model parameters and feature selection for input variables to the stock scoring model. We will show that the investment returns provided by our proposed methodology significantly outperform the benchmark return. Based upon the promising results obtained, we expect this hybrid fuzzy-GA methodology to advance the research in soft computing for finance and provide an effective solution to stock selection in practice.

2:30PM *Upper-Bound Multiple Fuzzy Frequent-Pattern Trees* [#526]

Tzung-Pei Hong
Chun-Wei Lin
Tsun-Ching Lin
Shing-Tai Pan

National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan

In this paper, a novel two-phase fuzzy mining approach based on the designed upper-bound multiple fuzzy frequent-pattern (UBMFFP) tree is proposed to obtain all fuzzy frequent itemsets from a quantitative database. It prunes unpromising itemsets in the first phase, and then finds the actual fuzzy frequent itemsets in the second

phase. Experimental results indicate that the proposed approach has better performance than some previous ones.

(W03-2) Workshop: Computational Intelligence Techniques for Smart Grids

Monday, June 27, 3:30PM-5:00PM, Room: Crane, Chair: Alfredo Vaccaro

3:30PM *Exploiting Timed Automata Based Fuzzy Controllers for Voltage regulation in Smart Grids* [#441]

Giovanni Acampora
Vincenzo Loia
Autilia Vitiello

University of Salerno, Italy
University of Salerno, Italy
University of Salerno, Italy

The large-scale deployment of the Smart Grid paradigm will support the evolution of conventional electrical power systems toward active, flexible and self-healing web energy networks composed of distributed and cooperative energy resources. In a Smart Grid platform, the optimal coordination of distributed voltage controllers is one of the main issues to address. In this field, the application of traditional control paradigms has some disadvantages that could hinder their application in Smart Grids where the constant growth of grid complexity and the need for massive pervasion of Distribution Generation Systems (DGS) require more scalable, more flexible control and regulation paradigms. To try and overcome these challenges, this paper proposes the concept of a decentralized non-hierarchical voltage regulation architecture based on intelligent and cooperative smart entities. The distributed voltage controllers employ traditional sensors to acquire local bus variables and mutually coupled oscillators to assess the main variables that characterize the operation of the global Smart Grid. These variables are then amalgamated by a novel fuzzy inference engine, named Timed Automata based Fuzzy Controllers, in order to identify proper control actions aimed at improving the grid voltage profile and reducing power losses.

3:50PM *A Novel Fuzzy System for Wind Turbines Reactive Power Control* [#411]

Geev Mokryani
Pierluigi Siano
Antonio Piccolo
Vito Calderaro
Carlo Cecati

University of Salerno, Italy
University of Salerno, Italy
University of Salerno, Italy
University of Salerno, Italy
University of L'Aquila, Italy

The paper proposes a new fuzzy controller for variable speed wind turbines (WTs) in order to compensate the variations at the point of common coupling (PCC) by controlling the reactive power generated by WT. A protection system is used to disconnect the WT from the grid when the controller is unable to compensate the voltage variations. Simulations carried out on a real 37-bus Italian weak distribution network demonstrated that the controller allows compensating voltage variations during voltage sags.

4:10PM *Terminal Sliding Mode Controlled CVCF Inverters* [#282]

En-Chih Chang
Li-Peng Yin
Rong-Ching Wu
Lung-Sheng Yang

I-Shou University, Taiwan
I-Shou University, Taiwan
I-Shou University, Taiwan
Far East University, Taiwan

A control technique called Terminal Sliding Mode Control (TSMC) to generate high-quality sinusoidal output voltage for a constant-voltage constant-frequency (CVCF) inverter is presented in this paper. Conventional Sliding Mode Control (SMC) has been used extensively due to its robustness and simplicity, but the convergence of the system states to the equilibrium point is usually asymptotic. TSMC not only has the robustness of the SMC but also guarantees the finite reaching time to the equilibrium point. The presented TSMC adjustable parameters are used to decrease the system state error to zero in finite time. With the better robustness of the proposed controller, the output voltage of the CVCF inverter will have the features of low distortion, and insensitivity to parameter variations and external disturbances. Simulation results are given to conform that the proposed controller can achieve satisfactory response under linear and nonlinear loads.

(W05-2) Workshop: Hybrid Computational Intelligence Applications

Monday, June 27, 3:30PM-5:00PM, Room: Swallow, Chair: Chuan-Kang Ting and Tzung-Pei Hong

3:30PM *Differential Evolution to Enhance Localization of Mobile Robots* [#584]

Michael Lisowski
Zhun Fan
Ravn Ole

Technical University of Denmark, Denmark
Technical University of Denmark, Denmark
Technical University of Denmark, Denmark

This paper focuses on the mobile robot localization problems: pose tracking, global localization and robot kidnap. Differential Evolution (DE) applied to extend Monte Carlo Localization (MCL) was investigated to better solve localization problem by increasing localization reliability and speed. In addition, a novel mechanism for effective robot kidnap detection was proposed. Experiments were performed using computer simulations based on the odometry data and laser range finder measurements collected in advance by a robot in real-life. Experimental

results showed that integrating DE enables MCL to provide more accurate robot pose estimations in shorter time while using fewer particles.

3:50PM Fuzzy C-Means Clustering Based Construction And Training For Second Order RBF Network
[#571]

Kanishka Tyagi
Xun Cai
Michael Manry

The University of Texas at Arlington, United States
Shandong University, China
The University of Texas at Arlington, United States

The paper presents a novel two-step approach for constructing and training of optimally weighted Euclidean distance based Radial-Basis Function (RBF) neural network. Unlike other RBF learning algorithms, the proposed paradigms use Fuzzy C- means for initial clustering and optimal learning factors to train the network parameters (i.e. spread parameter and mean vector). We also introduce an optimized weighted Distance Measure (DM) to calculate the activation function. Newton's algorithm is proposed for obtaining multiple optimal learning factor for the network parameters (including weighted DM). Simulation results show that regardless of the input data dimension, the proposed algorithms are a significant improvement in terms of convergence speed, network size and generalization over conventional RBF models which use a single optimal learning factor. The generalization ability of the proposed algorithm is further substantiated by using k-fold validation.

Tuesday, June 28

(SS02-1) Special Session: Evolutionary Fuzzy Systems

Tuesday, June 28, 8:00AM-10:20AM, Room: Swan, Chair: Rafael Alcalá

8:00AM *Evolutionary Learning of a Laser Pointer Detection Fuzzy System for an Environment Control System* [#320]

Chavez de la O Francisco
 Fernandez de Vega Francisco
 Alcalá Fernandez Rafael
 Alcalá Fernandez Jesus
 Herrera Trigeros Francisco

University of Extremadura, Spain
 University of Extremadura, Spain
 University of Granada, Spain
 University of Granada, Spain
 University of Granada, Spain

Recent studies in smart homes have proposed methods to use a laser pointer for interacting with home devices, which represents a more user-friendly and less expensive home device control environment. However, detecting the laser spot on the original non-filtered images, using standard and non expensive cameras, and considering real home environments with varying conditions, is currently an open problem. In this paper we propose a hybrid technique, combining a classic technique used in image detection processes, such as Template Matching, with an evolutionary learning of a Fuzzy Rule Based Systems for the laser spot detection system in real home environments. This proposal improves the success rate in images without laser spot of the previous classical and non-classical algorithms used for detecting the laser spot in previous works, decreasing the detection of the false offs which could lead to dangerous situations. Experimental results on a real home environment show the effectiveness of the proposed approach.

8:20AM *A Meta-Fuzzy Classifier for Specifying Appropriate Fuzzy Partitions by Genetic Fuzzy Rule Selection with Data Complexity Measures* [#606]

Yusuke Nojima
 Shinya Nishikawa
 Hisao Ishibuchi

Osaka Prefecture University, Japan
 Osaka Prefecture University, Japan
 Osaka Prefecture University, Japan

Tens of thousands of classifiers have been proposed so far. There is no best classifier among them for all the existing data sets. The performance of each classifier often depends on the data sets used for comparison. Even for a single classifier, suitable parameters of the classifier also depend on the data sets. That is, there is a possibility that a suited classifier and its parameter specification can be chosen beforehand if the target data sets or their characteristics were known. In recent years, a number of data complexity measures have been proposed to characterize data sets. The aim of this study is to develop a meta- classifier for selecting an appropriate classifier and/or its appropriate parameter specification by means of data complexity measures. In this paper, we focus on the parameter specification of fuzzy classifiers using data complexity measures as a preliminary study. To construct a meta- classifier, we generate a large number of artificial data sets from Keel benchmark data sets. Then we generate meta-patterns which are composed of the values of data complexity measures as inputs and an appropriate fuzzy partition as an output. Using meta-patterns, a meta-classifier is designed by multiobjective genetic fuzzy rule selection. We evaluate the proposed method through leave one-group out cross-validation.

8:40AM *Assessing The Effects Of Zero Abundance Data On Habitat Preference Modelling Using A Genetic Takagi-Sugeno Fuzzy Model* [#586]

Shinji Fukuda

Kyushu University, Japan

In this paper, the effects of zero abundance data on fish habitat modelling using a genetic Takagi-Sugeno fuzzy system were assessed with specific focus on habitat preference curves (HPCs) and model performance. Three independent data sets were prepared from a series of fish habitat surveys conducted in an agricultural canal in Japan. To quantify the effects of zero abundance data, two kinds of data (full abundance data and presence-only abundance data) were used, from which a fuzzy habitat preference model (FHPM) were developed. As a result, the HPCs obtained using presence-only abundance data resulted in similar HPCs across the different data sets used, while those obtained using full abundance data differed by the data sets. Because the model performance with regard to generalization ability was higher, the present study concluded that the use of presence-only abundance data can better capture the habitat preference of the target species.

9:00AM *A Multiple-Level Genetic-Fuzzy Mining Algorithm* [#512]

Chun-Hao Chen
 Tzung-Pei Hong
 Yeong-Chyi Lee

Tamkang University, Taiwan
 National University of Kaohsiung, Taiwan
 Cheng Shiu University, Taiwan

In this paper, we propose a multiple-level genetic-fuzzy mining algorithm for mining membership functions and fuzzy association rule on multiple-concept levels. It first encodes the membership functions of each item class (category) into a chromosome according to the given taxonomy. The fitness value of each individual is then evaluated by the summation of large 1-itemsets of each item in different concept levels and the suitability of membership functions in the chromosome. After the GA process terminates, a better set of multiple-level fuzzy

association rules can then be expected with a more suitable set of membership functions. Experimental results on a simulation dataset also show the effectiveness of the algorithm.

9:20AM *An Architecture for Constructing Fuzzy Regression Tree Forests Using Opt-aiNet* [#314]

Fathi Gasir
Zuhair Bandar
Keeley Crockett

Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom

This paper presents a new approach to combining multiple fuzzy regression trees, which are induced by applying the modified Elgasir fuzzy regression tree algorithm. This method utilises Trapezoidal membership functions for fuzzification and the Takagi-Sugeno fuzzy inference to obtain the final predicted values. A modified version of Artificial Immune Network model (opt- aiNet) is used for the simultaneous optimization of the membership functions across all trees within the forest. Boston housing and Abalone are two real- world datasets from the UCI repository used to evaluate the proposed approach. The empirical results have showed that fuzzy regression tree forests reduce the error rate compared with single fuzzy regression tree.

9:40AM *Fuzzy C-Means Clustering and Partition Entropy for Species-Best Strategy and Search Mode Selection in Nonlinear Optimization by Differential Evolution* [#456]

Tetsuyuki Takahama
Setsuko Takahama

Hiroshima City University, Japan
Hiroshima Shudo University, Japan

Differential Evolution (DE) is a newly proposed evolutionary algorithm. DE is a stochastic direct search method using a population or multiple search points. DE has been successfully applied to optimization problems including non-linear, non-differentiable, non-convex and multimodal functions. However, the performance of DE degrades in problems having strong dependence among variables, where variables are related strongly each other. In this study, we propose to utilize partition entropy given by fuzzy clustering for solving the degradation. It is thought that a directional search is desirable when search points are distributed with bias. Thus, when the entropy is low, algorithm parameters can be controlled to make the directional search. Also, we propose to use a species-best strategy for improving the efficiency and the robustness of DE. The effect of the proposed method is shown by solving some benchmark problems.

(SS12-1) Special Session: Recent Advances in Fuzzy-Model-Based Control Systems

Tuesday, June 28, 8:00AM-10:20AM, Room: Peacock, Chair: H. K. Lam

8:00AM *LMI-Based Stability Conditions for Interval Type-2 Fuzzy-Model-Based Control Systems* [#228]

H.K. Lam
Mohammad Narimani
L.D. Seneviratne

King's College London, United Kingdom
King's College London, United Kingdom
King's College London, United Kingdom

This paper investigates the stability of the interval type-2 (IT2) fuzzy-model-based (FMB) control systems. An IT2 T-S fuzzy model is developed to represent the nonlinear plant subject to parameter uncertainties, which are captured by the lower and upper membership functions. An IT2 fuzzy model is then be proposed to close the feedback loop. It is not required that the IT2 fuzzy controller shares the same premise membership functions or the same number of fuzzy rules as those of the IT2 T-S fuzzy model. Consequently, it offers a greater design flexibility to the IT2 fuzzy controllers. However, the mismatched premise membership functions are not favourable to the development of stability conditions and thus leads to a conservative stability analysis result. In this paper, with the consideration of the lower and upper membership functions, which carry the information of the nonlinearities and parameter uncertainties of the nonlinear plant, the stability of the IT2 FMB control systems is investigated based on the Lyapunov stability theory. Stability conditions in terms of linear matrix inequalities are developed to guarantee the stability of the IT2 FMB control systems and synthesize the IT2 fuzzy controller. A simulation example is given to demonstrates the effectiveness of the proposed approach.

8:20AM *Robust H-infinite Fuzzy Observer for A Class of Time-Delay Discrete Fuzzy Bilinear Systems with Parameter Uncertainties* [#54]

Shun-Hung Tsai
Ta-Tau Chen
Ming-Ying Hsiao
Chin-Sheng Chen

National Taipei University of Technology, Taiwan
Kun Shan University, Taiwan
Fortune Institute of Technology, Taiwan
National Taipei University of Technology, Taiwan

In this paper, a robust H-infinite fuzzy observer is proposed for a class of time-delay discrete fuzzy bilinear systems (DFBSs) with parameter uncertainties. Utilizing the Lipschitz conditions, a linear matrix inequality (LMI) approach is developed and a sufficient condition is obtained to design the robust H-infinite fuzzy observer. Besides, the robust H-infinite fuzzy observer for time-delay discrete fuzzy bilinear systems with parameter uncertainties can be obtained through the LMIs without any pre-assigned gain matrices. Finally, a numerical example is illustrated the feasibility and effectively of proposed observer design method.

8:40AM *Sum of Squares Solutions Assuring Non-quadratic Discrete Stability* [#39]

Ji-Chang Lo
Jhen-Shun Kao

National Central University, Taiwan
National Central University, Taiwan

A new stability condition in terms of SOS is studied in this paper for discrete-time systems. Based on a parameter-dependent Lyapunov function, we study asymptotically SOS relaxation families, releasing the conservatism that commonly exists in the quadratic stability approaches.

9:00AM Output Feedback Control for Discrete-Time Takagi-Sugeno Fuzzy Systems [#122]

Nao Ueno
Yuzu Uchida
Jun Yoneyama

Aoyama Gakuin University, Japan
Aoyama Gakuin University, Japan
Aoyama Gakuin University, Japan

This paper is concerned with output feedback control design for a discrete-time fuzzy system with immeasurable premise variables. It is well known that Takagi-Sugeno fuzzy model describes a wide class of nonlinear systems especially when its premise variables include immeasurable functions. However, when it comes to control design of such a fuzzy system with immeasurable premise variables, a conventional parallel distributed compensator (PDC) is not feasible because it shares the same premise variables as those of a fuzzy system. In this paper, we introduce an output feedback controller with the estimate of the premise variables of an original fuzzy system. We then formulate the stabilization problem for a discrete-time fuzzy system with immeasurable premise variables. Our control design method is based on a set of strict LMI conditions. No tuning parameter is necessary a priori to solve LMI conditions. Our method includes tuning matrices for control gains in a controller and hence they can be chosen to optimize the control performance of the system. Furthermore, we extend our results to a class of discrete-time fuzzy systems with uncertain parameters. A design method of robust controller for such uncertain systems is also given. Numerical examples are finally given to illustrate our control design method.

9:20AM Decentralized control of large scale switched Takagi-Sugeno systems [#156]

Dalel Jabri
Kevin Guelton
Noureddine Manamanni

University of Reims Champagne-Ardenne, France
University of Reims Champagne-Ardenne, France
University of Reims Champagne-Ardenne, France

This paper deals with decentralized stabilization of large scale switched nonlinear systems under arbitrary switching laws. A global large scale switched system can be split into a set of smaller interconnected switched Takagi-Sugeno fuzzy subsystems. Then, in order to stabilize the overall closed-loop system, a set of switched fuzzy controllers is employed. The latter is designed based on Linear Matrix Inequalities (LMI) conditions obtained from a multiple switched non quadratic like-Lyapunov candidate function. A numerical example is proposed to illustrate the effectiveness of the suggested decentralized switched controller design approach.

9:40AM Some Refinements for Non quadratic Stabilization of continuous TS Models [#381]

Thierry Marie Guerra
Abdelhafidh Jaadari
Juntao Pan
Antonio Sala

University of Valenciennes Hainaut-Cambresis, France
University of Valenciennes Hainaut-Cambresis, France
Southeast University, China
Polytechnic University of Valencia, Spain

Quadratic stability / stabilization / estimation for Takagi-Sugeno models have now reached maturity. Lots of results concerning performances (, , D-stability) for TS models with uncertainties, noise, time-delays ... exist in the literature. Nevertheless, it is illusive thinking to solve every nonlinear problem of stability using a simple quadratic Lyapunov function. Moreover, most of the nonlinear systems only have properties of local stability. This work follows the idea of using non quadratic Lyapunov functions for continuous Takagi-Sugeno models restricting the global asymptotic stability to a local one. Therefore, it tries to estimate the best stabilization domain possible. A rather "simple" LMI constraints problem is derived to answer to this question.

10:00AM Adaptive fault estimation design for T-S fuzzy systems with interval time varying delay [#496]

Hamdi Gassara
Ahmed EL Hajjaji
Mohamed Chaabane

University of Picardie Jules Verne, France
University of Picardie Jules Verne, France
University of Sfax, Tunisia

This paper is concerned with fault estimation design for continuous-time Takagi-Sugeno (T-S) fuzzy systems with time delay by using adaptive fault diagnostic observer. Through constructing an appropriate type of Lyapunov function, criteria is established to reduce the conservatism of the design procedure. Based on appropriate Lyapunov function, new sufficient delay-dependent conditions are given to guarantee the stability of error dynamics in terms of matrix inequalities. Finally, the effectiveness of the proposed approach is illustrated through a simulation example.

(SS14) Special Session: Advances in Fuzzy Theory and their Applications

Tuesday, June 28, 8:00AM-10:20AM, Room: Phoenix, Chair: Shyi-Ming Chen

8:00AM Fast Extracting of Change Area from Remote Sensing Image by Fuzzy Theory and Case Base Reasoning [#399]

Ting-shiuan Wang
Teng-to Yu

National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan

This study presents the technology to combine the remote sensing image of SPOT and FORMOSAT-2 satellite image by Fuzzy theory and case base reasoning. This method adopt three experience identify factors of NDVI, shape, and color to establish the membership function. The Fuzzy theory was applied to estimate the process of thinking as the human brain; while the Case Base Reasoning method was used to increase the capability of self-loop learning and support its consistency with the real nature. The results show that the successful rate of identification was between 90 percent. The Case Base Reasoning results show that the two data similarity was between 46 percent. The Fuzzy and Case Base Reasoning difference factor was (satellite sensors, inclination, date, shadowing, etc.). The rate can be increase if there is enough experienced data. It reveal that fuzzy theory with case base reasoning indeed can rapid screen the change area from remote sensing image in before and after the disaster event.

8:20AM *Weights-Learning for Weighted Fuzzy Rule Interpolation in Sparse Fuzzy Rule-Based Systems* [#253]

Shyi-Ming Chen
Yu-Chuan Chang

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

In this paper, we present a weights-learning algorithm based on the CHC algorithm, which is a specialization of traditional genetic algorithms, to automatically learn the optimal weights of the antecedent variables of the fuzzy rules for the proposed weighted fuzzy interpolative reasoning method based on bell-shaped membership functions. We also apply the proposed method to deal with the truck backer-upper control problem. The experimental results show that the proposed method using the optimally learned weights gets better accuracy rates than the existing methods for dealing with the truck backer-upper control problem.

8:40AM *On The Type-2 Fuzzy Thresholding Protocol For Event-Driven Wireless Sensor Networks* [#458]

Chung-Ming Own

St. John's University, Taiwan

Network lifetime is one of the most vital issues in wireless sensor network and is fundamental to any design and development effort. Extending the life time requires energy efficiency in every aspect. Besides, fuzziness, a feature of imperfect information was used to measure the distances between the sensed values. Involved with type-2 fuzzy sets, an effectively thresholding method is proposed and discussed in this study. Given an adaptive threshold value, the membership function of a sensed value is implemented, and the potential improvement gained by using our method is demonstrated by the simulated results presented.

9:00AM *A Theoretical Approach to Liu's Generalized Lambda-Fuzzy Measure* [#350]

Hsiang-Chuan Liu
Tung-Sheng Liu

Asia University, Taiwan
National Taipei University, Taiwan

All of Lambda-measure, P-measure, additive measure and B-measure are four well known fuzzy measure, all of them are univalent fuzzy measure with only one formulaic fuzzy measure solution. In this paper, first of all, it is proved that both Lambda-measure and additive measure are larger than P-measure and less than B-measure, in other words, both Lambda-measure and additive measure are never equal to the smallest fuzzy measure, P-measure and the largest fuzzy measure, B-measure. Furthermore, a novel multivalent fuzzy measure with infinitely many fuzzy measure solutions based on Lambda-measure, called a generalized Lambda-measure, is proposed. It is proved that the measure function of this new measure is continuous and increasing on Lambda, each different Lambda value corresponding different fuzzy measure, from the smallest fuzzy measure, P-measure to the largest fuzzy measure, B-measure, and containing Lambda-measure itself, in other words, all of above four univalent fuzzy measures are special cases of this new fuzzy measure. Moreover, this new generalized Lambda-measure is also satisfying the monotone condition rather than the old generalized Lambda-measure proposed by L.-Z. Yang, M.-H. Ha, X.-J. Wang and Z.-R. Zhang. However, the old one is just the Lambda-measure without the monotone condition. It is a generalized measure but no more a fuzzy measure. Hence, this new and true generalized fuzzy measure is called Liu's generalized Lambda-measure. Some properties about this new measure are also discussed.

9:20AM *A Fuzzy Intelligent Decision Support System for Typhoon Disaster Management* [#387]

Wang-Kun Chen
GuangJun Sui
DangLing Tang

Jinwen University of Science and Technology, Taiwan
Guangdong University of Foreign Studies, China
Chinese Academy of Sciences, China

This paper presents the conceptual framework of fuzzy intelligent decision support system for typhoon disaster management. The typhoon risk management pattern was mentioned in the first section. Several types of database should be established in the decision support system. There are three steps to predict the typhoon risk. The first one is the feature extraction of typhoon pattern. The second one is the damage estimation by case base reasoning method. And the third one is the linguistic estimation of typhoon risk. An example of risk evaluation from the experiment data shows that the decision supporting system can be further improved if there is a complete and accurate dataset in this system.

9:40AM *A Robust Fuzzy Trajectory Estimation Design of High Speed Reentry Vehicles* [#190]

Yung-Yue Chen
Chung-Shi Tseng

National Yunlin University of Science and Technology, Taiwan
Ming Hsin University of Science and Technology, Taiwan

A fuzzy trajectory estimation is proposed for robust tracking guidance and early warning in antitactical ballistic missile systems with model uncertainties and external disturbances. In order to avoid solving the nonlinear Hamilton-Jacobi-Isaac(H-J-I) partial differential equation for trajectory estimation of the nonlinear reentry vehicle

(RV) dynamic equation, the Takagi and Sugeno fuzzy linear model is employed to interpolate piecewise to approximate the RV nonlinear dynamic equation. Then, from the fuzzy linear model, a fuzzy state estimator is developed for robust trajectory estimation of RV with optimal attenuation of the worst-case effect of system uncertainties such as approximation error, external disturbance, maneuver and unpredictable external forces in flight and other sources. The proposed method parameterizes the Hinf trajectory estimation problem in terms of an eigenvalue problem (EVP), so that the worst-case effect of system uncertainties on the trajectory estimation error is minimized in the robust trajectory estimation design subject to certain linear matrix inequality (LMI) constraints. Convex optimization techniques are employed to solve the EVP of the fuzzy trajectory estimation in antitactical ballistic missile systems. Simulation results indicate that the proposed method possesses a satisfactory performance.

10:00AM Data-driven Based 3-D Fuzzy Logic Controller Design Using Nearest Neighborhood Clustering and Linear Support Vector Regression [#535]

Zhang Xianxia
Jiang Ye
Zou Tao
Qi Chenkun
Cao Guitao

Shanghai University, China
Shanghai University, China
Zhejiang University of Technology, China
Shanghai Jiao Tong University, China
East China Normal University, China

Three-dimensional fuzzy logic controller (3-D FLC) is a novel FLC developed for spatially distributed parameter systems. In this study, we are concerned with data-based 3-D FLC design. A nearest neighborhood clustering algorithm is employed to extract fuzzy rules from input-output data pairs, and then an optimization algorithm based on geometric similarity measure is used to reduce the obtained rule base. The consequent parameters are estimated using linear support vector regression. Finally, a catalytic packed-bed reactor is taken as an application to demonstrate the effectiveness of the 3-D FLC.

(SS28-1) Special Session: Current Development in Pattern Classification-Kernelization, Pairwise Constraints, and Classifiers

Tuesday, June 28, 8:00AM-10:20AM, Room: Crane, Chair: Yasunori Endo

8:00AM A Method of Explicit Mappings for Kernel Data Analysis and Applications [#276]

Sadaaki Miyamoto
Keisuke Sawazaki

University of Tsukuba, Japan
University of Tsukuba, Japan

The method of kernel data analysis is now a standard tool in modern data mining. An implicit mapping into a high-dimensional feature space is assumed in this method, in other words, an explicit form of the mapping is unknown but their inner product should be known instead. Contrary to this common assumption, we propose a method of explicit mappings. The reason why we use explicit mappings is as follows. (1) The use of these mappings does not lose any fundamental information in kernel data analysis. (2) We have the same formulas in kernel methods with and without the explicit mappings. (2) Usually the derivation becomes simpler by using these mappings. (3) New applications of the kernel methods become possible using these mappings. Two types of the mappings are proposed, one of which uses $\Phi(x_k) = \{e_k\}$ ($k=1, \dots, N$) while the second type uses $\Phi(x_k) = K \frac{1}{\sqrt{2}} \{e_k\}$, where $K = (K(x_i, x_j))$ is $N \times N$ matrix. As an application we consider L_1 space fuzzy c -means clustering and lower dimensional approximation of kernel K . The effectiveness of the proposed method is shown by numerical examples.

8:20AM Comparison of Scaling Behavior Between Fuzzy c -Means Based Classifier with Many Parameters and LibSVM [#77]

Hidetomo Ichihashi
Katsuhiro Honda
Akira Notsu

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

This paper reports the scaling behavior of the fuzzy c -means based classifier (FCMC) with many parameters. FCMC is a classifier based on clustering approaches. The classification accuracy on test sets (i.e., the generalization capability) is not necessarily improved by increasing the number of clusters. Especially when the number of training samples is relatively small, not only the classification boundary over-fits the data, but also covariance matrices and cluster centers are computed incorrectly, since the number of samples in each cluster becomes smaller. Hence, the test set accuracy deteriorates. The scaling behavior of FCMC is reported by testing with variously-sized training samples. The number of clusters of FCMC is increased up to eight. The number of clusters used in this paper is not very large but the number of parameters is relatively large. So, the parameters are optimized to training sets. The test set accuracy, training time and testing time (i.e., the detection time) of FCMC are compared with LibSVM by varying the size of training sets. FCMC shows a good generalization capability, though the parameters are optimized to training sets. The testing time is much shorter than LibSVM when the size of the training set is large.

8:40AM Ellipse Detection with Hard c -Regression Models and Random Initializations [#106]

Hidetomo Ichihashi
Li Chieu Lam

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Katsuhiko Honda
Akira Notsu

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Shell clustering methods partition data sets into several shell-shape clusters by extracting local circles or ellipses as prototypes of clusters. This paper proposes hard c-regression models (HCRMs) for shell clustering. The procedure is a defuzzified switching regression models. HCRMs successfully detect ellipses by using random initializations. We report the performance using 20 data sets each of which consists of two ellipses. The detection time on average is 14 milliseconds on DELL PRECISION T5400 3.16GHz.

9:00AM Trajectory Anonymization From a Time Series Perspective [#141]

Sergi Martinez-Bea
Vicenc Torra

IIIA-CSIC, Spain
IIIA-CSIC, Spain

In a world of constant technology evolution, the expansion of location tracking technologies is a fact. Most of us may have a device which can tell us our location with more or less accuracy. Most of those devices collect our location information and, usually, the trajectories we make. Publishing this information is essential for companies to improve their marketing strategies, for the traffic department in order to have some control about the traffic, and for many other entities. With the publication of this information an important problem arises, the privacy. On the literature, many approaches to trajectory protection are provided. We contribute to the scene providing a framework with a protection method and measures for both the computation of the perturbation added to the data, and the risk of linking a protected trajectory to its original.

9:20AM On Some Clustering Approaches For Graphs [#205]

Klara Stokes
Vicenc Torra

Universitat Rovira i Virgili, Spain
IIIA-CSIC, Spain

In this paper we discuss some tools for graph perturbation with applications to data privacy. We present and analyse two different approaches. One is based on matrix decomposition and the other on graph partitioning. We discuss these methods and show that they belong to two traditions in data protection: noise addition/microaggregation and k-anonymity.

9:40AM A Study on Regularization Effects of Fuzzified Memberships in FCM Clustering [#57]

Katsuhiko Honda
Yui Matsumoto
Akira Notsu
Hidetomo Ichihashi

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

FCM clustering is a fundamental technique for capturing intrinsic cluster structures of multivariate data sets. This paper presents a comparative study on the regularization effects of Fuzzy c-Means memberships estimated by two different fuzzification approaches: standard approach and entropy regularization approach. In this paper, the characteristics of the two fuzzification approaches are also discussed in noise fuzzy clustering (NFC) and it is revealed that the noise rejection mechanism of NFC can contribute to weakening the influence of initialization problems in entropy regularization approach although the approach is generally more sensitive to initial partition than the standard approach.

10:00AM Constrained Agglomerative Hierarchical Clustering Algorithms with Penalties [#75]

Sadaaki Miyamoto
Akihisa Terami

University of Tsukuba, Japan
University of Tsukuba, Japan

Semi-supervised clustering with constraints has widely been studied, but there are few studies on constrained agglomerative hierarchical algorithms. We have shown modified kernel algorithms of agglomerative hierarchical clustering, but there is a drawback that the modified kernels are not positive-definite in general. In this paper we consider another idea of agglomerative hierarchical algorithms with pairwise constraints. That is, merging of clusters is with penalties. The centroid method and the Ward method with and without a kernel are considered. Typical numerical examples show effectiveness of the proposed algorithms in generating clusters with nonlinear cluster boundaries. We also compare the results with those by COP K-means, showing that the proposed algorithms outperform the COP K-means.

(SS16 & SS11) Special Session: Fuzzy Interpolation & Large-Scale Clustering

Tuesday, June 28, 8:00AM-10:20AM, Room: Egret, Chair: Qiang Shen and Timothy Havens

8:00AM Adaptive Fuzzy Interpolation with Prioritized Component Candidates [#226]

Longzhi Yang
Qiang Shen

Aberystwyth University, United Kingdom
Aberystwyth University, United Kingdom

Adaptive fuzzy interpolation strengthens the potential of fuzzy interpolative reasoning. It first identifies all possible sets of faulty fuzzy reasoning components, termed the candidates, each of which may have led to all the contradictory interpolations. It then tries to modify one selected candidate in an effort to remove all the contradictions and thus restore interpolative consistency. This approach assumes that all the candidates are equally likely to be the real culprit. However, this may not be the case in real situations as certain identified reasoning components may be more liable to resulting in inconsistencies than others. This paper extends the

adaptive approach by prioritizing all the generated candidates. This is achieved by exploiting the certainty degrees of fuzzy reasoning components and hence of derived propositions. From this, the candidate with the highest priority is modified first. This extension helps to quickly spot the real culprit and thus considerably improves the approach in terms of efficiency.

8:20AM Fuzzy Rule Interpolation in Embedded Behaviour-based Control [#558]

Szilveszter Kovacs

University of Miskolc, Hungary

Fuzzy Rule Interpolation (FRI) methods are efficient structures for knowledge representation with relatively few rules. In spite of the good knowledge representation efficiency, the usually high computational demand turns the FRI methods hardly suitable for embedded real-time applications, where the short reasoning time has a high importance. On the other hand the fact of increasing computational power of nowadays available devices gives an opportunity to the FRI methods for appearance in real-time embedded applications. The goal of this paper is to introduce the benefit of adapting low computational and resource demanded FRI methods in embedded behavior-based control applications.

8:40AM An Evolutionary-Based Similarity Reasoning Scheme for Monotonic Multi-Input Fuzzy Inference Systems [#119]

Tay Kai Meng
Lim Chee Peng

UNIMAS, Malaysia
USM, Malaysia

In this paper, an Evolutionary-based Similarity Reasoning (ESR) scheme for preserving the monotonicity property of the multi-input Fuzzy Inference System (FIS) is proposed. Similarity reasoning (SR) is a useful solution for undertaking the incomplete rule base problem in FIS modeling. However, SR may not be a direct solution to designing monotonic multi-input FIS models, owing to the difficulty in getting a set of monotonically-ordered conclusions. The proposed ESR scheme, which is a synthesis of evolutionary computing, sufficient conditions, and SR, provides a useful solution to modeling and preserving the monotonicity property of multi-input FIS models. A case study on Failure Mode and Effect Analysis (FMEA) is used to demonstrate the effectiveness of the proposed ESR scheme in undertaking real world problems that require the monotonicity property of FIS models.

9:00AM Fuzzy Rule Interpolation Based on Interval Type-2 Gaussian Fuzzy Sets and Genetic Algorithms [#326]

Shyi-Ming Chen
Yu-Chuan Chang

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

In this paper, we present a new method for fuzzy rule interpolation with interval type-2 Gaussian fuzzy sets for sparse fuzzy rule-based systems based on genetic algorithms. The proposed fuzzy rule interpolation method deals with the interpolation of fuzzy rules based on the multiple fuzzy rules interpolation scheme. We also present a new learning method to learn optimal interval type-2 Gaussian fuzzy sets for sparse fuzzy rule-based systems based on genetic algorithms. We apply the proposed fuzzy rule interpolation method and the proposed learning method to deal with the Mackey-Glass chaotic time series prediction problem. The experimental result shows that the proposed fuzzy rule interpolation method using the optimally learned interval type-2 Gaussian fuzzy sets obtained by the proposed learning method gets higher average accuracy rates than the existing methods to deal with the Mackey-Glass chaotic time series prediction problem.

9:20AM Double-Linear Fuzzy Interpolation Method [#546]

Marcin Detyniecki
Christophe Marsala
Maria Rifqi

UPMC University Paris 06, France
UPMC University Paris 06, France
UPMC University Paris 06, France

In this paper, we present an original fuzzy interpolation method. In contrast to existing approaches, our method is able to always construct an interpolated fuzzy interval without a need of a special step dedicated to the "standardization" of non-viable solutions, which fractures the sense of the interpolation. In fact, these "standardization" steps imply that, for instance, a point obtained from the interpolation of the upper limit (right side) of the fuzzy sets, is used to build the lower limit (left side) of the interpolated conclusion, breaking the underlying hypothesis of (linear) graduality. To achieve the direct interpolation, our method is based on the deviation of the observation from the expected linearly interpolated solution and constrains of the constructed solution between extreme cases. We illustrate and discuss the behavior of our method by comparison to other well-known fuzzy interpolation methods.

9:40AM Speedup of Fuzzy and Possibilistic Kernel c-Means for Large-Scale Clustering [#443]

Timothy Havens
Radha Chitta
Anil Jain
Rong Jin

Michigan State University, United States
Michigan State University, United States
Michigan State University, United States
Michigan State University, United States

The ubiquity of personal computing technology has produced an abundance of staggeringly large data sets---the Library of Congress has stored over 160 terabytes of web data and it is estimated that Facebook alone logs over 25 terabytes of data per day. There is a great need for systems by which one can elucidate the similarity and dissimilarity among and between groups in these data sets. Clustering is one way to find these groups. In this paper, we propose an approximation method for the fuzzy and possibilistic kernel c-means clustering algorithms. Our approximation constrains the cluster centers to be linear combinations of a size m randomly selected subset

of the n input objects, where $m \ll n$. The proposed algorithm only requires an $m \times n$ rectangular portion of the full $n \times n$ kernel matrix and the n diagonal values, resulting in significant memory savings. Furthermore, the computational complexity of the c -means algorithm is substantially reduced. We demonstrate that up to 3 orders of magnitude of speedup are possible while achieving almost the same performance as the original kernel c -means algorithm.

10:00AM Adaptive Fuzzy Interpolation with Uncertain Observations and Rule Base [#397]

Longzhi Yang
Qiang Shen

Aberystwyth University, United Kingdom
Aberystwyth University, United Kingdom

Adaptive fuzzy interpolation strengthens the potential of fuzzy interpolative reasoning. It views interpolation procedures as artificially created system components, and identifies all possible sets of faulty components that may each have led to all detected contradictory results. From this, a modification procedure takes place, which tries to modify each of such components, termed candidates, in an effort to remove all the contradictions and thus restore consistency. This approach assumes that the employed interpolation mechanism is the only cause of contradictions, that is all given observations and rules are believed to be true and fixed. However, this may not be the case in certain real situations. It is common in fuzzy systems that each observation or rule is associated with a certainty degree. This paper extends the adaptive approach by taking into consideration both observations and rules also, treating them as diagnosable and modifiable components in addition to interpolation procedures. Accordingly, the modification procedure is extended to cover the cases of modifying observations or rules in a given rule base along with the modification of fuzzy reasoning components. This extension significantly improves the robustness of the existing adaptive approach.

(T2FL & FPR) Type-2 Fuzzy Logic and Fuzzy Pattern Recognition

Tuesday, June 28, 8:00AM-10:20AM, Room: Swallow, Chair: Frank Chung-Hoon Rhee

8:00AM General Type-2 Fuzzy Membership Function Design and its Application to Neural Networks [#590]

Eun-A Shim
Frank Chung-Hoon Rhee

Hanyang University, Republic of Korea
Hanyang University, Republic of Korea

Several type-1 fuzzy membership function (T1 FMF) generation methods have been proposed to model the uncertainty of pattern data. However, if we cannot obtain satisfactory results using type-1 fuzzy sets, employment of type-2 fuzzy sets (T2 FSs) for managing uncertainty may allow us to obtain desirable results. In this paper, a general T2 FMF design method and its application to back propagation (BP) neural networks is proposed. The general T2 FMF is designed using data histograms and then type-1 fuzzy membership values which are extracted from the centroid of the T2 FMF are used as inputs to the BP neural network. Applying our proposed membership assignment to BP neural networks shows improvement of the classification performance since the uncertainty of pattern data are desirably controlled by the T2 fuzzy memberships. Experimental results for several data sets are given.

8:20AM Human Action Recognition via Sum-Rule Fusion of Fuzzy K-Nearest Neighbor Classifiers [#510]

Teck Wee Chua
Karianto Leman
Nam Trung Pham

Institute for Infocomm Research, Singapore
Institute for Infocomm Research, Singapore
Institute for Infocomm Research, Singapore

Shape and motion are two most distinct cues observed from human actions. Traditionally, K-Nearest Neighbor (K-NN) classifier is used to compute crisp votes from multiple cues separately. The votes are then combined using linear weighting scheme. Usually, the weights are determined in a brute-force or trial-and-error manner. In this study, we propose a new classification framework based on sum-rule fusion of fuzzy K-NN classifiers. Fuzzy K-NN classifier is capable of producing soft votes, also known as fuzzy membership values. Based on Bayes theorem, we show that the fuzzy membership values produced by the classifiers can be combined using sum-rule. In our experiment, the proposed framework consistently outperforms the conventional counterpart (K-NN with majority voting) for both Weizmann and KTH datasets. The improvement may attribute to the ability of the proposed framework to handle data ambiguity due to similar poses present in different action classes. We also show that the performance of our method compares favorably with the state-of-the-arts.

8:40AM Fuzzy Clustering with Multiple Kernels [#150]

Naouel Baili
Hichem Frigui

University of Louisville, United States
University of Louisville, United States

In this paper, the kernel fuzzy c -means clustering algorithm is extended to an adaptive cluster model which maps data points to a high dimensional feature space through an optimal convex combination of homogenous kernels with respect to each cluster. This generalized model, called Fuzzy CMeans with Multiple Kernels (FCM-MK), strives to find a good partitioning of the data into meaningful clusters and the optimal kernel-induced feature map in a completely unsupervised way. It constructs the kernel from a number of Gaussian kernels and learns a resolution specific weight for each kernel function in each cluster. This allows better characterization and adaptability to each individual cluster. The effectiveness of the proposed algorithm is demonstrated for several toy and real data sets.

9:00AM Kernel-Based Fuzzy Clustering of Interval Data [#52]

Bruno Pimentel
Anderson Costa
Renata Souza

Cin/UFPE, Brazil
Cin/UFPE, Brazil
Cin/UFPE, Brazil

Kernel clustering methods have been very important in application of non-supervised machine learning to real problems. Kernel methods possess many advantages other than nonlinearity such as modularity, ability to work with heterogeneous descriptions of data, incorporation of prior knowledge etc. In this paper, we present a clustering method based on kernel functions for partitioning a set of interval-valued data. In addition, this method is compared to a fuzzy partitioning approach for interval data introduced previously. Experiments with real and syntectic symbolic interval-valued data sets are presented. The evaluation of the clustering results furnished by the methods is performed regarding the computation of an external cluster validity index and the global error rate of classification.

9:20AM Short Term Load Forecasting Using Interval Type-2 Fuzzy Logic Systems [#208]

Abbas Khosravi
Saeid Nahavandi
Doug Creighton

Deakin University, Australia
Deakin University, Australia
Deakin University, Australia

Accurate Short Term Load Forecasting (STLF) is essential for a variety of decision making processes. However, forecasting accuracy may drop due to presence of uncertainty in the operation of energy systems or unexpected behavior of exogenous variables. This paper proposes the application of Interval Type-2 Fuzzy Logic Systems (IT2 FLSs) for the problem of STLF. IT2 FLSs, with extra degrees of freedom, are an excellent tool for handling prevailing uncertainties and improving the prediction accuracy. Experiments conducted with real datasets show that IT2 FLS models appropriately approximate future load demands with an acceptable accuracy. Furthermore, they demonstrate an encouraging degree of accuracy superior to feedforward neural networks used in this study.

9:20AM An Adaptive Type-2 Input Based Non-Singleton Type-2 Fuzzy Logic System for Real World Applications [#528]

Nazanin Sahab
Hani Hagras

University of Essex, United Kingdom
University of Essex, United Kingdom

A Fuzzy Logic System (FLS) is generally credited with being an adequate methodology for real world applications which are subject to high uncertainty levels. Recent works have shown that interval type-2 FLSs can outperform type-1 FLSs in the applications which encompass high uncertainty levels. However, the majority of interval type-2 FLSs handle the linguistic and input numerical uncertainties using singleton interval type-2 FLSs that mix the numerical and linguistic uncertainties to be handled only by the linguistic labels type-2 fuzzy sets. This ignores the fact that if input numerical uncertainties were present, they should affect the incoming inputs to the FLS. Even in the papers that employed nonsingleton type-2 FLSs, the input signals were assumed to have a predefined shape (mostly Gaussian or triangular) which might not reflect the real uncertainty distribution which can vary with the associated measurement. In our previous work, we have presented some of the theoretical basis for generating an adaptive type-2 fuzzy input which is better able to represent the encountered uncertainty at a given measurement. The nonsingleton type-2 fuzzy inputs are dynamic and they are automatically generated from data and they do not assume a specific shape about the uncertainty distribution associated with the given sensor. In this paper, we will present an overview on how the adaptive type-2 input based nonsingleton interval type-2 FLS can operate in real time. We will present real world experiments using a mobile robot which will show how under high input uncertainty levels, the nonsingleton type-2 FLS can give a good performance and outperform its singleton type-2 and type-1 FLSs counterparts.

9:40AM Hospital Service Quality Evaluation: A Fuzzy Preference Relation Approach [#72]

Tsung-Han Chang

Kao Yuan University, Taiwan

This paper proposes a fuzzy preference relation approach to evaluate the hospital service quality in Taiwan. Pairwise comparisons based on consistent reciprocal additive transitivity are utilized to derive the importance weights of evaluation criteria and to obtain the performance rating of feasible hospitals with respect to each criterion. By multiplying the importance weights of evaluation criteria, and the performance ratings of feasible hospitals, the service qualities of hospital are determined. An illustrative example elicited from 5 public hospitals in southern Taiwan is used to demonstrate the evaluation procedures of this proposed approach.

(FA-1) Fuzzy Applications

Tuesday, June 28, 8:00AM-10:20AM, Room: Grand Ballroom II, Chair: Hisao Ishibuchi

8:00AM Structural Analysis on Team Internal Soft Factors to Project Success [#49]

Jyh-Fu (Don) Jeng

National Cheng Kung University, Taiwan

Project has witnessed a high rate of failure. The project management is concerned with disciplines that better manage the project inherent strengths and weaknesses. In contrast to the hard factors, soft factors are very often ignored during project management. Such factors, involved with the internal services within the team, are concerned with working with people, ensuring customer satisfaction and creating a conducive environment for the project team to deliver high quality products which meeting stakeholder expectations. This research aims to

investigate the intertwined effects of project team internal soft factors. Combining the exploratory factor analysis and fuzzy decision making trial and evaluation laboratory (DEMATEL) technique, an empirical case is demonstrated to show the effectiveness of the proposed method. The exploratory factor analysis is applied for extracting the dimension and criteria structure. The fuzzy DEMATEL technique is then used to analyze the intertwined effect. The proposed method has proven to be an effective one for analyzing the complex interrelation of human psychological concerns.

8:20AM *A Robust Portfolio Selection Problem based on a Confidence Interval with Investor's Subjectivity* [#100]

Takashi Hasuike
Hideki Katagiri

Osaka University, Japan
Hiroshima University, Japan

This paper considers a robust portfolio selection problem considering a confidence interval with subjectivity to the weight for the standard deviation. Since the proposed model is formulated as an ill-defined problem due to fuzziness and bi-object derived from maximizing both robustness and investor's satisfaction level to the total profit, it is hard to solve it directly. Therefore, introducing fuzzy goals for the bi-objective functions, the proposed model is transformed into the deterministic equivalent problem. Furthermore, in order to obtain the exact optimal portfolio analytically, the solution method is developed introducing a parameter and doing the equivalent transformations.

8:40AM *On Some Fuzzy Relations for Color Information* [#412]

Daniel Sanchez
Jose Manuel Soto-Hidalgo
Jesus Chamorro-Martinez
Pedro Martinez-Jimenez

European Centre for Soft Computing, Spain
University of Cordoba, Spain
University of Granada, Spain
University of Granada, Spain

In this paper we introduce several fuzzy resemblance relations between different combinations of crisp and fuzzy colors. As a starting point, we discuss about fuzzy colors and fuzzy color spaces as a way to represent color information, providing examples of conjunctive and disjunctive use of fuzzy colors for this purpose. Then we determine different types of relations measuring the degree of matching between different types of color information, using well known results from fuzzy sets and possibility theories. We study the particular case in which the user considers there is no resemblance between the fuzzy colors comprising the fuzzy color space under consideration. The proposal is based on definitions of fuzzy color and fuzzy color space provided by the authors in previous works.

9:00AM *The Positioning control of an Electro-Hydraulic Variable Rotational Speed Pump-Controlled System Using Adaptive Fuzzy Controller with Self-tuning Fuzzy Sliding Mode Compensation* [#463]

Lian-Wang Lee
I-Hsum Li
Chung-Chieh Chen
Jun-Yi Huang

Lunghwa University of Science and Technology, Taiwan
Lee-Ming Institute of Technology, Taiwan
De Lin Institute of Technology, Taiwan
Lunghwa University of Science and Technology, Taiwan

The electro-hydraulic variable rotational speed pump-controlled system (EHVRSPCS) performs specific characteristics on non-linearity and time-varying. An exact model-based controller is difficult to be realized. In this study, the design method and experimental implementation of an adaptive fuzzy controller with on-line self-tuning fuzzy sliding-mode compensation (AFC-STFSMC) are proposed to deal with the system time-varying and non-linear uncertain behaviours by adjusting the control rule parameters. This control strategy employs the adaptive fuzzy approximation technique to design the equivalent controller of the conventional sliding-mode control (SMC). Furthermore, the fuzzy sliding-mode control scheme with self-tuning ability is introduced to compensate the approximation error of the equivalent controller for improving the control performance. The tuning algorithms are derived in the sense of the Lyapunov stability theorem; thus, the stability of the system can be guaranteed. The experimental results show that the AFC-STFSMC can perform excellent positioning control for the EHVRSPCS.

9:20AM *Toward Quantitative Definition of Explanation Ability of Fuzzy Rule-based Classifiers* [#605]

Hisao Ishibuchi
Yusuke Nojima

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Explanation ability of a fuzzy rule-based classifier is its ability to explain why an input pattern is classified as a particular class in a convincing way. This ability is important especially when fuzzy rule-based classifiers are used as support systems for human users. This is because human users often want to know why the current input pattern is classified as a particular class. The explanation ability looks similar to the interpretability. They are, however, clearly different concepts. Whereas the explanation ability is directly related to the classification of each pattern, the interpretability is usually independent of classification results. The interpretability has been taken into account in multiobjective design of fuzzy rule-based classifiers. However, the explanation ability has not been used for fuzzy rule-based classifier design. This is because its quantitative definition is very difficult. In this paper, we discuss various factors that are related to quantitative definition of the explanation ability of fuzzy rule-based classifiers. Using simple numerical examples, we explain that the complexity minimization of fuzzy rule-based classifiers does not always lead to the explanation ability maximization. We also explain that the accuracy of fuzzy rules is related to the explanation ability.

9:40AM Multi-level Multi-Objective Decision Problem through Fuzzy Random Regression based Objective Function [#81]Nureize Arbaiy
Junzo WatadaWaseda University, Japan
Waseda University, Japan

A multi-level decision making problem confronts several issues especially in coordinating decision in hierarchic processes and in compromising conflicting objectives for each decision unit level. Therefore, its mathematical model plays a pivotal and essential role in solving such problem, and is influencing to the final result. However, it is sometimes difficult to estimate the coefficients of objective functions of the model in real situations specifically when the statistical data used may contain randomness and fuzziness. Thus, it is important that decision making scheme should provide an appropriate method to handle the presence of such uncertainties. Hence, this paper proposes a multi-level multi-objective programming problem through an additive fuzzy goal programming (FGP) approach where the objective functions are developed through fuzzy random regression model. The algorithm is constructed to obtain a satisfaction solution, which fulfills at least weak Pareto optimality. A numerical example illustrates the proposed solution procedure.

10:00AM A Fuzzy Toolbox for the R Programming Language [#612]Christian Wagner
Simon Miller
Jonathan M. GaribaldiUniversity of Nottingham, United Kingdom
University of Nottingham, United Kingdom
University of Nottingham, United Kingdom

In this paper, we describe the main functionality of an initial version of a new fuzzy logic software toolkit based on the R language. The toolkit supports the implementation of several types of fuzzy logic inference systems and we discuss and present several aspects of its capabilities to allow the straightforward implementation of type-1 and interval type-2 fuzzy systems. We include source code examples and visualizations both of type-1 and type-2 fuzzy sets as well as output surface visualizations generated using the R toolkit. Finally, we describe the significant benefits of relying on the R language as a language which is employed across several research disciplines (thus enabling access to fuzzy logic tools to a variety of researchers), outline future developments and most importantly call for contributions, comments and feedback to/on this open-source software development effort.

(PS01) Poster Session I

Tuesday, June 28, 2:30PM-4:30PM, Room: Grand Ballroom II

P101 A fuzzy hypothesis test based model for customer satisfaction measurement (Case study in PARS KHODRO CO.) [#22]Naimeh Borjalilu
Mahdi Zowghi
Abdolhamid Eshraghniaie JahromiSharif University of Technology, Iran
Sharif University of Technology, Iran
Sharif University of Technology, Iran

The article proposes a model for customer satisfaction measuring, which is adapted to use in automobile industries. The proposed methodology evaluates the satisfaction level of a set of customers in different aspect of customer focus based on hypothesis values. It permits to evaluate the validity of a service/manufacturing operation from the point of view of consumers. The main advantages of this method are fully considered the qualitative form of customers' judgments through fuzzy theory and evaluate customers' satisfaction in different aspect of customer focus. This model also allows fully evaluates by analysis of all possible hypothesis cases. In the end, we implement our model in KHODRO CO. in IRAN and show the results. This research does asking the opinions of the experts through a number of questionnaires related to the L90 auto customers of PARS KHODRO CO. in 5 fields. Customer's satisfaction of L90 auto in above fields attains among 81 hypotheses and concludes the following result: "Product quality is good, financial problems is good, Total quality of services is good and Guarantee is medium then customer satisfaction is good". Finally, future research directions are provided. Keywords- fuzzy hypothesis test; customer satisfaction analysis; subjective judgments

P102 Permutation Flow Shop Scheduling: Fuzzy Particle Swarm Optimization Approach [#29]S. H. Ling
F. Jiang
H. T. Nguyen
K. Y. ChanUniversity of Technology, Sydney, Australia
University of Technology, Sydney, Australia
University of Technology, Sydney, Australia
Curtin University of Technology, Australia

A fuzzy particle swarm optimization (PSO) for the minimization of makespan in permutation flow shop scheduling problem is presented in this paper. In the proposed fuzzy PSO, the inertia weight of PSO and the control parameter of the cross-mutated operation are determined by a set of fuzzy rules. To escape the local optimum, cross-mutated operation is introduced. In order to make PSO suitable for solving permutation flow shop scheduling problem, a roulette wheel mechanism is proposed to convert the continuous position values of particles to job permutations. Meanwhile, a swap-based local search for scheduling problem is designed for the local exploration on a discrete job permutation space. Flow shop benchmark functions are employed to evaluate the performance of the fuzzy PSO for flow shop scheduling problems and the results indicate that the algorithm performs better compared with existing hybrid PSO algorithms.

P103 Patent Valuation with a Fuzzy Binomial Model [#67]

Xiaolu Wang

Abo Akademi University, Finland

Patent valuation has always been a difficult task due to the considerable uncertainty involved in both the patent application procedure and the patent exploitation. This paper proposes, under the fuzzy framework, a multiperiod

binomial approach for patent valuation of the latter case. We depart from the model introduced by S. Muzzioli et al. by utilizing binomial tree to simulate the movement of patent monopoly benefits through time and representing the volatility of the patent monopoly benefits with fuzzy numbers, which is triggered by the fact that, in most cases, the Intellectual Property Rights (IPR) managers may not have good information on the parameters, and that the conventional probability theory is incapable of capturing this type of imprecision. Our model also reveals the values of the managerial flexibilities embedded in the patent exploitation.

P104 *Natural Topology via Fuzzy Metric* [#70]

Fagner Santana
Regivan Santiago

Federal University of Rio Grande do Norte (UFRN), Brazil
Federal University of Rio Grande do Norte (UFRN), Brazil

In this paper, we propose a natural way to define topologies by using fuzzy metrics; here the value of the distance between two points is a non-negative fuzzy number. With such topology, we also define notions like continuity, convergent sequence, Cauchy sequences and complete spaces. As an application, we provide a fixed point theorem quite similar to the classical theorem.

P105 *Fault diagnosis of turbine using an improved intuitionistic fuzzy cross entropy approach* [#79]

Hung Kuo-Chen
Lin Kuo-Ping
Weng Chia-Chun

National Defense University, Taiwan
National Defense University, Taiwan
National Defense University, Taiwan

The fuzzy cross entropy of intuitionistic fuzzy sets, so-called intuitionistic cross entropy, is introduced by analogy with the cross entropy of probability distributions. This paper introduces the concepts of discrimination information and cross-entropy in the intuitionistic fuzzy sets. Based on this improved entropy measure, we add information of hesitation and reveal an intuitive and mathematical connection between the notions of entropy for intuitionistic fuzzy sets in terms of fuzziness and intuitionism. Finally, a fault diagnosis example of the turbine has been illustrated. The example demonstrates that the proposed method cannot only diagnose the main fault types of the turbine, it can also detect useful information for future trends and multi-fault analysis.

P106 *Fuzzy delta separation axioms* [#91]

Seok Jong Lee
Sang Min Yun

Chungbuk National University, Republic of Korea
Chungbuk National University, Republic of Korea

We introduce a new type of separation axioms, which is called fuzzy delta separation axioms by using the concept of fuzzy delta open sets. Also we investigate the relation between the separation property and the subspaces. We show that fuzzy delta separation axioms are hereditary in fuzzy regular open subspaces.

P107 *Clustering Data and Imprecise Concepts* [#101]

Zengchang Qin
Weifeng Zhang

Robotics Institute, CMU, United States
Beihang University, China

Cluster analysis is the assignment of grouping a set of observations into clusters so that observations in the same cluster are similar in some sense. One of the key features for clustering is how to define a sensible similarity measure. However, classical clustering algorithms have no ability to cluster data instances and imprecise concepts using traditional distance measures. In this paper, we proposed a (dis)similarity measure based on a new knowledge representation framework called label semantics. Based on this new measure, we can automatically cluster data instance and descriptive concepts represented by logical expressions of linguistic labels. Experimental results on a toy problem in image classification demonstrate the effectiveness of the new proposed clustering algorithm. Since the new proposed measure can be extended to measuring distance between any two granularities, the new clustering algorithms can also be extended to clustering data instance and imprecise concepts represented by other granularities.

P108 *Fuzzy Variable Structure Control for PWM Inverters* [#102]

En-Chih Chang
Josep M. Guerrero

I-Shou University, Taiwan
Universitat Politècnica de Catalunya, Spain

This paper proposes the practical realization of a fuzzy variable structure control applied to a PWM inverter. Variable structure Control (VSC) is a robust control method for handling nonlinear systems where occur parameter variations and external disturbances. However, control input chattering round sliding surface exists, and may deteriorate the system performance. To reduce the chattering, a fuzzy logic for VSC is applied to overcome the problem. By composing the advantages of both VSC and fuzzy logic (FL), the PWM Inverter system can be designed and produces low total harmonic distortion (THD) output voltage and fast dynamic response under different types of load. Experimental results on a single-phase PWM inverter laboratory prototype controlled by a dSPACE-based DSP controller are presented to illustrate the improved performance, particularly under severe rectifier load. Moreover, for comparison purposes, a conventional variable structure controlled single-phase PWM inverter is also tested on the same experimental system.

P109 *An Adaptive Fuzzy Logic Controller based on Real Coded Quantum-Inspired Evolutionary Algorithm* [#103]

Pintu Shill
Amjad Hossain
Faijul Amin
Kazuyuki Murase

University of Fukui, Japan
Khulna University of Engineering and Technology, Bangladesh
University of Fukui, Japan
University of Fukui, Japan

In this paper, fuzzy logic control systems and real coded quantum inspired evolutionary algorithm (RCQIEA) are integrated for intelligent control. Here, RCQIEAs is utilized as an adaptive method for selection and definition of fuzzy control rules and for tuning the parameters of membership function for each fuzzy control rule in two different ways. The majority of fuzzy logic controllers (FLCs) to date are working based on the expert knowledge base derived from heuristic knowledge of experienced operators. These approaches are difficult and time

consuming for experts. Moreover, because manual coded FLCs use expert knowledge, there is no guarantee that the FLCs obtained will have sufficiently good performance, especially for a complex system problem with a large number of input variables. On the contrary, our proposed approach is an automatic knowledge acquisition learning method for generating or adapting FLCs using RCQIEA. In order to check the effectiveness of our proposed approach, it has been applied to solve the truck-and-trailer controller, which is well known test-bed for fuzzy control systems. The fuzzy controller obtained by the proposed approach performs better and effectively realizes the trajectory control of the truck with trailer.

P110 An Efficient Hybrid Particle Swarm Optimization for the Job Shop Scheduling Problem [#116]

Xue-Feng Zhang
Miyuki Koshimura
Hiroshi Fujita
Ryuzo Hasegawa

Kyushu University, China
Kyushu University, Japan
Kyushu University, Japan
Kyushu University, Japan

This paper proposes a hybrid particle swarm optimization algorithm for solving Job Shop Scheduling Problems (JSSP) to minimize the maximum makespan. A new hybrid heuristic, based on Particle Swarm Optimization (PSO), Tabu Search (TS) and Simulated Annealing (SA), is presented. PSO combines local search (by self-experience) with global search (by neighboring experience), achieving a high search efficiency. TS uses a memory function to avoid being trapped at a local minimum, and has emerged as an effective algorithmic approach for the JSSP. This method can also be referred to as calculation of the horizontal direction. SA employs certain probability to avoid becoming trapped in a local optimum and the search process can be controlled by the cooling schedule (also known as calculation of vertical direction). By reasonably combining these three different search algorithms, we develop a robust, fast and simply implemented hybrid optimization algorithm HPTS (Hybrid of Particle swarm optimization, Tabu search and Simulated annealing). This hybrid algorithm is applied to the standard benchmark sets and compared with other approaches. The experimental results show that the proposed algorithm could obtain the high-quality solutions within relatively short computation time. For 6 of 43 instances, new upper bounds among the unsolved problems are found in a short time in HPTS.

P111 A Framework of Multi-characteristics Fuzzy Dynamic Scheduling for Parallel Video Processing on MPSoC Architecture [#117]

Da Li
Yibin Hou
Zhangqin Huang
Chunhua Xiao

Xi'an Jiaotong University, China
Embedded Software and Systems Institute, China
Embedded Software and Systems Institute, China
Embedded Software and Systems Institute, China

This paper addresses the inherent unreliability and instability of the multiple uncertain characteristics of complex embedded multiprocessor systems, such as MPSoC (multi-processor system on chip) systems. In this work, we propose a fuzzy sets description for the multiple uncertain characteristics of system, and using fuzzy set membership calculation to determine the scheduling priorities of tasks and resources, in order to improve the capability of concurrent executions of tasks. And also we present a method estimation of comprehensive analysis on the multiple performances in order to increase utilization factor and balancing loads on processors. We implemented a prototype MPSoC system, which utilizes the proposed fuzzy dynamic scheduling algorithm to allocating tasks onto the multiprocessors. And in our case studies, we design a parallel architecture h.264 encoder, running on a multicore MPSoC system on FPGA. The speedup ratio of this prototype application system is up to 12.69.

P112 The Derivation of the Analytical Structure of a class of Interval Type-2 fuzzy PD and PI controllers [#127]

Maowen Nie
Woei Wan Tan

National University of Singapore, Singapore
National University of Singapore, Singapore

Analytical structure of a fuzzy logic system (FLS) is to establish its mathematical input-output relationship. In this paper, the analytical structure of a class of Interval type- 2 (IT2) fuzzy PD and PI controllers are derived by dividing the input space and identifying the input-output relationship for each region. Unlike the symmetric fuzzy PD and PI controller [12] which have three different consequent sets $H_4 < H_3 = H_2 < H_1$, the IT2 fuzzy PD and PI controllers considered in this paper have four different consequent sets $H_4 < H_3 < H_2 < H_1$. Compared with the symmetric IT2 fuzzy controllers investigated in [12], the relatively large number of divisions of the input space indicates the potential of this class of IT2 fuzzy controllers in achieving better performance. The equations describing the input-output relationship for each region provide mathematical tools for further investigations of these IT2 fuzzy PD controllers.

P113 Estimation of the Asymptotic Stability Region of Uncertain Fuzzy Systems with Bounded Controllers Using Variable Structure System Design Approach [#138]

Chung-Chun Kung
Ti-Hung Chen
Shuo-Chieh Chang
Chih-Chieh Chen

Tatung University, Taiwan
Lunghwa University of Science and Technology, Taiwan
Tatung University, Taiwan
Tatung University, Taiwan

In this paper, the problem of estimating the asymptotic stability region (ASR) of uncertain nonlinear systems is considered. Our approach is based on Takagi- Sugeno (T-S) fuzzy model and variable structure control (VSC) technique. To simplify the problem, we use a state transformation to reduce the system order of the T-S fuzzy systems. Then we design the sliding surface for the transformed system. By the Lyapunov stability theorem, the ASR can be estimated. A simulation example is presented to verify the effectiveness of the proposed scheme.

P114 A Study on Atanassov's Intuitionistic Fuzzy Graphs [#157]

M.G. Karunambigai

Sri Vasavi College, India

R. Parvathi
O.K. Kalaivani

Atanassov [1][9][10] defined Intuitionistic Fuzzy Graphs (IFGs) using five types of Cartesian products. In this paper IFGs so defined are named. Homomorphism, weak isomorphism and co-weak isomorphism of minmax IFGs are defined with suitable illustrations. Some of the properties of isomorphism on IFG and isomorphism on strong IFG are also analyzed.

Vellalar College for Women, India
T. John Institute of Technology, India

P115 Fuzzy Controller Based Output Power Leveling Enhancement for a Permanent Magnet Synchronous Generator [#159]

Abdul Motin Howlader
Naomitsu Urasaki
Shantanu Chakraborty
Atsushi Yona
Tomonobu Senjyu
Ahmed Y. Saber

University of the Ryukyus, Japan
University of the Ryukyus, Japan
University of the Ryukyus, Japan
University of the Ryukyus, Japan
University of the Ryukyus, Japan
Operation Technology Inc., United States

Due to irregular wind velocity, the output power of a wind turbine generator system (WTGS) is fluctuated. There are many methods to propose to generate smooth output power of a wind turbine. For example, energy storage devices, electric double layer capacitors, flywheels are well-known. But these methods are required a significant extra cost for installation and maintenance. In recent years, some researches have been conducted to generate smooth output power by using inertia or by controlling kinetic energy of a wind turbine. The major benefit of this method, it does not require extra energy storage to generate smooth output power. So, it can reduce of a system cost significantly. But this method is reduced output power radically at the steady wind velocity as compare with maximum power point tracking (MPPT) control method. To overcome this problem, this paper is proposed a fuzzy controller based output power smoothing method by controlling kinetic energy of a wind turbine. The generator electrical speed is controlled by the proposed method that helps to generate efficient smooth output power at different wind speeds. The proposed method is compared with conventional method and MPPT control method. The effectiveness of the proposed method is verified by MATLAB SIMULINK with SimPowerSystems and Fuzzy Logic Toolbox.

P116 Important Issues To Be Considered In Developing Fuzzy Cognitive Maps [#548]

Costas Neocleous
Christos Schizas
Maria Papaioannou

Cyprus University of Technology, Cyprus
University of Cyprus, Cyprus
University of Cyprus, Cyprus

The formalism of fuzzy cognitive maps as used for the modeling of various dynamical systems is presented with a critical point of view. Various issues related to terminology, concepts, sensitivities, time dependence, iteration procedures, and stability, are systematically considered with critical mind, aiming at making the overall system models be more realistic and useful, and to initiate discussions that can lead to clarifications and to uniformities. Emphasis is given to applications in social, political, eco-nomic and engineering systems.

P117 A Fall Detection Study on the Sensors Placement Location and a Rule-Based Multi-Thresholds Algorithm Using Both Accelerometer and Gyroscopes [#613]

Donald Lie
Jerene Jacob
Nguyen Tam

Texas Tech University, United States
Texas Tech University, United States
Texas Tech University, United States

Falls are dangerous among the elderly population and are a major health concern. Many investigators have reported the use of accelerometers for fall detection. In addition, the use of miniature gyroscopes has also been reported to be able to detect falls, but the effects of sensor placement on the back of a person have not been studied thoroughly. In this paper we present a simple solution for effective fall detection using both an accelerometer and two gyroscopes placed, as a single unit, on three different positions along the thoracic vertebrae (i.e., T-4, T-7, and T-10). Results indicated that T-10 was not a good location for the gyroscope placement for fall detection. However, both T-4 and T-7 were suitable, with the results for T-4 being slightly better. Using a simple rule-based multi-thresholds algorithm that utilizes the recorded resultant gravitational acceleration, angular change, angular velocity, and angular acceleration, we were able to successfully detect all 60 falls and differentiate between falls and activities of daily living (ADL) with no false positives on young volunteers. More testing data is needed, especially for backward falls, to test the robustness of our simple algorithm and to improve the sensor portability for future trial studies on geriatric populations.

P118 A Fuzzy Representation for Non-additive Weights of AHP [#196]

Shin-ichi Ohnishi
Takahiro Yamanoi
Hideyuki Imai

Hokkai-Gakuen University, Japan
Hokkai-Gakuen University, Japan
Hokkaido University, Japan

AHP (Analytic Hierarchy Process) has been widely used in a domain of decision making, and there are a lot of extensions using fuzzy measure and integrals. In the previous research, we propose a kind of sensitivity analyses for AHP or fuzzy measure AHP, because it often occurs that data of AHP loses its reliability. In other words a comparison matrix there in does not always have enough consistency. Also in these cases, the authors propose one representation for weights using results from the sensitivity analysis. In this paper we refine fuzzy weights

representation for fuzzy measure AHP. It can show how results of (fuzzy) AHP have fuzziness when the comparison matrix does not have relatively good consistency.

P119 *A social cognitive framework of knowledge contribution in the online community* [#192]

Fan-Chuan Tseng
Feng-Yuan Kuo

National University of Tainan, Taiwan
National Sun Yat-Sen University, Taiwan

In recent years, knowledge management has become an important issue for many organizations to boost their intellectual capital and business performance. Rather than the emphasis of system functions, a social cognitive model is proposed to examine the associations among members' cognition, interpersonal relationships, and their knowledge contribution behavior. The research results demonstrate that the online members' outcome expectancy, personal efficacious beliefs, as well as the strength of online ties among online peers, have positive and direct influence on their knowledge contribution behavior. Moreover, the mediating effects of outcome expectancy and self-efficacy are both significantly proved on members' engagement in knowledge contribution.

P120 *Fuzzy Clustering of Large-Scale Data Sets Using Principal Component Analysis* [#188]

Sassi Minyar
Arfaoui Olfa

ENIT, Tunisia
ENIT, Tunisia

To effectively exploit large-scale data sets using a limited storage space, it is necessary to find a special treatment which reduces them. There are certain methods with this intention. We can quote the clustering. However, this method proves its limits in the case of large-scale data sets. In this paper, we propose to reduce the workspace using the Principal Component Analysis (PCA). We work with fuzzy clustering of a data set in which users don't know the optimal number of clusters to be generated. We proved the effectiveness of the preprocessing use of this technique before any clustering operation.

P121 *Soft Subspace Clustering with Competitive Agglomeration* [#168]

Lin Zhu
Longbing Cao
Jie Yang

Shanghai Jiao Tong University, China
University of Technology, Sydney, Australia
Shanghai Jiao Tong University, China

In this paper, two novel soft subspace clustering algorithms, namely fuzzy weighting subspace clustering with competitive agglomeration (FWSCA) and entropy weighting subspace clustering with competitive agglomeration (EWSCA), are proposed to overcome the problems of the unknown number of clusters and the initialization of prototypes for soft subspace clustering. The main advantage of FWSCA and EWSCA lies in the fact that they effectively integrate the merits of soft subspace clustering and the good properties of fuzzy clustering with competitive agglomeration. This makes it possible to obtain the appropriate number of clusters during the clustering progress. Moreover, FWSCA and EWSCA algorithms can converge regardless of the initial number of clusters and initialization. Substantial experimental results on both synthetic and real data sets demonstrate the effectiveness of FWSCA and EWSCA in addressing the two problems.

(SS05) Special Session: Fuzzy Robotics

Tuesday, June 28, 2:50PM-4:30PM, Room: Swan, Chair: Honghai Liu

2:50PM *Hand Motion Recognition via Fuzzy Active Curve Axis Gaussian Mixture Models: A Comparative Study* [#96]

Ju Zhaojie
Liu Honghai

University of Portsmouth, United Kingdom
University of Portsmouth, United Kingdom

Unconstrained human hand motions consisting grasp motion and in-hand manipulation lead to a fundamental challenge that many algorithms have to face in both theoretical and practical development, mainly due to the complexity and dexterity of the human hand. In this paper, fuzzy active curve axis Gaussian Mixture Model (FAcaGMM) is proposed by introducing a weighting exponent on the fuzzy membership into active curve axis Gaussian Mixture Models (AcaGMM) to improve its convergence efficiency, and then FAcaGMM is used to recognize human hand motions. In addition, a comparative study of recognition methods including FAcaGMM, Time Clustering (TC), Empirical Copula (EC), GMM and HMM is presented to recognize human hand motions including both grasps and in-hand manipulations from different subjects with varying training samples.

3:10PM *Trajectory-based Control under ZMP Constraint for the 3D Biped Walking via Fuzzy Control* [#294]

Hsiu-Ming Wu
Chih-Lyang Hwang

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

In this paper, a fuzzy control policy is presented for dynamic walking of a biped robot that is modeled as a simulated five-link biped robot. Due to complex ground contact models, it is difficult to precisely model its dynamics. Besides, we present a spring/damper ground model and a simplified inverted pendulum model to represent the ground contact relation and the biped robot model as well. Moreover, Finite State Machine (FSM) is utilized to decompose a cycle of walking gait. Under zero moment point (ZMP) constraint, each joint follows desired trajectories in each state that are generated by quintic spline curve through the model free controller (i.e., fuzzy control). In addition, its robustness is investigated by imposing pulse perturbation on torso for some

directions. The results are demonstrated in simulations and animation and the proposed controller is compared to a PID controller.

3:30PM *Formation Behavior of Multiple Robots based on Tele-operation* [#565]

Yuki Wagatsuma
Yuichiro Toda
Naoyuki Kubota

Tokyo Metropolitan University, Japan
Tokyo Metropolitan University, Japan
Tokyo Metropolitan University, Japan

Recently, multi-robot systems have been discussed to realize a large size of distributed autonomous system. Furthermore, multi-robot systems have been applied to various problems such as autonomous guided vehicles, soccer robots, search and rescue system by multi-robot etc. This paper proposes intelligent formation behavior for multi-robot based on sensor fusion. First, we discuss multi-agent system. Next, we explain the hardware specification of robot system and intelligent behavior using fuzzy control and a steady-state genetic algorithm (SSGA) and tele-operated. Finally, we show results, and discussed the availability of intelligent formation behavior for multi-robots.

3:50PM *Evaluation of Pointing Navigation Interface for Mobile Robot with Spherical Vision System* [#521]

Kyohei Yoshida
Fuminori Hibino
Yasutake Takahashi
Yoichiro Maeda

University of Fukui, Japan
University of Fukui, Japan
University of Fukui, Japan
University of Fukui, Japan

In human robot interaction, intuitive interface is necessary. A specific interaction device, for instance, a joystick or a teaching pendant, is not usually intuitive and needs trainings for a general user. Instruction by gesture is one of the intuitive interfaces and a potential user does not need any training for showing a gesture. Pointing is one of the simplest gestures. We proposed a simple human pointing recognition system for a mobile robot that has an upward directed camera and recognizes human pointing and navigate itself to the place a user is pointing by simple visual feedback control. This paper shows improvement of the method and investigates the validity and usefulness of the proposed method with questionnaire investigations with the proposed and conventional user interfaces.

4:10PM *Fuzzy PID Controller Design for Artificial Finger based SMA Actuators* [#341]

Alireza Khodayari
Mohammad Mahdi Kheirikhah
Maryam Talari

Islamic Azad University, Pardis Branch, Iran
Islamic Azad University, Qazvin Branch, Iran
Islamic Azad University, Qazvin Branch, Iran

Shape Memory Alloy (SMA) wires are currently employed in robotics, as well as prosthetic limbs and medical equipment. Due to advantages such as reducing the size in the application, high power-to-weight ratio, elimination of complex transmission systems and noiseless actuation, and human-machine interface, these materials are used as actuators in the prosthesis limb. Because of hysteresis property and nonlinear behavior of SMA, control of these actuators is very complicated. In this paper, the design of control algorithms has been discussed for SMA actuators in the artificial fingers with 3 DOF, which includes PID-fuzzy controller. Gains of controllers are set so that the current applied to SMA wires has minimum overshoot and output of system has minimal time to achieve stability. The simulation results compared with actual measured data show how well the controllers decrease the overshoot and time of stability of input signal to SMA wires.

(SS18) Special Session: Recent Advances in Fuzzy Logic in Image Processing

Tuesday, June 28, 2:50PM-4:30PM, Room: Peacock, Chair: Mike Nachtgeael

2:50PM *Fuzzy shape Classification exploiting Geometrical and Moments Descriptors* [#557]

Ugo Erra
Sabrina Senatore

Universita' della Basilicata, Italy
Universita' di Salerno, Italy

In the era of data intensive management and discovery, the volume of images repositories requires effective means for mining and classifying digital image collections. Recent studies have evidenced great interest in image processing by mining visual information for objects recognition and retrieval. Particularly, image disambiguation based on the shape produces better results than traditional features such as color or texture. On the other hand, the classification of objects extracted from images appears more intuitively formulated as a shape classification task. This work introduces an approach for 2D shapes classification, based on the combined use of geometrical and moments features extracted by a given collection of images. It achieves a shape-based classification exploiting fuzzy clustering techniques, which enable also a query- by-image.

3:10PM *Piece-wise Convex Spatial-Spectral Unmixing of Hyperspectral Imagery using Possibilistic and Fuzzy Clustering* [#452]

Alina Zare
Paul Gader

University of Missouri, United States
University of Florida, United States

Imaging spectroscopy refers to methods for identifying materials in a scene using cameras that digitize light into hundreds of spectral bands. Each pixel in these images consists of vectors representing the amount of light reflected in the different spectral bands from the physical location corresponding to the pixel. Images of this type

are called hyperspectral images. Hyperspectral image analysis differs from traditional image analysis in that, in addition to the spatial information inherent in an image, there is abundant spectral information at the pixel or sub-pixel level that can be used to identify materials in the scene. Spectral unmixing techniques attempt to identify the material spectra in a scene down to the sub-pixel level. In this paper, a piece-wise convex hyperspectral unmixing algorithm using both spatial and spectral image information is presented. The proposed method incorporates possibilistic and fuzzy clustering methods. The typicality and membership estimates from those methods can be combined with traditional material proportion estimates to produce more meaningful proportion estimates than obtained with previous spectral unmixing algorithms. An analysis of the utility of using all three estimates produce a better estimate is given using real hyperspectral imagery.

3:30PM *Detection of Hyperintense Regions on MR Brain Images using a Mamdani Type Fuzzy Rule-Based System* [#603]

F. Xavier Aymerich	Universitat Politècnica de Catalunya; Hospital Vall Hebron, Spain, Spain
Eduard Montseny	Universitat Politècnica de Catalunya, Spain
Pilar Sobrevilla	Universitat Politècnica de Catalunya, Spain
Alex Rovira	Hospital Vall Hebron, Spain

In this paper we present an algorithm for detecting hyperintense regions in brain images acquired by Magnetic Resonance Imaging. The work is part of a more general research oriented to the design of support tools that assist the healthcare experts in their research activities on brain diseases. The algorithm has been focused on the detection of small multiple sclerosis lesions in PD- and T2-weighted images. In the design of the algorithm we have considered a fuzzy approach to deal with the uncertainty and vagueness characteristic of these lesions in magnetic resonance images. The core of the work is the introduction of a Mamdani type Fuzzy Rule-Based System to optimize the detection taking into account the necessary trade-off between true and false positives in this kind of problems. Results show a very good sensitivity of the algorithm in the detection of hyperintense regions associated with small multiple sclerosis lesions, and a low false positive rate with regard the number of pixels analyzed.

3:50PM *On Fuzzy Partitions for Visual Texture Modelling* [#360]

Jesus Chamorro-Martinez	University of Granada, Spain
Pedro Manuel Martinez-Jimenez	University of Granada, Spain
Jose Manuel Soto-Hidalgo	University of Cordoba, Spain

Texture is one of the most used low-level feature for image analysis and, in addition, one of the most difficult to characterize due to its imprecision. It is usual for humans to describe visual textures according to some perceptual properties like coarseness-fineness, orientation or regularity. In this paper, we propose to model the fineness property, that is the most popular one, by means of a fuzzy partition on the domain of representative fineness measures. In our study, a wide variety of measures is studied, and the partitions are obtained by relating each measure (our reference set) with the human perception of fineness. Assessments about the perception of this property are collected from pools. This information is used to analyze the capability of each measure to discriminate different fineness categories, which imposes the number of fuzzy sets of the partition. Moreover, it is used to calculate the parameters of the membership function associated to each fuzzy set.

(SS27) Special Session: Communication Robotics and Computational Intelligence Co-creation
 Tuesday, June 28, 2:50PM-4:30PM, Room: Phoenix, Chair: Yoichi Yamazaki

2:50PM *Educational System with the Android Robot SAYA and Field Trial* [#176]

Takuya Hashimoto	Tokyo University of Science, Japan
Naoki Kato	Tokyo University of Science, Japan
Hiroshi Kobayashi	Tokyo University of Science, Japan

Communication robots cannot completely interact with humans autonomously in everyday environment due to lack of intelligence even though robots can perform certainly only in limited environments and limited situations. However since intelligence of robots is handled by an operator, teleoperated robots are useful to investigate functions required for robots and effects of robots in real-environment. This paper proposes an educational system with a teleoperated android robot that has human-like appearance as an application of teleoperated robots. The developed android robot, named SAYA, is able to express human-like facial expressions and performs some communicative functions with its head and eye movements, and it is utilized as a roll of a teacher in this educational system. In addition, SAYA's utterances and behaviors are controlled remotely by an operator so that it is able to not only conduct the class but also interact with students. We carried out a field trial at an elementary school, and SAYA conducted the class concerning the principle of leverage as a topic of science classes while interacting with students. We then investigated how it affected students' interest and motivation. As results, the trial verified that some students came to be interested in science classes more than before the trial, and we confirmed its positive effects in educational field, especially elementary schools.

3:10PM *Multimodal Gesture Recognition Based on Choquet Integral* [#113]

Kaoru Hirota	Tokyo Institute of Technology, Japan
Hai An Vu	Tokyo Institute of Technology, Japan

Phuc Quang Le
Chastine Fatichah
Zhentao Liu

Tokyo Institute of Technology, Japan
Tokyo Institute of Technology, Japan
Tokyo Institute of Technology, Japan

A multimodal gesture recognition method is proposed based on fuzzy Choquet integral by fusing information from camera and 3D accelerometer data. The system consists of two modules, i.e., a camera based gesture recognition module and an accelerometers based gesture recognition module. The camera based gesture recognition module has following three steps; step1) skin blob detection and tracking based on the HSV color space by using OpenCV Library, step2) feature extraction for the both hands and a head based on data smoothing and quantization, and step3) gesture matching using the Angular Metrics for Shape Similarity algorithm (AMSS) to calculate the similarity between gesture sequence and template sequence. The accelerometer based gesture recognition module takes the output data of a 3D accelerometers as the input sequence of feature values. The AMSS is used for measuring the similarity of input sequence and template sequences. By calculating the optimal fuzzy measures for the camera recognition module and the accelerometer recognition module, the proposal obtains enough recognition rate 92.7% in average for 8 types of gestures by improving the recognition rate approximate 20% compared to that of each module. The proposed method aims to realize the casual communication from humans to robots by integrating nonverbal gesture messages and verbal messages.

3:30PM Emotional States Based 3-D Fuzzy Atmosfield for Casual Communication between Humans and Robots [#172]

Zhentao Liu
Min Wu
Danyun Li
Fangyan Dong
Yoichi Yamazaki
Kaoru Hirota

Tokyo Institute of Technology, Japan
Central South University, China
Central South University, China
Tokyo Institute of Technology, Japan
Kanto Gakuin University, Japan
Tokyo Institute of Technology, Japan

Emotional states based three-dimensional (3-D) Fuzzy Atmosfield (FA) is proposed to express the feeling between humans and robots in communication, and is built with 3-D coordinates, i.e. "friendly-hostile", "lively-calm", and "casual-formal" axes. The FA aims to be an effective tool to proceed with the communication paying attention to the atmosphere generated by individual emotional state which is calculated from bimodal communication cues namely emotional-speech and emotional-gesture by using weighted fusion and fuzzy inference. A novel emotion recognition approach is presented which consists of two steps, i.e., classification of six basic emotions for initial emotional states in the Affinity-Pleasure-Arousal emotion space, and emotional transition from prior state by using fuzzy logic. Home party enjoying demonstration confirms FA's availability empirically by questionnaires from unrelated persons of authors' group, where smooth communication between four humans and five eye robots is realized in Mascot Robot System.

3:50PM Presence Expression Using Eye Robot for Computer Go System [#455]

Yoichi Yamazaki
Masaya Hanada
Chang-Shing Lee
Takuya Hashimoto
Fangyan Dong
Makoto Motoki
Kaoru Hirota

Kanto Gakuin University, Japan
Kanto Gakuin University, Japan
National University of Tainan, Japan
Tokyo Unicesity of Science, Japan
Tokyo Institute of Technology, Japan
Kanto Gakuin University, Japan
Tokyo Institute of Technology, Japan

Friendly user interface is desired for robots and computer systems which support human in all areas of daily life, e.g., information service, educational system, support service for elderly, etc.. Presence expressions by eye robot is proposed, where the eye robot expressions help human to more deeply understand robot, and then effectively provide their service in its situation e.g., a personal learning program and an entertainment program. The proposed presence expression is applied a personal education system that involves the eye robot, learning contents on a laptop PC with a web camera, a wii remote (Nintendo Co.,Ltd.) for measuring attention span of a subject based on 3D accelerometer information. To estimate effects of presence expression by the eye robot, subjective questioner is performed in the personal education system. Three type of leaning programs are conducted by the system for 10 subjects with subjective questionnaires evaluated with the 3-poin scale. The results show that the proposed expressions by the eye robot help the subject to feel like one is watching and to have an uncanny impression. As a result, the system has enabled the subjects to take the program with feeling of tension. This research plans to apply computer go system, another personal educational and entertainment system, where the system realizes casual communication in the games.

4:10PM Emotion Recognition based on Human Gesture and Speech Information using RT Middleware [#367]

Hai An Vu
Yoichi Yamazaki
Fangyan Dong
Kaoru Hirota

Tokyo Institute of Technology, Japan
Kanto Gakuin University, Japan
Tokyo Institute of Technology, Japan
Tokyo Institute of Technology, Japan

A bi-modal emotion recognition approach is proposed for recognition of four emotions that integrate information from gestures and speech. The outputs from two uni-modal emotion recognition systems based on affective

speech and expressive gesture are fused on a decision level fusion by using weight criterion fusion and best probability plus majority vote fusion methods, and the performance of classifier which performs better than each uni-modal and is helpful in recognizing suitable emotions for communication situations. To validate the proposal, fifty Japanese words (or phrases) and 8 types of gestures that are recorded from five participants are used, and the emotion recognition rate increases up to 85.39%. The proposal is able to extent to using more than other modalities and useful in automatic emotion recognition system for human-robot communication.

(SS28-2) Special Session: Current Development in Pattern Classification-Kernelization, Pairwise Constraints, and Classifiers

Tuesday, June 28, 2:50PM-4:30PM, Room: Crane, Chair: Yasunori Endo

2:50PM FCMdd-type Linear Fuzzy Clustering for Incomplete Non-Euclidean Relational Data [#108]

Takeshi Yamamoto
Katsuhiro Honda
Akira Notsu
Hidetomo Ichihashi

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

A linear fuzzy clustering model based on Fuzzy c-Medoids (FCMdd) was proposed for extracting intrinsic local linear substructures from relational data. In the same way with Non-Euclidean Relational Fuzzy (NERF) c-Means, beta-spread transformation was also proved to be useful for handling non-Euclidean relational data in FCMdd-type linear clustering. In this paper, the FCMdd-type linear clustering model is further modified in order to handle incomplete data including missing values. In several numerical experiments, it is demonstrated that some pre-imputation strategies contribute to properly selecting representative medoids of each cluster.

3:10PM Hybrid Objective Function of Fuzzy c-Varieties and Cross-shape Fuzzy Cluster Extraction [#295]

Daisuke Yoshida
Katsuhiro Honda
Akira Notsu
Hidetomo Ichihashi

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

This paper proposes an FCM-type clustering method for capturing cross-shape fuzzy clusters in multi-dimensional data spaces. The proposed objective function is a combination of Fuzzy c-Varieties (FCV) and cross-shape cluster extraction in 2-D space, which is an extended linear fuzzy clustering model with local coordinate rotation. FCV is responsible for finding 2-D planes, on which cross-shape prototypes exist. Each prototypical cross is estimated on the FCV prototypes. Fuzzy memberships are updated using a combined clustering criterion of distances between data samples and FCV prototypes and measures for linear clustering on the FCV prototypes with local coordinate rotation.

3:30PM Kernelized Fuzzy c-Means Clustering for Uncertain Data using Quadratic Penalty-Vector Regularization with Explicit Mappings [#114]

Yasunori Endo
Isao Takayama
Yukihiro Hamasuna
Sadaaki Miyamoto

The University of Tsukuba, Japan
The University of Tsukuba, Japan
The University of Tsukuba, Japan
The University of Tsukuba, Japan

Recently, fuzzy c-means clustering with kernel functions is remarkable in the reason that these algorithms can handle datasets which consist of some clusters with nonlinear boundaries. However the algorithms have the following problems: (1) the cluster centers can not be calculated explicitly, (2) it takes long time to calculate clustering results. By the way, we have proposed the clustering algorithms using penalty-vector regularization to handle uncertain data. In this paper, we propose new clustering algorithms using quadratic penalty-vector regularization by introducing explicit mappings of kernel functions to solve the following problems. Moreover, we construct fuzzy classification functions for our proposed clustering methods.

3:50PM On Mahalanobis Distance Based Fuzzy c-Means Clustering for Uncertain Data Using Penalty Vector Regularization [#125]

Yukihiro Hamasuna
Yasunori Endo
Sadaaki Miyamoto

Kinki University, Japan
University of Tsukuba, Japan
University of Tsukuba, Japan

This paper presents Mahalanobis distance based fuzzy c-means clustering for uncertain data using penalty vector regularization. When we handle a set of data, data contains inherent uncertainty e.g., errors, ranges or some missing value of attributes. In order to handle such uncertain data as a point in a pattern space the concept of penalty vector has been proposed. Some significant clustering algorithms based on it have been also proposed. In conventional clustering algorithms, Mahalanobis distance have been used as dissimilarity as well as squared L2 and L1-norm. From the viewpoint of the guideline of dissimilarity, Mahalanobis distance based fuzzy c-means clustering for uncertain data should be considered. In this paper, we introduce fuzzy c-means clustering for uncertain data using penalty vector regularization as our conventional works. Next, we propose Mahalanobis distance based one. Moreover, we show the effectiveness of proposed method through numerical examples.

4:10PM On Hard and Fuzzy c-Means Clustering with Conditionally Positive Definite Kernel [#177]

Yuchi Kanzawa
Yasunori Endo
Sadaaki Miyamoto

Shibaura Institute of Technology, Japan
University of Tsukuba, Japan
University of Tsukuba, Japan

In this paper, we investigate three types of c-means clustering algorithms with a conditionally positive definite kernel. One is based on hard c-means, and the others are based on standard and entropy-regularized fuzzy c-means. First, based on a conditionally positive definite kernel describing a squared Euclidean distance between data in the feature space, these algorithms are derived from revised optimization problems of the conventional kernel c-means. Next, based on the relationship between the positive definite kernel and conditionally positive definite kernel, the revised dissimilarity between a datum and a cluster center in the feature space is shown. Finally, it is shown that a conditionally positive definite kernel c-means algorithm and a kernel c-means algorithm with a positive definite kernel derived from the conditionally positive definite kernel are essentially identical to each other. An explicit mapping for a conditionally positive definite kernel is also described geometrically.

(SS42-1) Special Session: Fuzzy Cognitive Maps-Theory and Applications

Tuesday, June 28, 2:50PM-4:30PM, Room: Egret, Chair: Chair: Elpiniki I. Papageorgiou and Sebastian Lozano

2:50PM Intuitionistic Fuzzy Reasoning with Cognitive Maps [#477]

Dimitris Iakovidis
Elpiniki Papageorgiou

Technological Educational Institute of Lamia, Greece
Technological Educational Institute of Lamia, Greece

Fuzzy cognitive maps have proven an exceptional means to reasoning for decision support. In this paper we propose a novel approach to hesitancy-aware reasoning based on cognitive maps and intuitionistic fuzzy logic. Intuitionistic fuzzy sets are considered for the linguistic representation of both the concepts of a cognitive map and the relations defined between them. A comparative advantage of this approach over the state of the art is an intrinsic mechanism of modeling human hesitancy, as introduced in the construction of a cognitive model, and propagated through the reasoning process to a final decision. A numerical example demonstrates its effectiveness which can extend to a variety of real-world applications.

3:10PM Review study on Fuzzy Cognitive Maps and their applications during the last decade [#516]

Elpiniki Papageorgiou

Technological Educational Institute of Lamia, Greece

This survey work tries to review the most recent applications and trends on fuzzy cognitive maps (FCMs) at the last ten years. FCMs are inference networks, using cyclic directed graphs, for knowledge representation and reasoning. In the past decade, FCMs have gained considerable research interest and are widely used to analyze causal systems such as system control, decision making, management, risk analysis, text categorization, prediction etc. Some example application domains, such as engineering, social and political sciences, business, information technology, medicine and environment, where the FCMs emerged a considerable degree of applicability were selected. Their dynamic characteristics and learning methodologies make them essential for modeling, analysis, prediction and decision making tasks as they improve the performance of these systems. A survey on FCM studies concentrated on FCM applications on diverse scientific fields is elaborated during the last decade.

3:30PM Nonlinear Cause-Effect Relationships In Fuzzy Cognitive Maps [#361]

Maria Ketipi
Dimitrios Koulouriotis
Evangelos Karakasis
George Papakostas
Vassilios Tourassis

Democritus University of Thrace, Greece
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Democritus University of Thrace, Greece

Fuzzy Cognitive Maps (FCMs) have been widely used for a plethora of applications, exploiting its ability to represent the knowledge and the dynamics of a system. The diversity of inference mechanisms, which have been proposed until nowadays, discloses the effort for an effective concept value calculation methodology. In contrast with the most research efforts which consider a linear relation of the influence that a concept exercise to another concept, in this paper a nonlinear representation of that influence is introduced. The importance which is associated with the proposed methodology is that a nonlinear cause-effect relationship strengthens the behavior of an FCM through the simulation process. The analysis of this proposal through a progressive reasoning is followed by appropriately selected problems.

3:50PM Case Based Fuzzy Cognitive Maps (CBFCM) : New method for medical reasoning [#567]

Nassim Douali
Elpiniki Papageorgiou
Jos De Roo
Marie-Christine Jaulent

Cordeliers Research CenterParis, France
Technological Educational Institute of Lamia, Greece
Agfa HealthCare Agfa HealthCare NV, Belgium
Cordeliers Research CenterParis, France

Doctor usually uses his experience from the clinical practice to confirm a diagnosis and to prescribe an appropriate treatment for a specific patient. The computerized medical reasoning should not only focus on existing medical knowledge but also on physician's previous experiences and new knowledge. Such knowledge and experience are vague and define uncertain relationships between facts and diagnosis. Case Based Fuzzy

Cognitive Maps (CBFCM) are proposed as an evolution of Fuzzy Cognitive Maps (FCM) that allow more complete representation of knowledge since case-based fuzzy rules are introduced to improve FCM decision support systems. Semantic web is used to implement both FCM approaches. A database of 71 patients with urinary tract infections was used to perform the proposed approach. A comparative study between FCM (92%) and CBFCM (99%) conducted and the results derived by CBFCM approach showed superior to FCM.

4:10PM Training Fuzzy Cognitive Maps by Using Hebbian Learning Algorithms: A Comparative Study
[#343]

George Papakostas
Athanasios Polydoros
Koulouriotis Dimitrios
Tourassis Vasileios

Democritus University of Thrace, Greece
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Democritus University of Thrace, Greece
Democritus University of Thrace, Greece

A detailed analysis of the Hebbian-like learning algorithms applied to train Fuzzy Cognitive Maps (FCMs) is presented in this paper. These algorithms aim to find appropriate weights between the concepts of the FCM so the model equilibrates to a desired state. For this manner, four different types of Hebbian learning algorithms have been proposed in the past. Along with the theoretical description of these algorithms, their performance in system modeling problems is investigated in this work. The algorithms are studied in a comparative fashion by using appropriate performance indices and useful conclusions about their training capabilities are experimentally derived.

(SS21-1) Special Session: Fuzzy Control in Industrial and Application

Tuesday, June 28, 2:50PM-4:30PM, Room: Swallow, Chair: Shun-Hung Tsai

2:50PM Applications of Fuzzy Classification with Fuzzy C-Means Clustering and Optimization Strategies for Load Identification in NILM Systems [#126]

Yu-Hsiu Lin
Men-Shen Tsai
Chin-Sheng Chen

National Taipei University of Technology, Taiwan
National Taipei University of Technology, Taiwan
National Taipei University of Technology, Taiwan

Due to global warming and climate changes, it is very important to use and conserve the power energy effectively. Monitoring the electrical consumption of consumers is one of the methods that can improve the energy usage efficiency. In this paper, a Non-Intrusive Load Monitoring (NILM) system, which applies a fuzzy classifier with the Fuzzy C-Means (FCM) clustering and optimization algorithms to identify the energizing and de-energizing statuses of each appliance, is proposed. Load energizing and de-energizing transient features are extracted, and the fuzzy classifier performs load identification based on these features. A two-stage fuzzy classifier is used in this paper. For the first stage, the FCM clustering is used to coarsely determine the parameters of the fuzzy classifier. Following this stage, two optimization algorithms, Error Back-Propagation Algorithm (EBPA) and Genetic Algorithm (GA), are employed to fine tune those parameters. As the classification results obtained from different realistic experimental environments, the proposed system is confirmed that it is able to identify the operational status of each appliance.

3:10PM Knowledge-Based Fuzzy Imbalanced Force Compensator Design for a Single Active Magnetic Bearing Suspended Rotor System [#347]

Yi Hua Fan
Ying Tsun Lee

Chung Yuan Christian University, Taiwan
Chung Yuan Christian University, Taiwan

A fuzzy imbalanced force estimator and feed-forward controller designed by the knowledge of rotor dynamics for a single active magnetic bearing suspended rotor system was proposed to eliminate the unbalancing vibration of rotor in the paper. The variable parameters used in the fuzzy estimator are displacement and velocity of the rotor and control current of the magnetic bearing. Based on the estimating signal, a feed-forward control system is set to suppress the unbalancing vibration. The simulation and experiment results show that the proposed estimation system could accurately estimate the unbalance force and the feed-forward control system could restrain the unbalancing vibration to improving the rotational accuracy.

3:30PM DSP-Based Cross-Coupled Synchronous Control for Dual Linear Motors via Functional Link Radial Basis Function Network [#129]

Chin-Sheng Chen
Po-Huan Chou
Faa-Jeng Lin

National Taipei University of Technology, Taiwan
National Dong Hwa University, Taiwan
National Central University, Taiwan

A digital signal processor (DSP)-based cross-coupled functional link radial basis function network (FLRBFN) control is proposed in this study for the synchronous control of a dual linear motors servo system which is installed in a gantry position stage. The dual linear motors servo system comprises two parallel permanent magnet linear synchronous motors (PMLSMs). First, the dynamics of the field-oriented control PMLSM servo drive with a lumped uncertainty, which contains parameter variations, external disturbance and friction force, is introduced. Then, to achieve accurate trajectory tracking performance with robustness, an intelligent control approach using FLRBFN is proposed for the field-oriented control PMLSM servo drive system. The proposed FLRBFN is a radial basis function network (RBFN) embedded with a functional link neural network (FLNN). The

network structure and its on-line learning algorithms for connective weights, means and standard derivations are described in detail. Moreover, since a cross-coupled technology is incorporated into the proposed intelligent control scheme for the gantry position stage, both of the position tracking errors and synchronous errors of dual linear motors will converge to zero, simultaneously. Finally, some experimental results are illustrated to depict the validity of the proposed control approach.

3:50PM *An Interactive Fuzzy Satisficing Method for Multiobjective Stochastic Defensive Location Problems*
[#284]

Takeshi Uno
Kosuke Kato

The University of Tokushima, Japan
Hiroshima Institute of Technology, Japan

This paper extends the defensive location problems (DLPs), proposed by Uno and Katagiri, considering the situations that the decision maker locates defensive facilities for preventing her/his enemies from reaching some important nodes in a network. Their DLPs are assumed that her/his enemies exist on a given node in it. On the other hand, this paper considers a new DLP that there are several nodes with her/his enemies given uncertainly. By representing their nodes as random variables with scenarios, the new DLP can be formulated as a multiobjective bilevel 0-1 stochastic programming problem. In order to find a satisficing solution of the decision maker for the multi-objective DLP, an interactive fuzzy satisficing method with tabu search algorithm based on strategic oscillation is proposed. The efficiency of the proposed method is shown by applying it to numerical examples of the DLPs.

4:10PM *A Comparison of Non-stationary, Interval Type-2 and Dual-Surface Interval Type-2 Fuzzy Control*
[#423]

Naisan Benatar
Uwe Aickelin
Jonathan M. Garibaldi

University of Nottingham, United Kingdom
University of Nottingham, United Kingdom
University of Nottingham, United Kingdom

Type-1 fuzzy logic has frequently been used in control systems. However this method is sometimes shown to be too restrictive and unable to adapt in the presence of uncertainty. In this paper we compare type-1 fuzzy control with several other fuzzy approaches under a range of uncertain conditions. Interval type-2 and non-stationary fuzzy controllers are compared, along with 'dual surface' type-2 control, named due to utilising both the lower and upper values produced from standard interval type-2 systems. We tune a type-1 controller, then derive the membership functions and footprints of uncertainty from the type-1 system and evaluate them using a simulated autonomous sailing problem with varying amounts of environmental uncertainty. We show that while these more sophisticated controllers can produce better performance than the type-1 controller, this is not guaranteed and that selection of FOU size has a large effect on this relative performance.

(PS02) Poster Session II

Tuesday, June 28, 4:30PM-7:00PM, Room: Grand Ballroom II

P301 *Robust Speed-Controlled Permanent Magnet Synchronous Motor Drive using Fuzzy Logic Controller*
[#162]

Gunawan Dewantoro
Yong-Lin Kuo

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

The Permanent Magnet (PM) Synchronous Motor is ideal in the field of the low power high performance servo, since it is controllable and its vigorous performance is excellent. However, the variations of moment inertia, load torque, and motor internal parameters have been a major difficulty to deal with speed control. This paper investigates the fuzzy logic controller based speed control for a vector-controlled PM synchronous motor drive. The fuzzy logic is based on the speed error and change of speed error measured between the actual motor speed and the reference speed. The robust control performance of the fuzzy logic controller is evaluated for various operating conditions using the parameters of a prototype PM synchronous motor and compared to that of conventional PI controller. The design and application of the fuzzy logic controller are considered and discussed.

P302 *Possibilistic Regression Analysis by Support Vector Machine* [#183]

Pei-Yi Hao

National Kaohsiung University of Applied Sciences, Taiwan

Support vector machines (SVMs) have been very successful in pattern recognition and function estimation problems for crisp data. This paper proposes a new method to evaluate interval linear and nonlinear regression models combining the possibility and necessity estimation formulation with the principle of SVM. For data sets with crisp inputs and interval outputs, the possibility and necessity models have been recently utilized, which are based on quadratic programming approach giving more diverse spread coefficients than a linear programming one. The SVM also uses quadratic programming approach whose advantage in interval regression analysis is to be able to perform interval nonlinear regression analysis by constructing an interval linear regression function in a high dimensional feature space. The proposed algorithm is a attractive approach to modeling nonlinear interval data, and is model-free method in the sense that we do not have to assume the underlying model function for interval nonlinear regression model with crisp inputs and interval output. Experimental results are then presented which indicate the performance of this algorithm.

P303 *Cognitive Simulation-Based on Knowledge Evolution in Fuzzy Discrete Event Systems* [#199]

Paul-Antoine Bisgambiglia

University of Corsica CNRS, France

Paul Antoine Bisgambiglia
Jean-Sebastien Gualtieri

University of Corsica CNRS, France
University of Corsica CNRS, France

Discrete event systems (DES) theory has been developed and widely used to study the behavior of complex systems. In this paper, from a formalism based on this theory (DEVS), we propose to present a formal approach for taking into account the knowledge evolution. Indeed, knowledge is not static; it can evolve in time, or during the simulation. Few tools offer to take into account these developments, which may have a significant impact on the validity of results. To deal this knowledge, we suggest adding a lifespan to the modeled data, the latter is used to define the validity degree of knowledge; it is a kind of confidence measure.

P304 *A Fuzzy Tool for the Validation of Individual Risk Premia in High-Technology Venture Valuation* [#202]

Lars Krueger
Peter Heydebreck
Ralf Salomon

engage Key Technology Ventures, Germany
inno Germany AG, Germany
University of Rostock, Germany

Venture valuation is an essential technique in economics. Depending on the reason for a valuation, there are several methods applicable. It becomes even more complex when it comes to the valuation of companies that possess mainly intangible assets and whose success lies in the future. In this article a further step towards a Fuzzy Method is presented and discussed that allows the determination of a relevant parameter for a widely used valuation method. We focus on the application of a novel methodological framework to convert Fuzzy Cognitive Maps into Fuzzy rule-based Inference Systems. We demonstrate the principal feasibility and elucidate a method to optimize the functionality.

P305 *Soft-Core Implementation for Centre of Slice Area Average Defuzzifier* [#206]

Antonio Hernandez Zavala
Oscar Camacho Nieto
Cornelio Yanez Marquez

Instituto Politecnico Nacional - UPIITA, Mexico
Instituto Politecnico Nacional - CIC, Mexico
Instituto Politecnico Nacional - CIC, Mexico

Fuzzy systems are broad used for the decision making task given its capability of extract knowledge from an expert and translate it into rules that define described system. Implementations are made according to speed requirements of the problem, for the case of critical real time systems hardware is the best choice. One important issue on fuzzy systems is the final step, defuzzifier, when computed fuzzy data is turned into crisp data. There are many different defuzzifier methods from which most used for hardware purposes are Center Of Gravity and Mean Of Maxima. This work presents hardware implementation for Center of Slice Area Average defuzzifier, for digital soft-core implementation; its main advantages are reduction on resource consumption and reduction of calculation time without loss of accuracy.

P306 *Fuzzy Integral-based Composite Facial Expression Generation for a Robotic Head* [#234]

Bum-Soo Yoo
Se-Hyoung Cho
Jong-Hwan Kim

KAIST, Republic of Korea
KAIST, Republic of Korea
KAIST, Republic of Korea

Conventional methods produced composite facial expressions by interpolating the representative facial expressions under the assumption that the transitions between facial expressions are linear. Considering the nonlinear property, this paper proposes a fuzzy integral-based method for generating composite facial expressions. Fuzzy measures represent the relationship among emotions and the partial evaluation of current emotion state is obtained from a predefined error function of the ideal basic emotion states and the current emotion state. Fuzzy integral of the partial evaluation with respect to fuzzy measures is employed to globally evaluate the current emotion state for generating composite facial expressions. The effectiveness of the proposed method for generating composite facial expressions is demonstrated through the experiments with a robotic head with 19 degrees of freedom, developed in RIT Laboratory, KAIST.

P307 *Comparing soft clusters and partitions* [#243]

Derek Anderson
James Keller
Ozy Sjahputera
James Bezdek
Mihail Popescu

University of Missouri, United States
University of Missouri, United States
University of Missouri, United States
University of Missouri, United States
University of Missouri, United States

Previously, we presented a method for comparing soft partitions (i.e. crisp, probabilistic, fuzzy and possibilistic) to a known crisp reference partition. Many of the classical indices that have been used with outputs of crisp clustering algorithms were generalized so that they are applicable for candidate partitions of any type. In particular, focus was placed on generalizations of the Rand index. In this article, we extend our prior work by (1) investigating the behavior of the soft Rand for comparing non-crisp, specifically possibilistic, partitions and (2) we demonstrate how the possibilistic Rand and visual assessment of (cluster) tendency (VAT) algorithm can be used to discover the number of actual clusters and coincident clusters for outputs from the possibilistic c-means (PCM) algorithm.

P308 *An Adaptive Hybrid Data Fusion Based Identification of Skeletal Muscle Force with ANFIS and Smoothing Spline Curve Fitting* [#245]

Parmod Kumar
Cheng-Hung Chen
Anish Sebastian
Madhavi Anugolu

Idaho State University, United States
Idaho State University, United States
Idaho State University, United States
Idaho State University, United States

Chandrasekhar Potluri
 Amir Fassih
 Yimesker Yihun
 Alex Jensen
 Yi Tang
 Steve Chiu
 Ken Bosworth
 D. S. Naidu
 Marco P. Schoen
 Jim Creelman
 Alex Urfer

Idaho State University, United States
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 Idaho State University, United States

Precise and effective prosthetic control is important for its applicability. Two desired objectives of the prosthetic control are finger position and force control. Variation in skeletal muscle force results in corresponding change of surface electromyographic (sEMG) signals. sEMG signals generated by skeletal muscles are temporal and spatially distributed that result in cross talk between adjacent sEMG signal sensors. To address this issue, an array of nine sEMG sensors is used with a force sensing resistor to capture muscle dynamics in terms of sEMG and skeletal muscle force. sEMG and skeletal muscle force are filtered with a nonlinear Teager-Kaiser Energy (TKE) operator based nonlinear spatial filter and Chebyshev type-II filter respectively. Multiple Takagi-Sugeno-Kang Adaptive Neuro Fuzzy Inference Systems (ANFIS) are obtained using sEMG as input and skeletal muscle force as output. Outputs of these ANFIS systems are fitted with smoothing spline curve fitting. To achieve better estimate of the skeletal muscle force, an adaptive probabilistic Kullback Information Criterion (KIC) for model selection based data fusion algorithm is applied to the smoothing spline curve fitting outputs. Final fusion based output of this approach results in improved skeletal muscle force estimates.

P309 A Functional-Link based Interval Type-2 Compensatory Fuzzy Neural Network for Nonlinear System modeling [#249]

Jyh-Yeong Chang
 Yang-Yin Lin
 Ming-Feng Han
 Chin-Teng Lin

National Chiao-Tung University, Taiwan
 National Chiao-Tung University, Taiwan
 National Chiao-Tung University, Taiwan
 National Chiao-Tung University, Taiwan

In this paper, the Functional-Link based Interval Type-2 Compensatory Fuzzy Neural Network (FLIT2CFNN) is a six-layer structure, which combines compensatory fuzzy reasoning method, and the consequent part is combined the proposed functional-link neural network with interval weights. The compensatory fuzzy reasoning method uses adaptive fuzzy operations of neuro-fuzzy systems that can make the fuzzy logic system more adaptive and effective. Initially, there is no rule in the FLIT2CFNN. A FLIT2CFNN is constructed using concurrent structure and parameter learning. The advantages of this learning algorithm are that it converges quickly and the obtained fuzzy rules are more precise. All of the antecedent part parameters and compensatory degree values are learned by gradient descent algorithm. Several simulation results show that the FLIT2CFNN achieves better performance than other feedforward type-1 and type-2 FNNs.

P310 Infrared Image Segmentation using Enhanced Fuzzy C-Means clustering for Automatic Detection Systems [#251]

Sitanshu Gupta
 Asim Mukherjee

Motilal Nehru National Institute of Technology, Allahabad, India
 Motilal Nehru National Institute of Technology, Allahabad, India

This paper proposes Enhanced Fuzzy C-means technique (EFCM) based infrared image segmentation and its broad application in Automatic detection systems. The EFCM based image segmentation is able to approximate the exact number of clusters present in the image. EFCM based segmentation is applied on various infrared images that can be used for automatic detection systems and compared with widely used clustering techniques such as K-means and EM. Clustering performance has been compared in terms of well-proven and widely accepted validation indices, Global Silhouette Index and Separation Index. The segments or clusters obtained from above mentioned clustering methods have been assessed visually. Automatic Detection Systems based on EFCM can help in reducing complexities present in conventional systems.

P311 Image-Correlation Data Association with Global Uncertainty Techniques [#274]

Stephen Stubberud
 Kathleen Kramer

Oakridge Technology, United States
 University of San Diego, United States

A data association technique for target tracking that uses image correlation is enhanced by incorporating uncertainty. The approach uses fuzzy logic to simplify the mapping of the uncertainty to a usable construct to adjust the image generation based on the uncertainty of the measurements. The application of the uncertainty mapping for two methods is developed. The first technique varies the size of the image based on uncertainty. The second modifies the phase variation range that is used to generate the elements in the tile. The techniques are compared to the baseline image correlation technique in a baseline target-tracking example.

P312 A Non-Singleton Interval Type-2 Fuzzy Logic System for Universal Image Noise Removal using Quantum-Behaved Particle Swarm Optimization [#291]

Daoyuan Zhai
 Minshen Hao
 Jerry Mendel

University of Southern California, United States
 University of Southern California, United States
 University of Southern California, United States

Removing Mixed Gaussian and Impulse Noise (MGIN) is considered to be very important in the domain of image restoration, but it is a somewhat more challenging topic than removing pure Gaussian or impulse noise.

Therefore, relatively fewer works have been published in this area. This paper proposes a Non-Singleton Interval Type-2 (IT2) Fuzzy Logic System (FLS) for MGIN removal, explains how it can be designed based on a Quantum-behaved Particle Swarm Optimization algorithm, and shows that it provides both quantitatively and visually much better results compared to other often-used non-fuzzy techniques as well as its Type-1 and singleton IT2 counterparts.

P313 Fuzzy Folksonomy-based Index Creation for e-Learning Content Retrieval on Cloud Computing Environments [#306]

Wen-Chung Shih
Chao-Tung Yang
Shian-Shyong Tseng

Asia University, Taiwan
Tunghai University, Taiwan
Asia University, Taiwan

Due to the trend of individualization and adaptation of e-Learning, more and more SCORM-compliant teaching materials are developed by institutes and individuals in different sites. Also, cloud computing environments are emerging as powerful infrastructures to support e-Learning applications. Therefore, how to rapidly retrieve SCORM-compliant documents on cloud computing environments has become an important issue. Creating an index from folksonomies has been investigated in previous researches; however, the involved uncertainty has not been addressed. This paper focuses on the fuzzy index creation problem for learning content retrieval. A bottom-up approach to constructing the fuzzy index is proposed. The index creation method has been implemented, and a synthetic learning object repository has been built on a Hadoop cloud platform to evaluate the proposed approach. Experimental results show that this method can increase precision of retrieval.

P314 Relationship between Intuitionistic Fuzzy Similarity Measures [#308]

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Adel M. Alimi
Robert I. John

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ENIS, Tunisia
De Montfort University, United Kingdom

Numerous similarity measures between intuitionistic fuzzy sets are proposed in literature using different approaches. In this paper, relationship between some existing intuitionistic fuzzy similarity and distance measures are investigated. These relations are paramount for the choice of a similarity or a distance measure and its application for any research topic.

P315 Decomposition of Term-Document Matrix Representation for Clustering Analysis [#316]

Jianxiong Yang
Junzo Watada

Waseda University, Japan
Waseda University, Japan

Latent Semantic Indexing (LSI) is an information retrieval technique using a low-rank singular value decomposition (SVD) of term-document matrix. The aim of this method is to reduce the matrix dimension by finding a pattern in document collection with concurrently referring terms. The methods are implemented to calculate the weight of term- document in vector space model (VSM) for document clustering using fuzzy clustering algorithm. LSI is an attempt to exploit the underlying semantic structure of word usage in documents. During the query-matching phase of LSI, a user's query is first projected into the term-document space, and then compared to all terms and documents represented in the vector space. Using some similarity measure, the nearest (most relevant) terms and documents are identified and returned to the user. The current LSI query-matching method requires computing the similarity measure about the query of every term and document in the vector space. In this paper, the Maximal Tree Algorithm is used within a recent LSI implementation to mitigate the computational time and computational complexity of query matching. The Maximal Tree data structure stores the term and document vectors in such a way that only those terms and documents are most likely qualified as the nearest neighbor to the query will be examined and retrieved. In a word, this novel algorithm is suitable for improving the accuracy of data miners.

P316 Visual-Based Guiding Method for Unmanned Helicopter Approaching to Landmark [#171]

Kuo-Hsien Hsia
Shao-Fan Lien
Juhng-Perng Su

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National Yunlin University of Science and Technology, Taiwan
National Yunlin University of Science and Technology, Taiwan

This paper proposes an image-guided method for estimating the position of an AUH (autonomous unmanned helicopter) from one captured landmark image. The proposed method is intended for application as auxiliary information for the guidance of an AUH during approach of a landmark based landing. The relation between the camera position and landmark image can be analyzed by projective geometry with the provision of sufficient landmark features. ANFIS is utilized for establishing the mapping relation and establishing a fuzzy model for efficient camera position estimation. The proposed method provides a highly accurate method of AUH guidance during landmark approach.

P317 On the Type-1 and Type-2 Fuzziness Measures for Thresholding MRI Brain Images [#200]

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Satheesh Kumar J.
Shanmuga Priya B.
Thilagavathy C.
Priya K.

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Bharathiar University, India
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Bharathiar University, India
Bharathiar University, India

The result of image thresholding is not always satisfactory due to the disturbing factors like vagueness, non-uniform illumination etc and to overcome these problems recently various researchers have proposed fuzzy image thresholding. The linear index of fuzziness for type-1 fuzzy sets by Zenzo et. al. and measure of

ultrafuzziness for type-2 fuzzy sets by Tizhoosh has difficulties in handling MRI brain images with one level of gray value as background and other two levels of grayness as white matter and gray matter. Hence this paper proposes new modified thresholding measures for MRI brain images using type-1 and type-2 fuzzy sets. The results show the effectiveness of the proposed modified thresholding measures.

P318 *A Fast Algorithm for Mining Frequent Closed Itemsets over Stream Sliding Window* [#587]

Show-Jane Yen
Cheng-Wei Wu
Yue-Shi Lee
Vincent S. Tseng
Chaur-Heh Hsieh

Ming Chuan University, Taiwan
National Cheng Kung University, Taiwan
Ming Chuan University, Taiwan
National Cheng Kung University, Taiwan
Ming Chuan University, Taiwan

Mining frequent patterns refers to the discovery of the sets of items that frequently appear in a transaction database. Many approaches have been proposed for mining frequent itemsets from a large database, but a large number of frequent itemsets may be discovered. In order to present users fewer but more important patterns, researchers are interested in discovering frequent closed itemsets which is a well-known complete and condensed representation of frequent itemsets. In this paper, we propose an efficient algorithm for discovering frequent closed itemsets over a data stream. The previous approaches need to do a large number of searching operations and computations to maintain the closed itemsets when a transaction is added or deleted. Our approach only performs few intersection operations on the transaction and the closed itemsets related to the transaction without doing any searching operation on the previous closed itemsets. The experimental results show that our approach significantly outperforms the previous approaches.

P319 *Neuro-Fuzzy System Design using Differential Evolution with Local Information* [#313]

Lin Chin-Teng
Han Ming-Feng
Lin Yang-Yin
Liao Shih-Hui
Chang Jyh-Yeong

National Chiao Tung University, Taiwan
National Chiao Tung University, Taiwan
National Chiao Tung University, Taiwan
National Chiao Tung University, Taiwan
National Chiao Tung University, Taiwan

This paper proposes a DE with local information (DELI) for TSK-type NFS optimization. The DELI consider neighborhood between each individual to keep the diversity of population. An adaptive parameter tuning based on 1/5 rule is used to tradeoff between local search and global search. For structure-learning algorithm, the online cluster algorithm is used for rule generation. The structure learning algorithm generates a new rule which compares the fire strength. Initially, there is no rule in NFS model. The rules are automatically generated by fuzzy measure. For parameter learning, the parameters are optimized by DELI algorithm. Finally, the proposed NFS with DELI model (NFS-DELI) is applied in chaotic sequence prediction problem. Results of this paper demonstrate the effectiveness of the proposed NFS-DELI model.

P320 *Stability Analysis and Synthesis of Markovian Jump Nonlinear Systems with Incomplete Transition Descriptions via Fuzzy Control* [#325]

Min Kook Song
Jin Bae Park
Young Hoon Joo

Yonsei University, Republic of Korea
Yonsei University, Republic of Korea
Kunsan National University, Republic of Korea

This paper is concerned with exploring an extended approach for the stability analysis and synthesis for Markovian jump nonlinear systems (MJNLSs) with incomplete transition descriptions via fuzzy control. The Takagi-Sugeno(T-S) fuzzy model is employed to represent the Markovian jump nonlinear systems. In this paper, not all the elements of the rate transition matrices (RTMs) are assumed to be known. By fully considering the properties of the RTMs and the convexity of the uncertain domains, sufficient criteria of stability and stabilization are obtained. The proposed stability conditions are much less conservative than most of the existing results and stabilization conditions with a mode-dependent fuzzy controller are derived for Markovian jump fuzzy systems (MJFSs) in terms of linear matrix inequalities (LMIs). Finally, illustrative numerical examples are provided to demonstrate the effectiveness of the proposed approach.

P321 *Bio-inspired computing of vision - fuzzy and neuromorphic processing* [#426]

Woo Joon Han
Il Song Han

KAIST, Republic of Korea
KAIST, Republic of Korea

This paper describes the early vision of bio-inspired neuromorphic system enhanced by fuzzy processing, mimicking the primitive behaviour of visual cortex. The proposed bio-inspired system exhibits the biologically plausible function of mimicking the cat's visual cortex experimentation of Hubel and Wiesel. The neuromorphic implementation of vision is inspired by the directional visual signal selectivity of cortex and the CMOS spiking neuron based on Hodgkin- Huxley formalism. The membership function is introduced to improve the early vision and the improvement is demonstrated for robust applications, based on the recognition of human head figures.

(SS10-1) Special Session: Medical and Wellness Engineering

Tuesday, June 28, 5:00PM-7:00PM, Room: Swan, Chair: Yutaka Hata

5:00PM *A Testicular Tubule Evaluation Method by Ultrasonic Array Probe* [#89]

Yuya Takashima

University of Hyogo, Japan

Kei Kuramoto
Kobashi Syoji
Hata Yutaka
Ishikawa Tomomoto

University of Hyogo, Japan
University of Hyogo, Japan
University of Hyogo, Japan
Ishikawa Hospital, Japan

This paper describes a testicular tubules evaluation using 1.0MHz ultrasonic array probe. In this system, we evaluate a diameter of testicular tubules. We employ an ultrasonic array probe with the center frequency of 1.0MHz. We employ evaluation index that cumulative relative frequency of amplitude values. In the experiment, we employ 24 nylon lines as the testicular tubules. Amplitude of large nylon line echo is larger than that of small nylon echo. For the evaluation, we calculate cumulative relative frequency amplitude of acquisition data. Fuzzy if-then rules are made by the cumulative relative frequency of large and small lines. We evaluate a rate of large lines among all lines by using the fuzzy MIN-MAX center-of-gravity method. In this experiment, the proposed method successfully evaluated the rate of the large lines. We changed the rate of large lines in 24 nylon lines, and tested our method 20 times for each rate. We evaluated the rate with 5.77 % in mean absolute error.

5:20PM Fuzzy RASP Determination by 1kHz Ultrasonic Probe for Total Hip Arthroplasty [#98]

Naomi Yagi
Yoshitetsu Oshiro
Osamu Ishikawa
Yutaka Hata
Nao Shibamura

Ishikawa Hospital, Japan
Ishikawa Hospital, Japan
Ishikawa Hospital, Japan
University of Hyogo, Japan
Kobe Kaisei Hospital, Japan

This paper describes an effective system of selecting most suitable rasp for the patients. We suggest the ultrasonic system with a single ultrasonic probe. Firstly, we make a knock to the upper point of the rasp inserted with a hammer which has the trigger signals. We detected the acoustic signals with the knocking signals. An ultrasonic probe is fixed in the upper side of the rasp with a built-in magnet. A personal computer got the acoustic data. In the surgery, the surgeon tries to adapt for the patient from the small size rasp to the larger size rasp in turn. There is a correlation between the degree of tightening and the attenuation time of acoustic signal for the knocked sound by a hammer when inserting the rasp. The higher tightened degree implies shorter attenuation period. At the present time, the surgeon's experience chooses the suitable rasp. Therefore, we suggest the rasp determination system which selects the suitable rasp by fuzzy inference which dynamically corresponds for each patient. As the result, we successfully determined the suitable rasp in comparison to the results obtained from the practical surgery. We could indicate the indexes in order to judge how degree the rasp fits in the clinical treatment.

5:40PM A Fuzzy Logic Approach to Predict Human Body Weight Based on AR Model [#88]

Hideaki Tanii
Hiroshi Nakajima
Tsuchiya Naoki
Kei Kuramoto
Syoji Kobashi
Yutaka Hata

University of Hyogo, Japan
OMRON Corporation, Japan
OMRON Corporation, Japan
University of Hyogo, Japan
University of Hyogo, Japan
University of Hyogo, Japan

This paper proposes a body weight prediction method using autoregressive (AR) model and Fuzzy-AR model. First, we employ 6 persons body weight change data of 365 days. AR model predicts body weight of a day from these time-series data. We calculate an order of AR model for each person by Akaike's Information Criterion. In the experiment, we predicted body weight change of next day for those subjects. The AR model obtained 0.798 in correlation coefficient between predicted and truth values. Second, we propose a Fuzzy-AR model that predicts body weight of next p days from last p days, where p is the order of AR model. In this method, we propose a Fuzzy-AR model with the fuzzy membership function using last p days data. In the experiment, the Fuzzy-AR model obtained 0.558 in correlation coefficient on 2 subjects.

6:00PM Consideration of Invasion, Intrusion, and Consciousness in Biomedical Sensing with Uncertainty [#209]

Hiroshi Nakajima
Naoki Tsuchiya
Yutaka Hata

Omron Corporation, Japan
Omron Corporation, Japan
University of Hyogo, Japan

Both burden of human and performance of sensing technology should be carefully considered in bioinstrumentation. The article proposes the ideas of invasion, intrusion, and consciousness in biomedical sensing to improve its comfort and performance. Consideration of the three concepts is very important to realize burden-reduction of human. They also save sensing accuracy when sensing targets and sensor heads are influenced by invasion, intrusion, or consciousness during sensing. Realizing noninvasive, nonintrusive, and unconscious sensing requires solutions against uncertainty in sensory signals and estimation models. Sensory signals from these sensing methods might superimpose various types of signals besides target one. Target signals would be appropriately extracted by the causal analysis-based model. Case studies were investigated by considering the method and experimental results were reported in the article.

6:20PM Load Forecasting using Fuzzy Wavelet Neural Networks [#273]

Mahdi Amina
Vassilis Kodogiannis

University of Westminster, United Kingdom
University of Westminster, United Kingdom

Load forecasting is an important component for power system energy management system. Precise load forecasting helps the electric utility to make unit commitment decisions, reduce spinning reserve capacity and schedule device maintenance plan properly. This paper presents the development of a novel fuzzy wavelet neural network model and validates its prediction on the short-term electric load forecasting of the Power System of the Greek Island of Crete. In the proposed scheme, a wavelet neural network has replaced the classic TSK model in the consequent part, while subtractive clustering has been applied to the definition of fuzzy rules. The forecasting error statistical results, corresponding to the minimum and maximum load time-series, indicate that the proposed load forecasting model provides more accurate forecasts, compared to conventional neural networks models.

6:40PM Fuzzy Modelling Using a New Compact Fuzzy System: A Special Application to the Prediction of the Mechanical Properties of Alloy Steels [#593]

Qian Zhang
Mahdi Mahfouf

The University of Sheffield, United Kingdom
The University of Sheffield, United Kingdom

In high-dimensional modelling cases, a fuzzy modelling approach based on the grid-partitioning of fuzzy sets always meets great challenges, as it cannot avoid the problem of introducing a huge number of fuzzy rules. To tackle this issue, a new grid-partitioning based fuzzy modelling paradigm is proposed in this paper to construct a compact fuzzy system by including 'short fuzzy rules', in which only a few but strategic premises are used. In the proposed approach, the generation of fuzzy rules is data-orientated, a consideration which can greatly reduce the computational complexity. A new framework for fuzzy reasoning and defuzzification is also devised, which employs some archived reference data to help choose the most suitable fuzzy rules. In material engineering, describing the behaviour of mechanical properties of alloys is often a high-dimensional modelling problem, which involves the complexity of materials' chemical composites and their underlying physical processing mechanisms. In this paper, the proposed approach was successfully applied to generate models of ultimate tensile strength of alloy steel. Compared with the standard grid-partitioning based fuzzy modelling paradigms, the new method shows an improvement in both complexity and interpretability. Compared with the clustering-based fuzzy modelling approaches, the proposed method can achieve the same accuracy level and is more transparent.

(SS09) Special Session: Applications of Fuzzy Logic to Awareness Promotion

Tuesday, June 28, 5:00PM-7:00PM, Room: Peacock, Chair: Kiyota Hashimoto

5:00PM Agent Simulation for Contents Evaluation with User Models for Hierarchical Knowledge Relations [#356]

Kiyota Hashimoto
Kazuhiro Takeuchi

Osaka Prefecture University, Japan
Osaka Electro-Communication University, Japan

To construct an appropriate e-learning system, it is inevitable to evaluate it by testing it with real human learners, but it naturally implies some sacrifices on the part of learners. To minimize the risk, some computational simulative evaluations are desirable. In this paper, we propose a multi-layered multi-agent simulation model for learner's growth through using an e-learning system. As a typical example of complex learning objects, we employ the task of learning presentation skills for which we are constructing a comprehensive learner support system and learners' data, and the knowledge model and learner growth model are prototypically proposed. By a preparatory experiment, our attempt, though it is still in its fancy, is shown to be on the right track.

5:20PM Giving Awareness of Maturity by Capability Assessment [#607]

Yi-Ling Kuo
Yu Nakamura
Masayuki Sakoda
Hiroshi Tsuji
Chang-Shing Lee

National University of Tainan, Taiwan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
National University of Tainan, Taiwan

Based on knowledge management and the spiral learning model for E- Learning, this paper proposes an interactive system, SPIral Capability Enhancement (SPICE) support system, to define two subjects: Human Education and Information Security. A student can review his situation on the subject to get feedback to evaluate his own capabilities based on comparisons. Basic idea of the proposed system originates in the pineapples of Capability Maturity Model Integration (CMMI) to allow the organizations and the systems to do the personal learning. This paper also discusses the possibility to adopt fuzzy markup language (FML) to infer the capability of maturity model which let the teachers as well as students know their capability of maturity model. Keywords: E-Learning; Knowledge Management; CMMI; FML

5:40PM Medical Care System Evaluation Based on DEA Of Prefectures In Japan [#335]

Kenji Fukuoka
Shingo Aoki
Yukie Majima

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Recently, the shortage of medical employees connects with the regional and medical disparity, and it becomes a bigger problem. However, not only the number of employees but also the enhancement of the equipment is critical to offer the better medical service. And the regional and medical disparity should be considered by data

including employees' and equipment's information. Therefore, in order to reveal the disparity and its cause, this paper applies the following three methods to data published by Ministry of Health: (1) DEA/BCC model estimates the disparity between prefectures, (2) "RM-DEA using Cone-Ratio approach" estimates the cause of the disparity, and (3) Improved MF-DEA (Multi-Frontier based DEA) model estimates the disparity between eastern and western Japan. As a result, the disparity and its cause have been shown by three numerical experiments.

6:00PM Structured DEA Model Considering Relation among Input and Output Elements [#331]

Yamasaki Shingo
Aoki Shingo

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Data Envelop Analysis (DEA) is method for evaluating management efficiency of DMU (Decision Making Unit). DEA can analyze DMU's characteristic of data by assigning variable weight to each input and output elements. However the more the number of input and output elements is, the more complex assigning weight is. So, there is a problem that when the number of input and output elements is so large, it is difficult to analyze DMU's characteristics. This paper proposed new DEA model considering relation between input and output elements in order to analyze DMU's characteristics more easily. This model can limit assigned weights. Therefore, above problem can be solved. The power of the proposed method is examined by applying data set of Japanese professional baseball player's result in 2010.

6:20PM Component-Based Search Engine for Blogs [#490]

Sachio Hirokawa
Chengjiu Yin
Tetsuya Nakatoh

Kyushu University, Japan
Kyushu University, Japan
Kyushu University, Japan

A wrapper is a program that selectively extracts a necessary part (component) from Web pages. Automatic or semi-automatic wrapper construction is crucial to achieve a fine grained search engine for Web pages. However, this is not an easy task to achieve. This paper proposes a component-based search engine in which the content components gain a high score in the search results. Thus, the required segments for a query can be obtained without using a wrapper.

6:40PM Influence of the Space Segmentation and its Adaptive Automation for Reinforcement Learning [#290]

Akira Notsu
Yuki Komori
Katsuhiko Honda
Hidetomo Ichihashi

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

We performed a single pendulum simulation and observed the influence of the situation space segmentation pattern in reinforcement learning processes in order to propose a new adaptive automation for situation space segmentation. Usually, in real-world reinforcement learning processes, infinite states and actions and the uncertainty of the optimum solution make the learning process more difficult than the finite Markov decision process. In a numerical experiment, a single pendulum simulation is performed in order to demonstrate the influence and adaptability of the proposed method.

(SS08) Special Session: Innovative Fuzzy Approaches to Management Engineering

Tuesday, June 28, 5:00PM-7:00PM, Room: Phoenix, Chair: Junzo Watada

5:00PM Learning with Imbalanced Datasets using Fuzzy ARTMAP-based Neural Network Models [#43]

Shing Chiang Tan
Junzo Watada
Zuwarie Ibrahim
Marzuki Khalid
Wen Jau Lee

Multimedia University, Malaysia
Waseda University, Japan
University of Technology Malaysia, Malaysia
University of Technology Malaysia, Malaysia
ATTD Automation (APAC) Pathfinding Intel Technology Sdn. Bhd., Malaysia

One of the main difficulties in real-world data classification and analysis tasks is that the data distribution can be imbalanced. In this paper, a variant of the supervised learning neural network from the Adaptive Resonance Theory (ART) family, i.e., Fuzzy ARTMAP (FAM) which is equipped with a conflict-resolving facility, is proposed to classify an imbalanced dataset that represents a real problem in the semiconductor industry. The FAM model is combined with the Dynamic Decay Adjustment (DDA) algorithm to form a hybrid FAMDDA network. The classification results of FAM and FAMDDA are presented, compared, and analyzed using several classification metrics. The outcomes positively indicate the effectiveness of the proposed FAMDDA network in undertaking classification problems with imbalanced datasets.

5:20PM Re-Scheduling the Unit Commitment Problem in Fuzzy Environment [#18]

Bo Wang
You Li
Junzo Watada

Waseda University, Japan
Waseda University, Japan
Waseda University, Japan

The conventional prediction of future power demands are always made based on the historical data. However, the real power demands are affected by many other factors as weather, temperature and unexpected

emergencies. The use of historical information alone cannot well predict real future demands. In this study, the experts' opinions from related fields are taken into consideration. To deal the uncertainty of historical data and imprecise experts' opinions, we employ fuzzy variables to better characterize the forecasted future power loads. The conventional unit commitment problem (UCP) is updated here by considering the spinning reserve costs in a fuzzy environment. As the solution, we proposed a heuristic algorithm called local convergence averse binary particle swarm optimization (LCAPSO) to solve the UCP. The proposed model and algorithm are used to analyze several test systems. The comparisons between the proposed algorithm and the conventional approaches show that the LCA-PSO performs better in finding the optimal solutions.

5:40PM *Building a Fuzzy Multi-objective Portfolio Selection model with Distinct Risk Measurements* [#19]

You Li

Bo Wang

Junzo Watada

Waseda University, Japan

Waseda University, Japan

Waseda University, Japan

Based on portfolio selection theory, this study proposes an improved fuzzy multi-objective model that can evaluate the invest risk exactly and increase the probability of obtaining the expected return. In building the model, fuzzy Value-at-Risk is used to evaluate the exact future risk, in term of loss. The VaR can directly reflect the greatest loss of a selection case under a given confidence level. On the other hand, variance is utilized to make the selection more stable. This model can provide investors with more significant information in decision-making. To better solve this model, an improved particle swarm optimization algorithm is designed to mitigate the conventional local convergence problem. Finally, the proposed model and algorithm are exemplified by some numerical examples. Experiment results show that the model and algorithm are effective in solving the multi-objective portfolio selection problem.

6:00PM *Statistic Test on Fuzzy Portfolio Selection Model* [#65]

Pei-Chun Lin

Junzo Watada

Berlin Wu

Waseda University, Japan

Waseda University, Japan

National Chengchi University, Taiwan

Markowitz's mean-variance model is based on probability distribution functions which have known or were assumed as some kinds of probability distribution functions. When our data are vague, we can't know the underlying distribution functions. The objective of our research was to develop a method of decision making to solve portfolio selection model by statistic test. We used central point and radius to determine the fuzzy portfolio selection model and statistic test. Empirical studies were presented to illustrate the risk of fuzzy portfolio selection model with interval values. We can conclude that it is more explicit to know the risk of portfolio selection model. According to statistic test, we can get a stable expected return and low risk investment in different choose K.

6:20PM *An Approach Based on Takagi-Sugeno Fuzzy Inference System Applied to the Operation Planning of Hydrothermal Systems* [#279]

Ricardo Rabelo

Ricardo Fernandes

Adriano Carneiro

Rosana Braga

University of Sao Paulo, Brazil

University of Sao Paulo, Brazil

University of Sao Paulo, Brazil

University of Sao Paulo, Brazil

The operation planning in hydrothermal systems with great hydraulic participation, as it is the case of Brazilian system, seeks to determine an operation policy to specify how hydroelectric plants should be operated, in order to use the hydroelectric resources economically and reliably. This paper presents an application of Takagi-Sugeno Fuzzy Inference Systems to obtain an operation policy (PBFIS - Policy Based on Fuzzy Inference Systems) that follows the principles of the optimized operation of reservoirs for electric power generation. PBFIS is obtained through the application of an optimization algorithm for the operation of hydroelectric plants. From this optimization the relationships between the stored energy of the system and the volume of the reservoir of each plant are extracted. These relationships are represented in the consequent parameters of the fuzzy linguistic rules. Thus, PBFIS is used to estimate the operative volume of each hydroelectric plant, based on the value of the energy stored in the system. In order to verify the effectiveness of PBFIS, a computer simulation model of the operation of hydroelectric plants was used so as to compare it with the operation policy in parallel; with the operation policy based on functional approximations; and also with the result obtained through the application of the optimization of individualized plants' operation. With the proposed methodology, we try to demonstrate the viability of PBFIS' obtainment and application, and with the obtained results, we intend to illustrate the effectiveness and the gains which came from it.

6:40PM *Fuzzy Cognitive Maps in estimating the repercussions of oil/gas exploration on politico-economic issues in Cyprus* [#495]

Costas Neocleous

Maria Papaioannou

Christos Schizas

Cyprus University of Technology, Cyprus

University of Cyprus, Cyprus

University of Cyprus, Cyprus

The politico-economic dynamics, in relation to different scenarios involving the finding and exploitation of oil/gas in the exclusive economic zone of Cyprus has been modeled and examined through the use of suitable fuzzy cognitive maps. In the interrelated dynamics, various important dynamical parameters have been taken into account, reflecting the interests of the republic of Cyprus, as well as the interests of the Greek and Turkish Cypriot communities. In some respects these interests are antagonistic, while in others could be cooperative. The

interests of other countries involved in the Cyprus problem have also been taken into account. These are primarily Greece, Turkey, United Kingdom, USA, Russia, Israel and the European Union. The main parameters involved in the interrelated dynamics are nationalism, religiousness, knowledge of history, level of educational development, tourism, unemployment, external debt, oil extraction, Anatolian settlers, and the general interests of the countries involved and those of the two communities. The system that has been developed can be used to study the effects of a change in any parameter, or a combination of parameters, on the stability and growth of the remaining parameters. Different scenarios on the effects on economies, politics and military involvement have been implemented, observed and appraised.

(SS37) Special Session: Fuzzy Logic Based Computer Vision and Its Applications to Guidance and Control

Tuesday, June 28, 5:00PM-7:00PM, Room: Crane, Chair: Kuo-Hsien Hsia

5:00PM *The Picked and Placed Control of the Objects for a Pneumatic X-Y Servo Platform by Integrating Image Processing Techniques and a Fuzzy Sliding Mode Controller Design* [#390]

Hong-Ming Chen
Yi-Ping Shyu
Chun-Sheng Shen
Hong-Jia Yang

Chien-kuo Technology University, Taiwan
Chien-kuo Technology University, Taiwan
Chien-kuo Technology University, Taiwan
Chien-kuo Technology University, Taiwan

In this paper, integrated a image processing techniques and a fuzzy sliding mode control design for a pneumatic X-Y servo platform system was proposed to realize the picked and placed control of the objects. The key feature of this control scheme is by means of immediately modulated the boundary layer sliding surface and fuzzy function design to improve the steady state error of time response effect. Then, use the image pattern recognition technique to determine the loading and unloading object positions, and drive the Z axle device to active the picking and placing control of the objects to obtain automatic loading-unloading device performance. The validity of the proposed control scheme is verified through practical testing on an experimental pneumatic cylinder X-Y axle servo system device and CCD video camera. In the cases of the step position command input, the test results show that the proposed control scheme and object image pattern recognition technique are capable of reaching the picking and placing precision control of the object.

5:20PM *The Dynamic Measurement System Design for Stewart Platform by Using Digital Image Processing Method* [#161]

Yu Ker-Wei
Zhou Yu-Quan

National Kaohsiung Marine University, Taiwan
National Kaohsiung Marine University, Taiwan

In this study, the digital image processing method in the dynamic measurement system for Stewart platform is investigated. The measured signals of the platform based on the digital image processing method represent as the feedback signal of control system. In the study, the accuracy of control system is reasonable by capturing the image information of platform by using the digital image processing method and getting the detail of platform action directly.

5:40PM *Orientation control of hovercraft systems via an SMFLC and Image-Guided Techniques* [#318]

Chun-Chieh Wang

Chienkuo Technology University, Taiwan

This paper is concerned with the control of a hovercraft vessel using a sliding mode fuzzy logic control and image-guided techniques. Firstly, we introduce the R/C hovercraft type vessel dynamics. Secondly, the sliding mode fuzzy logic control (SMFLC) is proposed in this paper. A significant feature is that the transient response during the reaching phase has been remarkably improved by the proposed control. Finally, an image-guided technique is presented. To illustrate the effectiveness of the proposed method, we choose the R/C hovercraft vessel as the experimental system. Simulation results showed good responses via the proposed techniques.

6:00PM *PSO-based Estimation for Gaussian Blur in Blind Image Deconvolution Problem* [#529]

Yang-Chih Lai
Chih-Li Huo
Yu-Hsiang Yu
Tsung-Ying Sun

National Dong Hwa University, Taiwan
National Dong Hwa University, Taiwan
National Dong Hwa University, Taiwan
National Dong Hwa University, Taiwan

This study focuses on Gaussian blur estimation for blind image deconvolution (BID) problem. In BID problem, it only uses blurred image and less information of point spread function (PSF) to restore the received the blurred image. Due to restore the received image, the first step is to identify the proper PSF model. The received image does not uniquely define the PSF. Nevertheless these are many applications where the received image have been blurred either by an unknown or a partially know PSF. Therefore, this paper choose Gaussian blur image for further research, which utilized the particle swarm optimization algorithm to search for the unknown PSF. The objective function for searching the parameters of PSF is based on edge detection and image morphology. It can identify the parameters of PSF exactly. Finally, the feasibility and validity of proposed algorithm are demonstrated by several simulations.

6:20PM Fuzzy integrals for the aggregation of confidence measures in speech recognition [#494]

Julie Mauclair
 Laurent Wendling
 David Janiszek

University of Paris Descartes, France
 University of Paris Descartes, France
 University of Paris Descartes, France

This paper presents a study on merging confidence measures using fuzzy logic. Instead of the previous approaches using the notion of probability, we propose to observe the uncertainty of the recognition hypotheses and the notion of possibility thanks to fuzzy reasoning. Four different confidence measures are developed, coming from different parts of a speech recognizer. Various merging methods are studied to improve the performance of the confidence measures. The methods are evaluated in terms of Confidence Error Rate (CER) and in terms of their Detection Error Tradeoff (DET) curves on a French broadcast news corpus. They are compared to some fuzzy logic aggregation techniques among which the technique based on the Choquet Integral yields a significant improvement in terms of CER.

6:40PM Active Tracking Using Intelligent Fuzzy Controller and Kernel-Based Algorithm [#400]

Moteaal Asadi Shirzi
 M.R. Hair-Yazdi

University of Tehran, Iran
 University of Tehran, Iran

This paper introduces a practical system by combining an Intelligent Fuzzy Controller and vision processing algorithm to obtain an efficient active tracker. Target tracking performance is heavily dependent on a good blend of vision algorithm and control. Because of performance and computational complexity, many visual tracking algorithms cannot be linked with control systems in the real-time tracking. Robustness and speed are the bottlenecks of current visual tracking algorithms. Here, the target's visual model is used along with a kernel-based searching algorithm and a motion detection module to predict the target position. A model update is also incorporated to recognize when the target's appearance is changing due to variations in its position. An Intelligent Fuzzy Controller (IFC) is also synthesized to reach control performance objectives. The IFC used in this tracking system not only helps to track the target accurately in different situations, but also tries to find the target's presence after track loss. Additionally, the parallel processing technique has also been deployed to provide the desired accuracy and speed in real-time tracking. The idea has been implemented in an active camera system to track moving targets.

(SS17-1) Special Session: Practical and Applications Aspects of Type-2 Fuzzy Logic Systems

Tuesday, June 28, 5:00PM-7:00PM, Room: Egret, Chair: Woei Wan Tan

5:00PM An Interval Type 2 Fuzzy Approach to Multilevel Image Segmentation [#591]

Debanga Raj Neog
 Muhammad Amjad Raza
 Frank Chung-Hoon Rhee

Indian Institute of Technology Guwahati, India
 Hanyang University, Republic of Korea
 Hanyang University, Republic of Korea

In this paper, an interval type 2 (IT2) fuzzy entropy based approach is used to compute optimum thresholds for multilevel gray scale image segmentation. By finding the maximum IT2 fuzzy entropy of the gray scale image, the optimum thresholds are computed. A termination criterion for multilevel segmentation is also proposed based on the range of computed entropy values of the images. Several experimental results are shown to demonstrate the performance of our proposed algorithm which outperforms type 1 fuzzy based methods.

5:20PM Navigation System of Mobile Robot in an Uncertain Environment Using Type-2 Fuzzy Modelling [#585]

Sittichok Junratanasiri
 Sansanee Auephanwiriyaikul
 Nipon Theera-Umpon

Chiang Mai University, Thailand
 Chiang Mai University, Thailand
 Chiang Mai University, Thailand

A navigation system of a mobile robot in an uncertain environment is one of a popular research area. There are both static and dynamic obstacles in an uncertain environment. If a robot finds a static obstacle, it can select a safe path very easily. However, a dynamic obstacle can move very randomly in the global map. Hence, in this paper, we propose a navigation system in an uncertain environment focusing on dynamic obstacles for a mobile robot. The future position of a dynamic obstacle is modeled using a fuzzy vector. The dangerous region of that obstacle is then computed. Then the free road candidates are computed based on those dangerous regions found. Then the best free road is selected. Finally, the interval type-2 fuzzy logic system is utilized to compute the velocity and angular velocity of a mobile robot. The experiment results show that our navigation system worked in an uncertain environment, i.e., an environment with an obstacle with stable velocity and angular velocity, an environment with an obstacle with random velocity, and an environment with several obstacles with both condition.

5:40PM Multi-attribute Decision Making Models under Interval Type-2 Fuzzy Environment [#95]

Weize Wang
 Xinwang Liu

Southeast University, China
 Southeast University, China

Interval type-2 fuzzy sets, each of which is characterized by the footprint of uncertainty, are a very useful means to depict the decision information in the process of decision making. In this article, we investigate the decision making problems in which all the information provided by the decision maker is expressed as interval type-2

fuzzy decision matrix where each of the elements is characterized by interval type-2 fuzzy set, and the information about attribute weights is partially known, which may be constructed by various forms. We first utilize the average centroid measure to calculate the average centroid of each attribute value and construct the average centroid matrix of the interval type-2 fuzzy decision matrix. Based on the average centroid matrix and the given attribute weight information, we establish some optimization models to determine the weights of attributes. Furthermore, we develop a procedure to identify the best alternative(s). Finally, we give an illustrative example.

6:00PM *A Perceptual Computer Based Method for Supplier Selection Problem* [#186]

Han Shilian
Liu Xinwang

Nanjing University of Finance and Economics, China
Southeast University, China

The supplier selection is one of the most important components of production and logistics management for many companies. The supplier selection problem involves different kinds of words in which all of the criteria are weighted using one kind of words and the performance evaluations for all sub-criteria are another kind of words. How to aggregate these words without losing information is a very daunting task using a type-1 fuzzy set (T1 FS) approach. This paper applies a new methodology-- Perceptual Computer (Per-C)--to help solve this hierarchical group multi-criteria decision making problem. The Per-C has three components: encoder, computing with words (CWW) engine and decoder. First, the interval approach (IA) is used to obtain interval type-2 fuzzy set (IT2 FS) word models for the words in a pre-specified vocabulary. Second, a linguistic weighted average (LWA) is used to aggregate all the words modeled by IT2 FSs. Finally, a centroid-based ranking method is used to rank the supplier selections, and a similarity measure is used to obtain similarities of the supplier selections. A committee of judges organized with P decision makers and K experts decides the winning supplier selection as the one with the highest ranking and least similarity to other suppliers.

(SS19) Special Session: Fuzzy Inference Systems-Theory and Applications

Tuesday, June 28, 5:00PM-7:00PM, Room: Swallow, Chair: Hirosato Seki

5:00PM *Type-2 Fuzzy Functional Inference Method* [#573]

Hirosato Seki
Masaharu Mizumoto

Osaka Institute of Technology, Japan
Osaka Electro-Communication University, Japan

This paper proposes a type-2 fuzzy functional inference method which extends fuzzy sets of the antecedent parts to type-2 fuzzy sets. This paper next explains that the type-2 fuzzy functional inference method can be classified to the three models: Model 1 is most common method, and Model 2 is a special case of Model 1. We show that the inference results of both Models 1 and 2 can be easily obtained from the area of fuzzy sets of the consequent parts and center of gravity. Moreover, we state that Model 3 can obtain different results compared with the simplified fuzzy inference method and T-S inference method.

5:20PM *On Extension of Consequent Parts of T-S Inference Model* [#553]

Hirosato Seki
Masaharu Mizumoto

Osaka Institute of Technology, Japan
Osaka Electro-Communication University, Japan

This paper discusses the extension of consequent parts of T-S inference model. First, it proposes an extended T-S inference model in which the coefficients of consequent parts of the fuzzy rules are extended from constants to functions. It also shows the property of the proposed model from the point of view of the equivalence and the monotonicity, by using simplified model of the proposed model.

5:40PM *Optimization of Gaussian Fuzzy Membership Functions and Evaluation of the Monotonicity Property of Fuzzy Inference Systems* [#118]

Tay Kai Meng
Lim Chee Peng

UNIMAS, Malaysia
USM, Malaysia

In this paper, two issues relating to modeling of a monotonicity-preserving Fuzzy Inference System (FIS) are examined. The first is on designing or tuning of Gaussian Membership Functions (MFs) for a monotonic FIS. Designing Gaussian MFs for an FIS is difficult because of its spreading and curvature characteristics. In this study, the sufficient conditions are exploited, and the procedure of designing Gaussian MFs is formulated as a constrained optimization problem. The second issue is on the testing procedure for a monotonic FIS. As such, a testing procedure for a monotonic FIS model is proposed. Applicability of the proposed approach is demonstrated with a real world industrial application, i.e., Failure Mode and Effect Analysis. The results obtained are analysis and discussed. The outcomes show that the proposed approach is useful in designing a monotonicity-preserving FIS model.

6:00PM *Refinement CTIN for General Type-2 Fuzzy Logic Systems* [#417]

Thanh Long Ngo

Le Quy Don Technical University, Hanoi, Viet Nam

Triangulated irregular network (TIN) has been used for representing general type-2 fuzzy sets and gained some results of reducing computational complexity. In general, TIN based algorithms are still complex and difficulty to deploy in applications. So, an approach based on refinement constraint TIN (CTIN) for representing general type-2 fuzzy set is proposed. The paper deals with the use CTIN in general type-2 fuzzy logic systems (GT2FLS).

Operations are developed for general type-2 fuzzy sets. A T2FLS is designed and implemented in comparing previous approaches under an application of robot navigation.

6:20PM *On a Strengthening Connective for Flexible Database Querying* [#7]

Patrick Bosc
Olivier Pivert

University of Rennes 1, France
University of Rennes 1, France

In most of query languages, conjunctive and disjunctive combinations of conditions remain the usual way for aggregation. Fuzzy query languages also offer trade-off operators, such as means in order to compensate between elementary conditions. In this paper, we investigate a new type of condition basically founded on the interaction between two predicates, thus enriching the panoply of tools the user is provided with and enhancing the power of query languages.

Wednesday, June 29

(SS02-2) Special Session: Evolutionary Fuzzy Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Swan, Chair: Rafael Alcalá

8:00AM *Studying the Behavior of a Multiobjective Genetic Algorithm to design Fuzzy Rule-Based Classification Systems for Imbalanced Data-Sets* [#189]

Pedro Villar
Alberto Fernandez
Francisco Herrera

University of Granada, Spain
University of Jaen, Spain
University of Granada, Spain

This paper studies the behavior of a multiobjective Genetic Algorithm for jointly performing a feature selection and granularity learning for Fuzzy Rule-Based Classification Systems in the scenario of imbalanced data-sets. We refer to imbalanced data-sets when the class distribution is not uniform, a situation that it is present in many real application areas. We consider two different measures, one for the precision of the model and other for its complexity as the two objectives to optimize. In one previous approach, we aggregate these two measures in a single-objective Genetic Algorithm, and thus, a multiobjective approach of that Genetic Algorithm would yield a set of models with different trade-off between high accuracy and low complexity rather than a unique model, provided by the single-objective Genetic Algorithm. The experimental analysis, carried out over a wide range of imbalanced data-sets, shows that our approach is able to obtain a set of models with good trade-off between the two objectives considered but it is an open problem how to select the solution with best prediction ability from the whole set of solutions obtained.

8:20AM *On the Cooperation of Interval-Valued Fuzzy Sets and Genetic Tuning to Improve the Performance of Fuzzy Decision Trees* [#258]

Jose Antonio Sanz
Alberto Fernandez
Humberto Bustince
Francisco Herrera

Universidad Publica de Navarra, Spain
University of Jaen, Spain
Universidad Publica de Navarra, Spain
University of Granada, Spain

Fuzzy decision trees are widely employed to face classification problems since they combine the high interpretability given by the decision tree and the capability of management of the uncertainty inherent to fuzzy logic. However, the success of fuzzy systems in general depends, to a large degree, on the choice of the membership functions. For this reason, we propose to model the linguistic labels by means of Interval-Valued Fuzzy Sets to take into account the ignorance related to their definition. On the other hand, we define an evolutionary method to tune the shape of the Interval-Valued Fuzzy Sets looking for the best ignorance degree that each Interval-Valued Fuzzy Set represents. In this contribution, we will make use of the fuzzy ID3 algorithm as a base technique from which to apply our methodology. The experimental study shows how our methodology enhances the performance of the base fuzzy decision tree. Furthermore, we compare our approach with respect to four state-of-the-art fuzzy decision trees and C4.5 as a representative algorithm for crisp decision trees. The goodness of our proposal is tested on a large collection of data-sets and it is supported by an exhaustive statistical analysis.

8:40AM *A Two-Step Approach of Feature Construction for a Genetic Learning Algorithm* [#388]

David Garcia
Antonio Gonzalez
Raul Perez

University of Granada, Spain
University of Granada, Spain
University of Granada, Spain

Traditionally, fuzzy rule based models work with a fixed set of features to describe a particular problem. Our proposal is to use feature construction by means of functions in order to obtain new variables that allow us to get more information about the problem. In particular, we propose the use of previously defined functions over the input variables in the antecedent of the rules. This let us to know if a combination of variables is able to provide us with more information than each one of them separately. In addition, we use a structure that helps us to manage and also restrict the number of functions under consideration by the learning algorithm. We also present a new model of rule in order to represent this kind of knowledge by extending a basic learning fuzzy rule-based model. Finally, we show the experimental study associated with this work.

9:00AM *Using the Adaboost algorithm for extracting fuzzy rules from low quality data: some preliminary results* [#487]

Ana Palacios
Luciano Sanchez
Ines Couso

Universidad de Oviedo, Spain
Universidad de Oviedo, Spain
Universidad de Oviedo, Spain

When the Adaboost algorithm is used for extracting fuzzy rules from data, each rule is regarded as a weak learner, and knowledge bases as assimilated to ensembles. Rules are iteratively added to a base, and the search of the best rule is driven by a genetic algorithm at each iteration. In this paper we propose an extension of this framework for obtaining fuzzy rule-based classifiers from imprecise data. In the new approach, the mentioned

search of the best rule at each iteration is carried out by a genetic algorithm with a fuzzy fitness function. The instances will be assigned fuzzy weights, however each fuzzy rule will be associated to a crisp number of votes.

9:20AM *Checking Orthogonal Transformations and Genetic Algorithms for Selection of Fuzzy Rules based on Interpretability-Accuracy Concepts* [#324]

M.Isabel Rey
Marta Galende
Gregorio I. Sainz
MariaJ. Fuente

INDOMAUT, Spain
CARTIF, Spain
UVA, Spain
UVA, Spain

Fuzzy modeling is one of the most known and used techniques in different areas to emulate the behavior of systems and processes. In most cases, as in data-driven fuzzy modeling, these fuzzy models reach a high performance from the point of view of accuracy, but from other points of view, such as complexity or interpretability, the models can present a poor performance. Several approaches are found in the specialized literature to reduce the complexity and improve the interpretability of the fuzzy models. Here, a post-processing approach is taken into account via the definition of the rules selection criterion that aims to choose the most relevant rules according to the well-known accuracy-interpretability trade-off. This criterion is based on Orthogonal Transformations, here the QRP transformation is taking into consideration, and its parameters are tuned genetically. The main objective is to check the true significance, drawbacks and advantages the firing matrix of the rules, that is the foundation of the most usual approaches based on orthogonal transformations for the complexity reduction of the fuzzy models. A neuro-fuzzy system, FasArt (Fuzzy Adaptive System ART based), and several case studies, data sets from the KEEL Project Repository, are used to tune and check this approach. This neuro-fuzzy system generates Mamdani fuzzy rule based systems (FRBSs), each with its own particularities and complexities from the point of view of fuzzy sets and rule generation. NSGA-II is the MOEA tool used to tune the criterion parameters based on accuracy-interpretability ideas.

9:40AM *A Hierarchical Genetic Fuzzy Rule-Based Classifier for High-Dimensional Classification Problems* [#395]

Dimitris Stavrakoudis
Ioannis Gitas
John Theocharis

Aristotle University of Thessaloniki, Greece
Aristotle University of Thessaloniki, Greece
Aristotle University of Thessaloniki, Greece

This paper proposes a novel Hierarchical Genetic Fuzzy Rule-Based Classification System (HGFRBCS), targeted at effectively handling high-dimensional classification tasks. A hierarchical fuzzy rule base comprises rules with linguistic terms from a multi-granular fuzzy sets database, whereby lower levels define thicker granularities of the input space fuzzy partition. The proposed system is developed through sequential repeating steps: in each step a fuzzy rule base is created using a given granularity. Subsequently, the best performing rules are inserted in the hierarchical rule base and the process is repeated again, considering a thicker granularity. The whole process is coordinated by a boosting scheme, which localizes new rules in uncovered regions of the feature space. Comparative results for various real-world high-dimensional classification problems indicate the effectiveness of the proposed methodology.

10:00AM *A New Approach to Handle High Dimensional and Large Datasets in Multi-objective Evolutionary Fuzzy Systems* [#432]

Michela Antonelli
Pietro Ducange
Francesco Marcelloni

University of Pisa, Italy
University of Pisa, Italy
University of Pisa, Italy

In the framework of multi-objective evolutionary fuzzy systems (MOEFSs), the search space grows as the number of features of the dataset increases, leading to a slow and possibly difficult convergence of the evolutionary algorithm. Furthermore, mainly due to the fitness evaluation, datasets with a large number of instances require very high computational costs. In this paper, we propose a co-evolutionary approach to generate sets of Mamdani fuzzy rule-based systems (MFRBSs) with different trade-offs between accuracy and interpretability. We aim to deal with high dimensional and large datasets and to learn together the rule base (RB) and the membership function parameters. To reduce the search space, we perform the multi-objective evolutionary learning of the RB by selecting reduced sets of rules and conditions from a previously generated RB. Further, to lessen the computational costs, during the multi-objective evolutionary learning process, periodically, a single-objective genetic algorithm evolves a population of reduced training sets. We show the preliminary results obtained by applying our approach to two real world high dimensional and large regression datasets.

(SS12-2) Special Session: Recent Advances in Fuzzy-Model-Based Control Systems
Wednesday, June 29, 8:00AM-10:20AM, Room: Peacock, Chair: H. K. Lam

8:00AM *Generalized Stabilizing Controllers for Fuzzy Systems via Circle Criterion -- LMI and SOS* [#40]

Ji-Chang Lo
Wei-Cheng Liao

National Central University, Taiwan
National Central University, Taiwan

We investigate a generalized control problem via the Circle criterion borrowed from system theory; the generalized controller can be cast into existing canonical controllers depending on parameterizations. We first

show a fuzzy version of the Circle criterion and then provide a synthesis result based on the Circle criterion, establishing closed-loop stabilizability for state-feedback controllers. In this paper, we show how to incorporating the membership information by approximating the cone of copositive matrices via SOS that is solvable by SOSTOOLS. Finally the validity and applicability of the approach are illuminated by examples.

8:20AM T-S Fuzzy Systems Approach to Approximation and Robust Controller Design for General Nonlinear Systems [#216]

Qing Gao
Xiao-Jun Zeng
Gang Feng
Yong Wang

USTC-CityU Joint Advanced Research Center, China
University of Manchester, United Kingdom
City University of Hong Kong, Hong Kong
University of Science and Technology of China, China

A novel approach to control of general nonlinear system based on T-S fuzzy model is presented in this paper. Firstly, it is shown that a general nonlinear system can be approximated by a generalized T-S fuzzy model to arbitrary degree of accuracy on any compact set. And the basic idea of the proposed approach is to stabilize the general nonlinear system by solving a robust stabilization problem of the developed T-S fuzzy system with the approximation errors as the uncertainty term. Then using a piecewise Lyapunov function, robust semi-global stabilization and generalized H₂ control of the general nonlinear system are formulated in the form of linear matrix inequalities. Finally, an example is provided to demonstrate the effectiveness of the proposed approaches.

8:40AM A Polynomial Observer Design for a Wider Class of Polynomial Fuzzy Systems [#62]

Toshiaki Seo
Hiroshi Ohtake
Kazuo Tanaka
Ying-Jen Chen
Hua O. Wang

The University of Electro-Communications, Japan
The University of Electro-Communications, Japan
The University of Electro-Communications, Japan
National Central University, Taiwan
Boston University, United States

This paper presents a polynomial fuzzy observer design for a wider class of polynomial fuzzy systems via a sum of squares (SOS, for brevity) approach. The proposed SOS-based framework provides a number of innovations and improvements over the existing LMI-based approaches to Takagi-Sugeno (T-S) fuzzy controller and observer designs. First, we briefly summarize previous results for a class of polynomial fuzzy systems that is more general representation of the well-known T-S fuzzy system. Next, we propose a polynomial fuzzy observer to estimate states in a wider class of polynomial fuzzy systems and derive SOS conditions to design polynomial fuzzy controllers and observers. A remarkable feature of the SOS design conditions is that they realize the so-called separation principle, that is, that a polynomial fuzzy controller and observer for this class can be separately designed without lack of guaranteeing the stability of the overall control system in addition to converging state estimation error (via the observer) to zero. The design conditions in the proposed approach can be represented in terms of SOS and are symbolically and numerically solved via the recent developed SOSTOOLS and a semidefinite program (SDP) solver, respectively. To illustrate the validity and applicability of the proposed approach, a design example is provided. The example demonstrates advantages of the SOS-based approach for the existing LMI approaches to T-S fuzzy observer designs.

9:00AM A SVD Approach to H_{∞} Decentralized Static Output Feedback Fuzzy Control Design for Nonlinear Interconnected Systems [#45]

Chung-Shi Tseng
Yung-Yue Chen

Ming Hsin University of Science and Technology, Taiwan
National Yunlin University of Science and Technology, Taiwan

This study introduces H_{∞} decentralized static output feedback fuzzy control design for nonlinear interconnected systems via T-S fuzzy models. In general, due to the interactions among subsystems, it is difficult to design an H_{∞} decentralized output feedback controller for nonlinear interconnected systems. A singular value decomposition (SVD) method is proposed in this study to solve the H_{∞} decentralized static output feedback fuzzy control problem. By the proposed SVD method, the problem of H_{∞} decentralized static output feedback fuzzy control design for nonlinear interconnected systems is characterized in terms of solving an eigenvalue problem (EVP). This EVP can be easily solved by using a LMI-based optimization method. Finally, simulation example is given to illustrate the design procedure and robust performance of the proposed methods.

9:20AM Adaptive Fuzzy Sliding-Mode Control for a Class of Nonlinear Systems with Uncertainties [#111]

Hugang Han

Prefectural University of Hiroshima, Japan

An approach to adaptive fuzzy sliding-mode control (SMC) for a class of nonlinear dynamical systems with lumped parameter uncertainties accompanied with control input is proposed and analyzed. The approach guarantees that the system state will be uniformly ultimately bounded. Also, discussion on how to alleviate the conservativeness of the approach is provided. Finally, computer simulations illustrate the effectiveness of the control approach proposed in this paper.

9:40AM Mixed H₂/H- ∞ Optimization with Discrete Smith Predictor for Fuzzy Decentralized Control of Nonlinear Interconnected Discrete Dynamic Systems with Large Delay [#44]

Chih-Lyang Hwang

National Taiwan University of Science and Technology, Taiwan

Each subsystem of a nonlinear interconnected discrete dynamic delayed system is approximated by a weighted combination of L pulse transfer function delayed systems (PTFDS). The H₂-norm of the difference between the

transfer function of a reference model and the closed-loop transfer function of the j th PTFDS of subsystem i is minimized to obtain a suitable frequency response. In addition, the H-infinity norm of the weighted sensitivity function between the output disturbance and its corresponding output of the j th PTFDS is simultaneously minimized to reduce its effect. To deal with large time-delay of the controlled system, the proposed control not only accomplishes the above-mentioned optimizations but also attenuates the effect of time-delay. The comparisons between with and without discrete Smith predictor are also discussed. The main contributions of this paper are three folds. First, the large nominal time- delay is compensated by a discrete Smith predictor. Secondly, the proposed control can achieve the suitable response of the closed-loop system with the attenuation of output disturbance and time-varying delay. Thirdly, an observer is not needed and the discrete controller is more suitable for the implementation.

10:00AM *A Hybrid Fuzzy Sliding-Mode Control for a Class of Generalized, Under-Actuated and Uncertain Nonlinear Dynamic Systems* [#120]

Chih-Lyang Hwang
Hsiu-Ming Wu

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

Due to the under-actuated feature, the reference signals using the combination of the system outputs, whose number is larger than that of reference signal, are designed so that the number of control inputs and sliding surfaces is the same, and that the uncontrollable mode is indirectly controlled. Under the uncertain environment, the sliding-mode under-actuated control (SMUC) with the satisfaction of suitable condition is designed to asymptotically track the reference signal. Otherwise, a bounded tracking result is obtained for the mild condition. In this situation, an on-line fuzzy modeling for the uncertainty is employed to design a fuzzy model-based sliding-mode under-actuated control (FSMUC) to improve the system performance; e.g., the bounded tracking result of SMUC becomes an asymptotical tracking. The proposed hybrid fuzzy sliding- mode under-actuated control (HFSMUC) combining SMUC and FSMUC with a transition can be applied to a class of generalized, under-actuated and uncertain nonlinear systems, e.g., the trajectory tracking control of a differential mobile robot (DMR). Finally, the simulations of the HFSMUC system are presented to confirm the efficiency and effectiveness of the proposed control.

(SS31) Special Session: Human Symbiotic Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Phoenix, Chair: Daisuke Katagami

8:00AM *Visualization and Analytical Support of Questionnaire Free-Texts Data based on HK Graph with Concepts of Words* [#365]

Daisuke Kobayashi
Tomohiro Yoshikawa
Takeshi Furuhashi

Nagoya University, Japan
Nagoya University, Japan
Nagoya University, Japan

A lot of companies carry out questionnaires. These questionnaires often have questions which need respondents to answer by free description. It is, however, inefficient for an analyzer to read whole texts to get outlines or classify them, or it is difficult to correctly analyze them without subjective biases. The authors have proposed "HK Graph" (Hierarchical Keyword Graph) which is a support tool for text mining. HK Graph can visualize the relationships among attributes and words with hierarchical graph structure based on frequency of co-occurrence. However, the result of HK Graph is not enough helpful for the analyzer to grasp the outlines of the texts and extract opinions from them, because it regards divided words as different ones unless they perfectly match and that makes the visualized result complicated. This paper presents a new visualization method for the HK Graph incorporating an aggregating words method based on concepts of words. An experiment is carried out by applying the proposed method to actual questionnaire data on disasters and studies the effectiveness of the proposed method.

8:20AM *Development of Body Mapping from Human Demonstrator to Inverted-Pendulum Mobile Robot for Imitation* [#353]

Takahashi Sataya
Takahashi Yasutake
Maeda Yoichiro
Nakamura Takayauki

University of Fukui, Japan
University of Fukui, Japan
University of Fukui, Japan
Wakayama University, Japan

This paper addresses development of body mapping from a human demonstrator to an inverted-pendulum mobile robot for imitation. An inverted-pendulum mobile robot with torso and body links learns a dynamic kicking motion shown by a human. The robot observes the human demonstration with a camera, extracts the human region in each of images, maps the region to its own two links, estimates the link posture trajectories, and starts kicking motion learning based on the trajectory parameters for imitation. The mapping parameter gives an important role for successive imitation. A reasonable and feasible procedure of learning from observation for an inverted-pendulum robot and development of the body mapping is proposed and investigated in this paper.

8:40AM *Social Interaction of Cooperative Communication and Group Generation in Multi-Agent Reinforcement Learning Systems* [#389]

Kun Zhang

University of Fukui, Japan

Yoichiro Maeda
Yasutake Takahashi

University of Fukui, Japan
University of Fukui., Japan

Recently, researches on multi-agent systems (MAS) which autonomous agents are able to learn cooperative behavior are actively performed. It is necessary for social agents to interact each other in order to have excellent cooperative performance in MAS. But it is difficult to give appropriate coordination at the right time, not to mention the generation of group behavior. We have aimed at the group behavior generation of social agents who have excellent autonomous learning ability like human through cooperative communication between agents to acquire cooperative behavior. Social agents are able to change the environment states to individual states and communicate their cooperative behavior by sending a special signal, which can not be understood originally but could be understood by other agents through reinforcement learning (RL) after some learning processes. Furthermore, if the agents could communicate their cooperative behavior successfully, their group identity will be strengthened by exchanging rewards among them. As the learning process, social agents can get the better cooperative ability than normal reinforcement learning method through group identity. Lastly, social agents not only adjust themselves to environment but also affect other agents to generate intelligent group behavior.

9:00AM Estimation Of Subjective Stress Via Finger Plethysmogram [#255]

Yusuke Kobashi
Genma Sano
Tsuyoshi Nakamura
Masayoshi Kanoh

Nagoya Institute of Technology, Japan
Nagoya Institute of Technology, Japan
Nagoya Institute of Technology, Japan
Chukyo University, Japan

It could be very important and useful to enable human stress to be estimated on basis of quantitative values via objective analysis. There have been several approaches to estimate subjective stress so far. Most of them need a lot of time to measure or calculate it, and what is more, they might cause physical or mental burden for human subjects. The purpose of our study is to propose and develop a method to estimate subjective stress through a simple approach which doesn't cause much burden for users. Our study adopts a TPA based approach which is a kind of heart rate variability analysis, and it estimates the stress through pulse wave acquired from user's finger. Our experimental results indicated that it has a certain relationship between subjective stress and TPA. A method based on TPA could be efficient to estimate subjective stress.

9:20AM Human Preference Learning by Robot Partners Based on Multi-objective Behavior Coordination [#560]

Naoyuki Kubota
Aiko Yaguchi
Utaki Ishikawa

Tokyo Metropolitan University, Japan
Tokyo Metropolitan University, Japan
Tokyo Metropolitan University, Japan

This paper discusses the human preference learning by robot partners through interaction with a person. We use a robot music player; Miuro, and we focus on the music selection for providing the comfortable sound field for the person. First, we propose a control architecture of Miuro based on autonomous behavior mode, interactive behavior mode, and human control mode. Next, we propose a learning method of the relationship between human position and its corresponding music selection based on Q-learning. Furthermore, we proposed a similarity matrix to reduce the learning time of Q-learning. The experimental results show that the proposed method can learn the relationship between human position and its corresponding human preferable music.

9:40AM A Report The Difference Features Of A Multi-agent Using An Overlay Knowledge In The Fire Panic Problem [#554]

Yukinobu Hoshino

Kochi University of Technology, Japan

This report on this paper shows performances of the heterogeneous multi-agent, which have the overlay knowledge. The overlay knowledge is one kind of layered rule-base system we tested on experiments. Basic idea is a tile-coding rule on reinforcement learning. In tile-coding, all reinforced rules are spread any categorical states of rule table. Proposal style of overlay knowledge easy to find that phenomenon, we made ideas from a tile-coding. We examined the nature of the featuring learning principle about the heterogeneous multi-agent. As a result, it was proved that the overlay knowledge was useful sufficiently for the heterogeneous multi-agent. The robust characteristic was the cause which outputs absolute behavior. By the change of the robust levels, behavior of the agent expected a change into the flexible movement.

10:00AM Group Pressure Generation of Multi-Agents on Cross-cultural Simulation Game [#377]

Daisuke Katagami
Tam Huynh van

Tokyo Polytechnic University, Japan
Tokyo Polytechnic University, Japan

In this paper, we pay attention to strong atmosphere of a group momentarily constructed by a place because the agent who expresses gesture and face expression gathers plurals. We called the atmosphere socially constructed as group pressure of agents. The purpose of the paper is to develop a group pressure and investigate the influence to human. We verify if the group pressure made by multiple life-like agents exert an influence on the judgment of player by using the cross-cultural simulation game we developed before.

(FC& IS) Fuzzy Control and Intelligent Systems

Wednesday, June 29, 8:00AM-10:20AM, Room: Crane, Chair: Li-Wei Ko

8:00AM H2 Guaranteed Cost of Uncertain Continuous T-S Fuzzy Systems by Multiple Lyapunov Function Approach [#87]

Wen-Ren Horng	National Kaohsiung University of Applied Sciences, Taiwan
Chun-Hsiung Fang	National Kaohsiung University of Applied Sciences, Taiwan
Ching-Hsiang Lee	National Kaohsiung University of Applied Sciences, Taiwan
Jyh-Horng Chou	National Kaohsiung University of Applied Sciences, Taiwan

In this paper, the guaranteed cost of H2 control of uncertain continuous T-S fuzzy systems is investigated. We approach this problem by considering the multiple Lyapunov function and utilizing non-PDC controller. Sufficient conditions to ensure H2 cost and globally asymptotically stable are in terms of LMI optimization problems, which can be solved by existing convex function optimization tools. The advantage of our approach is the assumption of known upper bound of time derivative of membership functions can be completely eliminated by introduction slack variables. Furthermore, the numerical examples are also shown the upper bound of performance index obtained by our proposed approach is smaller than the existing ones.

8:20AM Higher Order Sliding Fuzzy Type-2 Interval Control for SISO Uncertain Nonlinear Systems [#508]

Malik Manceur	University of Champagne-Ardenne, France
Essounbouli Najib	University of Champagne-Ardenne, France
Hamzaoui Abdelaziz	University of Champagne-Ardenne, France

A higher order sliding fuzzy type-2 controller scheme for nonlinear uncertain perturbed systems is proposed in the paper. To overcome the constraint on the knowledge of the system model, local models related to some operating points were used to synthesize a nominal fuzzy type-2 global model. The controller uses integral sliding mode concept and contains two parts. The first one leads to achieve finite time stabilization of the higher order input output dynamics without uncertainties. The second part has the object to reject bounded uncertainties throughout the entire response of the system. Two adaptive fuzzy type-2 systems have been introduced to generate the two Super Twisting signals to avoid both the chattering and the constraint on the knowledge of upper bounds of both disturbances and uncertainties. These fuzzy type-2 systems are adjusted on-line by adaptation laws deduced from the stability analysis in Lyapunov sense. The advantages of the method are that its implementation is easy, the convergence time is chosen in advance and the robustness is ensured. A robot arm actuated by a DC motor is used as illustrative example. The obtained results show the good tracking performances and the applicability of the method.

8:40AM Output Regulation Using Integral Fuzzy Predictive Control with Piecewise Lyapunov Functions [#248]

Chien-Hung Liu	China University of Science and Technology, Taiwan
Kuang-Yow Lian	National Taipei University of Technology, Taiwan

This study proposes an LMI-based integral fuzzy model predictive control (MPC) for output regulation via piecewise Lyapunov function. In order to eliminate the system's bias and guarantee the zero-offset output regulation performance, firstly we take coordinate translation on equilibrium point and introduce an added integral state of output regulation error for the nonlinear plant, and then convert the resulting augmented system into a Takagi-Sugeno fuzzy model. Under the input constraint, an integrator based state feedback control law is computed by solving a convex optimization problem based on the infinite horizon predictive control scheme. Moreover, the proposed control design has following merits: i) reducing the conservatism by using piecewise Lyapunov function; ii) improving the transient performance by adding a decay rate condition; and iii) ensuring asymptotic stability for output regulation in the presence of time varying parameter. Finally, a numerical example is presented to demonstrate the effectiveness of the proposed integral fuzzy predictive controller.

9:00AM Power Management of a Variable Speed Wind Turbine for Stand-Alone System using Fuzzy Logic [#580]

Minh Huynh Quang	CRéSTIC, France
Frederic Nollet	CRéSTIC, France
Najib Essounbouli	CRéSTIC, France
Abdelaziz Hamzaoui	CRéSTIC, France

In this paper, a wind energy conversion system (WECS) using a variable speed synchronous generator is proposed with a battery bank for storing the extra wind energy. A fuzzy logic supervisor is developed to manage both the energy production and its storage to obtain an optimal behaviour of the system and to ensure the load requirement. Many simulation results are presented to show that the proposed method gives good performance for its application in autonomous wind energy systems and can extend the life of battery.

9:20AM Robust stabilization for continuous fuzzy systems with time varying delay [#550]

Chedia Latrach	National School of Engineers of Sfax, Tunisia
Mourad Kchaou	National School of Engineers of Sfax, Tunisia
Ahmed Hajjaji	University of Picardie Jules Verne, France
Ahmed Toumi	National School of Engineers of Sfax, Tunisia

This paper focuses on the problem of robust control for Takagi-Sugeno (T-S) fuzzy systems with time-delay. The less conservative conditions are developed by considering a parameter dependent Lyapunov-Krasovskii functional and slack matrix variables. The design conditions are formulated as an LMI (linear matrix inequality) feasibility problem, that can be efficiently solved using convex optimization numerical techniques. Numerical example is presented to illustrate the effectiveness of the proposed approach with the comparisons to other conditions from the literature.

9:40AM *Splitting K-means Generated Neural Fuzzy System with Support Vector Regression* [#406]

Cheng-Da Hsieh
Chia-Feng Juang

Hsiuping Institute of Technology, Taiwan
National Chung-Hsing University, Taiwan

This paper proposes a Splitting K-means generated Neural Fuzzy System with Support Vector Regression (SKNFS-SVR). The consequent layer in SKNFS-SVR is a Takagi-Sugeno-Kang (TSK)-type consequent. For structure learning, a splitting K-means algorithm clusters the input training data and determines the rule number. For parameter learning, a linear support vector regression (SVR) algorithm is proposed to tune free parameters in the consequent part. The motivation for using SVR for parameter learning is to improve the SKNFS-SVR generalization ability. This paper demonstrates the capabilities of SKNFS-SVR by conducting simulations in clean and noisy function approximations. This paper also compares simulation results from the SKNFS-SVR with Gaussian kernel-based SVR.

10:00AM *Fuzzy Reinforcement Learning Control for Decentralized Partially Observable Markov Decision Processes* [#523]

Rajneesh Sharma
Matthijs T. J. Spaan

Netaji Subhas Institute of Technology, India
Instituto Superior Tecnico, Portugal

Decentralized Partially Observable Markov Decision Processes (Dec-POMDPs) offer a powerful platform for optimizing sequential decision making in partially observable stochastic environments. However, finding optimal solutions for Dec-POMDPs is known to be intractable, necessitating approximate/suboptimal approaches. To address this problem, this work proposes a novel fuzzy reinforcement learning (RL) based game theoretic controller for Dec-POMDPs. The proposed controller implements fuzzy RL on Dec-POMDPs, which are modeled as a sequence of Bayesian games. The main contributions of the work are the introduction of a game based RL paradigm in a Dec-POMDP settings, and the use of fuzzy inference systems to effectively generalize the underlying belief space. We apply the proposed technique on two benchmark problems and compare results against state-of-the-art Dec-POMDP control approach. The results validate the feasibility and effectiveness of using game theoretic RL based fuzzy control for addressing intractability of Dec-POMDPs, thus opening up a new research direction.

(SS10-2) Special Session: Medical and Wellness Engineering

Wednesday, June 29, 8:00AM-10:20AM, Room: Egret, Chair: Yutaka Hata

8:00AM *A challenge to biometrics by sole pressure while walking* [#338]

Takahiro Takeda
Kei Kuramoto
Syoji Kobashi
Yutaka Hata

University of Hyogo, Japan
University of Hyogo, Japan
University of Hyogo, Japan
University of Hyogo, Japan

This paper describes a personal verification method based on fuzzy logic using dynamic sole pressure distribution while walking. The method employs a pair id sole pressure distribution change, and it is acquired by a mat type load distribution sensor. As a preliminary experiment for shoes, we take sole pressure data by bare foot and two kind of slippers. We extract thirty nine gait features from each sole pressure distribution change. We calculate a fuzzy degree of a feature from two fuzzy if-then rules and their fuzzy membership functions for a feature. These fuzzy membership functions are statistically determined by learning data. The fuzzy degree of acquisition sole pressure data is calculated by total of fuzzy degree of all features. The method verifies the walking person by using the fuzzy degree of the acquisition sole pressure data. When the fuzzy degree of acquisition data higher than a threshold, we verify the walking person as the target person. In our experiments, we employed 11 volunteers and took sole pressure data six times for each volunteer and foot situation. When the learning data included same kind of test data, we obtained low equal error rate. We obtained low false acceptance rate.

8:20AM *Six Degree of Freedom Calculation Based on Principal Component Analysis for the Knee Joint in MDCT Image* [#433]

Yosuke Uozumi
Kouki Nagamune
Daisuke Araki
Tomoyuki Matsumoto
Takehiko Matsushita

University of Fukui, Japan
University of Fukui, Japan
Kobe University, Japan
University Graduate School of Medicine, Japan
University Graduate School of Medicine, Japan

The anterior cruciate ligament (ACL) injury can cause a reason of instability along anterior - posterior translation at extension. Thus, it is important to examine the knee joint quantitatively for understanding clinical outcome.

However, an quantitative calculation method of the knee joint has not been reported. Therefore, we have developed six degree of freedom (6 DOF) calculation based on principal component analysis (PCA) for the knee joint in multi-detector row computer tomography (MDCT) image. The proposal method was applied to six ACL injured knees obtained at two periods. As a result, the proposed methods could calculated 6 DOF of the knee joint quantitatively.

8:40AM Nursing-care Text Classification using Additional Term Information from Web [#336]

Manabu Nii	University of Hyogo, Japan
Takafumi Yamaguchi	University of Hyogo, Japan
Yusuke Mori	University of Hyogo, Japan
Yutaka Takahashi	University of Hyogo, Japan
Atsuko Uchinuno	University of Hyogo, Japan

In this paper, for improving performance of the nursing-care text classification, we introduce a mechanism of retrieving terms from Web. Every year, the nursing-care texts are collected by using Web application to improve nursing-care quality in Japan. The collected nursing-care texts are decomposed into morphemes (i.e., terms), and then terms are stored as a term list. Each text is represented as a feature vector by using the term list and classified using a SVM based classification system. The training data sets for constructing SVM based classification system are different from the evaluation data sets. That is, there are differences between the term lists of the nursing-care texts because the nursing-care texts are collected and evaluated every year. To cover this difference, we introduce a mechanism of retrieving terms from Web. A new term which appeared in the evaluation data sets is used as a query of a search engine. The terms in the term list are also used as queries. Terms are represented by the search results, and then are compared with each other. We use the most similar term in the term list as an alternative of the new term. From experimental results, we show effectiveness of our proposed method.

9:00AM A Development of Navigation System for MOSAIC PLASTY using Electromagnetic Sensor [#413]

Takayasu Toyoshima	University of Fukui, Japan
Kouki Nagamune	University of Fukui, Japan
Daisuke Araki	Kobe University, Japan
Tomoyuki Matsumoto	Kobe University, Japan
Seiji Kubo	Kobe University, Japan

Mosaic plasty is a surgery that transplant osteochondral grafts for osteochondritis dissecans. In mosaic plasty, cylindrical osteochondral grafts are harvested from normal area, and transplanted to injured area. The one of the most important thing of this surgery is that the graft should be perpendicular to the surface of the cartilage. The navigation system that aims improvement of precision is already studied, however cannot be applied to use an endoscope. In addition, it is a problem to have bad precision of the transplant in the freehand. Therefore, we thought that the system would widely used if we develop the mosaic plasty navigation system under an endoscope. This study proposes a navigation system to determine a proper position and pose for harvesting. In the experiments, a femoral imitation bone is used as a profile of the femoral joint surface. The experiment consists of the following three procedures: Trace and display of the femoral joint surface profile and a harvester. Display of a normal vector for the femoral joint surface. Measurement of the deviation of the normal vector. In the results, the developed system could display the femoral joint surface and the normal vector for the femoral joint surface virtually. Also, the deviation of the normal vector was an average of 7.27 degrees. As future works, there are to decrease the deviation of the normal vector by improving the precision to acquire the femoral joint surface profile, and to visualize the normal vector for the generated surface.

9:20AM A Quantitative Measurement System of Endpoint during Lachman tTest with Force Sensor [#379]

Shogo Kawaguchi	University of Fukui, Japan
Kouki Nagamune	University of Fukui, Japan
Daisuke Araki	Kobe University, Japan
Tomoyuki Matsumoto	Kobe University, Japan
Seiji Kubo	Kobe University, Japan

Lachman test is one of manual tests for examining the anterior cruciate ligament (ACL). An examiner discriminates an injured degree of the ACL by feeling finger stress. Some measurement devices for Lachman test have been developed. However, these devices aim to analyze not the stress but a motion of the knee joint. Therefore, we set the goal of this study to develop a measurement system for the finger stress with force sensor during Lachman test. In the experiment, the developed system was applied to twelve healthy knees of six subjects by a beginner, and one injured and one healthy knee of two subjects by an expert. In the results, the maximum force of "endpoint" during Lachman test was analyzed. The variation of inter-subjects was larger than intra-subjects. Future works are to improve the finger force sensors, and to apply more subjects, so that the system could classify an examiner into a skill level.

9:40AM Human Motion Tracking for Cognitive Rehabilitation in Informationally Structured Space Based on Sensor Networks [#569]

Yuichiro Toda	Tokyo Metropolitan University, Japan
Kodai Yuki	Tokyo Metropolitan University, Japan
Eriko Hiwada	Tokyo Metropolitan University, Japan

Naoyuki Kubota

Tokyo Metropolitan University, Japan

This paper discusses measurement methods of human behaviors based on sensor network and human interaction of rehabilitation using robot partners. First, we explain robot partners and sensor networks for rehabilitation. Next, we apply a steady-state genetic algorithm to extract human motions from 3D distance image. Finally, we discuss the effectiveness of the proposed methods through several experimental results.

10:00AM *A Pervasive Multi-sensor Data Fusion for Smart Home Healthcare Monitoring* [#472]

Hamid Medjahed

ESIGETEL/LRIT, France

Dan Istrate

ESIGETEL/LRIT, France

Jerome Boudy

TSP/EPH, France

Jean-Louis Baldinger

TSP/EPH, France

Bernadette Dorizzi

TSP/EPH, France

Today elderly people are the fastest growing segment of the population in developed countries, and they desire to live as independently as possible. But independent lifestyles come with risks and challenges. Medical in-home telemonitoring (and, more generally, telemedicine) is a solution to deal with these challenges and to ensure that elderly people can live safely and independently in their own homes for as long as possible. In this context we propose an automatic in-home healthcare monitoring system for several uses and to meet the needs identified above. The proposed telemonitoring system is a multimodal platform with several sensors that can be installed at home and enables us to have a full and tightly controlled universe of data sets. It integrates elderly physiological and behavioral data, the acoustical environment of the elderly, environmental conditions and medical knowledge. Each modality is processed and analyzed by specific algorithms. A data fusion approach based on fuzzy logic with a set of rules directed by medical recommendations, is used to fuse the various subsystem outputs. This multimodal fusion increases the reliability of the whole system by detecting several distress situations. In fact this fusion approach takes into account temporary sensor malfunction and increases the system reliability and the robustness in the case of environmental disturbances or material limits (Battery, RF range, etc.). The Fuzzy logic fusion methods brings high flexibility to the telemonitoring platform especially in combining modalities or adding other sensors. The proposed telemonitoring system will ensure pervasive in-home health monitoring for elderly people.

(SS13-1) Special Session: Fuzzy Multiple Criteria Decision Making

Wednesday, June 29, 8:00AM-10:20AM, Room: Swallow, Chair: Gwo-Hshiung Tzeng

8:00AM *Value Driver Derivations for Embedded Memories* by Fuzzy DEMATEL based Hybrid MCDM Methods [#530]

Chi-Yo Huang

National Taiwan Normal University, Taiwan

Gwo-Hshiung Tzeng

Kainan University, Taiwan

The embedded memories have already played a very important role in the modern system on a chip (SoC) designs from the aspects of performance enhancement, power reduction, form factor optimization, etc. Meanwhile, embedded memories usually occupied for the major portion of an SoC layout. Thus, how an embedded memory IP (intellectual property) provider can differentiate the product to maximize the value of that IP has already become a key factor for profit maximization. However, very few scholars tried to resolve such problems. The product and service differentiation problem of memory IPs is in nature a multiple attribute decision making (MADM) problem. Moreover, the differentiators of an embedded memory IP usually interact with each other. Furthermore, evaluations of customers' needs and wants, which are vague, are often required for such a product marketing strategy definition problem. Thus, a fuzzy DEMATEL based multiple criteria decision making (MCDM) framework will be proposed for maximizing the value of an embedded memory IP. The value driver for differentiating an embedded memory IP will first be derived by literature review. The most influential value drivers will be selected. Then, strategies will be proposed for maximizing the value through the most influential value drivers. An empirical study based on an embedded memory IP being provided by an SOC design service provider will be used for verifying the feasibility of the framework. Based on the empirical study results, both power consumption as well as the area of the embedded memory core are the most important value drivers. The proposed product marketing strategies can also be used for maximizing the value of the embedded IP.

8:20AM *Fuzzy Multiple Attribute Decision Making Theory With The Balanced Scorecard Application In Mobile Industry* [#369]

Chiu-Hung Su

Hwa-Shia Institute of Technology, Taiwan

Ying-Hsun Hung

Hwa-Shia Institute of Technology, Taiwan

Gwo-Hshiung Tzeng

National Chiao Tung University, Taiwan

This study is the use of fuzzy multi-attribute decision making as a business management application in the balanced scorecard performance assessment. The study expected to help enterprises to establish effective expression of those feelings with subjective indicators of weight value. In order to increase the accuracy of weight and practice, so that more perfect performance of the Balanced Scorecard in the business. The use of the Balanced Scorecard to evaluate the importance of screening criteria in Taiwan mobile industry operators and fuzzy multi attribute decision making through the match with the comparison with the fuzzy multiple criteria decision making, to establish Taiwan's mobile industry business model assessment. Fuzzy multi- attribute

decision making can be vague, uncertain or unstructured problems trying to provide a solution to this. Finally, this study found results, the implementation of the model created to operate as a decision-making in Taiwan mobile industry reference, and can understand the fuzzy multiple attribute decision making not only in dealing with the definition of ambiguous or unclear information, as an effective Methods, but in the real world where a lot of created process can easily be used, it will also help assess the performance of the Balanced Scorecard.

8:40AM Fuzzy MCDM Application for Strategy Evaluation [#383]

Mei-Chen Lo

National United University, Kainan University, Taiwan

Gwo-Hshiung Tzeng

Kainan University, National Chiao Tung University, Taiwan

The essence of strategy formulation is coping with competition. Therefore, the nature and degree of competition in an industry hinge on four basic forces: Production, Technology, Marketing and research/development are defined. To establish a strategic agenda for dealing with these contending currents and to grow despite them, a company must understand how they work in its industry and how they affect the company in its particular situation. This study adopt Fuzzy MCDM methods and details how these forces operate and suggests ways of adjusting to them, and, where possible of evaluation, of taking advantage of them. Knowledge of these underlying sources of competitive pressure provides the groundwork for a strategic agenda of action. The result highlights the critical strategies distance of the company, animate the positioning of the company in its industry, clarify the areas where strategic changes may yield the greatest payoff, and highlight the places where industry trends promise to hold the greatest significance as either opportunities or threats.

9:00AM Exploring the SPM System Structure Model by Using Fuzzy DEMATEL for NPD [#342]

Chang Yu-Yun

Kainan University, Taiwan

Kuan Meng-Jong

Kainan University, Taiwan

Chuang Yen-Ching

Kainan University, Taiwan

Tzeng Gwo-Hshiung

Kainan University, Taiwan

Standardized project management (SPM) is regarded as a well-structured system for improving the success of new product development projects. SPM can be defined as a standardized set of project management practices. It helps achieve the company's strategic goal through the effective use of project-driven approach. This paper used a Decision Making Trial and Evaluation Laboratory (DEMATEL) method to help companies to create a critical Standardized Project Management system and identify the influence of dimensions and criteria in the SPM system. First of all the dimensions and criteria of the SPM system are determined. DEMATEL approach is then applied to construct the SPM system structure model with Fuzzy number influence interrelationship among dimensions and associated criteria. An empirical case from industry is used to explore the effectiveness of the proposal approach.

9:20AM Interdependent Multiple Objective Programming- A Monte Carlo Method [#398]

Jih-Jeng Huang

Soochow University, Taiwan

Chin-Yi Chen

Chung Yuan Chirstian University, Taiwan

Although multiple objective programming (MOP) skills have been extensively studied in various issues, the problem of MOP with interdependence has received little attention. In this paper, we overcome the problem of Carlsson and method and propose a novel index to measure the interdependence grade between objectives by using Monte Carlo simulation and regression analysis. Then, an interdependent multiple objective programming (IMOP) model is proposed. In addition, we give three numerical examples to demonstrate the proposed method. From the numerical results, we can conclude that the proposed method can rationally deal with the problem of MOP with interdependence.

9:40AM Handling Fuzzy Decision Making Problem based on Linguistic Information and Intersection Concept [#93]

Chen-Tung Chen

National United University, Taiwan

Ping-Feng Pai

National Chi Nan University, Taiwan

Wei-Zhan Hung

National Chi Nan University, Taiwan

Multi-criteria decision-making (MCDM) is one of the most widely used decision methodologies. Because every kind of MCDM approach has its strong point and weakness, it is hard to make sure that what kind of MCDM approach is suitable to a specific problem. Therefore, a new decision making method is proposed in this paper based on linguistic information and intersection concept which is called linguistic intersection method (LIM). The linguistic variables are used to express the opinion of each decision-maker. There are four MCDM methods such as TOPSIS, ELECTRE, PROMETHEE, and VIKOR are included in the linguistic intersection method. First, each MCDM approach is used to determine the ranking order of all alternatives in accordance with the linguistic evaluations by decision-makers. And then, the intersection set is determined for the better alternatives of all methods. Third, the final ranking order of alternatives in the intersection set can be determined by the proposed method. This study presented an example to implement and compare the proposed method with individual linguistic MCDM method. Finally, some conclusions and future research will be discussed at the end of this paper.

10:00AM Evaluate and Identify Optimal Weapon Systems Using Fuzzy Multiple Criteria Decision Making [#14]

Ying Bai

Johnson C. Smith University, United States

Dali Wang

Christopher Newport University, United States

The weapon identification and selection issue is an important and strategic component and has a significant impact on the efficiency of defense system in US. The main purpose of this research is to develop a universal model and system to effectively assess, evaluate and identify the optimal weapons from a large collection of available weapon systems that have multiple criteria based on a fuzzy multiple criteria decision making (FMCDM) model. A simple but effective weight estimation method is adopted in this paper to make this selection more objective and reliable. There are some different weight estimation methods reported by researchers, however, most methods need a lot of mathematical operations and make the process very time consuming and even more complicated. In this paper, we adopted a weight estimation method based on the paired comparison matrix to simplify this estimation process. The evaluation and selection process can be significantly simplified and improved by using this method.

(FA-2) Fuzzy Applications

Wednesday, June 29, 8:00AM-10:20AM, Room: Grand Ballroom II, Chair: Qiang Shen

8:00AM Fuzzy-rough Classifier Ensemble Selection [#134]

Ren Diao
Qiang Shen

Aberystwyth University, Wales
Aberystwyth University, Wales

Classifier ensembles constitute one of the main research directions in machine learning and data mining. Ensembles allow higher accuracy to be achieved which is otherwise often not achievable with a single classifier. A number of approaches have been adopted for constructing classifier ensembles and aggregate ensemble decisions. In most cases, these constructed ensembles contain redundant members that, if removed, may further increase ensemble diversity and produce better results. Smaller ensembles also relax the memory and storage requirements of an ensemble system, reducing its run-time overhead while improving overall efficiency. In this paper, a new approach to classifier ensemble selection based on fuzzy-rough feature selection and harmony search is proposed. By transforming the ensemble predictions into training samples, classifiers are treated as features. Harmony search is then used to select a minimal subset of such artificial features that maximises the fuzzy-rough dependency measure. The resulting technique is compared against the original ensemble and ensembles formed using random selection, under both single algorithm and mixed classifier ensemble environments.

8:20AM Kernel-Based Fuzzy-Rough Nearest Neighbour Classification [#135]

Yanpeng Qu
Changjing Shang
Qiang Shen
Neil MacParthalain
Wei Wu

Aberystwyth University, Wales
Aberystwyth University, Wales
Aberystwyth University, Wales
Aberystwyth University, Wales
Dalian University of Technology, China

Fuzzy-rough sets play an important role in dealing with imprecision and uncertainty for discrete and real-valued or noisy data. However, there are some problems associated with the approach from both theoretical and practical viewpoints. These problems have motivated the hybridisation of fuzzy-rough sets with kernel methods. Existing work which hybridises fuzzy-rough sets and kernel methods employs a constraint that enforces the transitivity of the fuzzy \mathcal{S} -norm operation. In this paper, such a constraint is relaxed and a new kernel-based fuzzy-rough set approach is introduced. Based on this, novel kernel-based fuzzy-rough nearest-neighbour algorithms are proposed. The work is supported by experimental evaluations, showing that the new kernel-based methods offer improvements over the existing fuzzy-rough nearest neighbour classifiers.

8:40AM FAPOP: Feature Analysis Enhanced Pseudo Outer-Product Fuzzy Rule Identification System [#240]

Sau Wai Tung
Chai Quek
Cuntai Guan

Nanyang Technological University, Singapore
Nanyang Technological University, Singapore
Institute for Infocomm Research (A*Star), Singapore

Most existing neural fuzzy systems either overlook the importance of feature analysis; or it is performed as a separate phase prior to the design stage of the systems. This paper proposes a novel neural fuzzy system, named Feature Analysis Enhanced Pseudo Outer-Product Fuzzy Rule Identification System (FAPOP), which integrates its design with feature analysis. The objective is two-folds; namely, (1) to improve the interpretability of the system by identifying features relevant to its computational structure; and (2) to improve the accuracy of the system by identifying features relevant to the application problem. The proposed FAPOP model is subsequently employed in a series of benchmark simulations to demonstrate its efficiency as a neural fuzzy modeling system, and excellent performances have been achieved.

9:00AM Tracking Control of Surface Vessels via Adaptive Type-2 Fuzzy Logic Control [#256]

Xue Tao Chen
Woei Wan Tan

National University of Singapore, Singapore
National University of Singapore, Singapore

This paper presents an indirect adaptive type-2 fuzzy logic controller (FLC) as well as a direct adaptive type-2 FLC for tracking control of surface vessels under time-varying hydrodynamic disturbances. The combination of approximation-based adaptive control technique and type-2 fuzzy logic system (FLS) allows us to handle

time-varying disturbances without exact information on them. The stability of the design is proved through Lyapunov analysis where globally asymptotical convergence of the tracking errors is guaranteed. Although designed from different points of view, both indirect and direct adaptive type-2 FLC yield same and passive closed-loop systems. Comparative simulations with their adaptive type-1 counterparts are carried out. The proposed techniques are found to be effective, robust, and reduce tracking errors

9:20AM *Relaxed Fuzzy Lyapunov Approach for Dynamic Local Model Networks* [#263]

Christian Mayr	Vienna University of Technology, Austria
Christoph Hametner	Vienna University of Technology, Austria
Martin Kozek	Vienna University of Technology, Austria
Stefan Jakubek	Vienna University of Technology, Austria

This paper deals with the problem of stability analysis of dynamic local model networks. Established methods in this context are mainly based on Lyapunov stability theory and are targeted to be as little conservative as possible. In this respect it is essential to take into account the transitions between the different local models. For that purpose this paper presents and discusses a method to determine possible model transitions of such dynamic local model networks utilizing identification or simulation data. The effectiveness of the proposed method is shown by a simulation example in connection with the fuzzy Lyapunov approach as a stability criterion. The example demonstrates how identification data can be used to reduce the conservatism compared to standard approaches.

9:40AM *Vehicle Warning System for Lane Departure and Collision Avoidance: Using Adaptive Fuzzy Decision Making* [#484]

Chih-Li Huo	National Dong Hwa University, Taiwan
Yu-Hsiang Yu	National Dong Hwa University, Taiwan
Jhieh-Cheng Syu	National Dong Hwa University, Taiwan
Tsung-Ying Sun	National Dong Hwa University, Taiwan

This paper focuses on vehicle warning system based on fuzzy decision making for lane departure and forward collision avoidance for dealing with driver assistant system. The proposed system is composed of vision-based preprocessing and a fuzzy decision making. The objective of vision-based preprocessing part is lane tracking and forward vehicle detection, and provides the necessary information for fuzzy decision making to trigger the warning device. The fuzzy decision making unit can adjust the fuzzy decision rule base follow the driving behavior to increase the warning strength for lane departure and/ or forward collision.

10:00AM *Centroid Density of Interval Type-2 Fuzzy Sets: Comparing Stochastic and Deterministic Defuzzification* [#444]

Ondrej Linda	University of Idaho, United States
Milos Manic	University of Idaho, United States

Recently, Type-2 (T2) Fuzzy Logic Systems (FLSs) gained increased attention due to their capability to better describe, model and cope with the ubiquitous dynamic uncertainties in many engineering applications. By far the most widely used type of T2 FLSs are the Interval T2 (IT2) FLSs. This paper provides a comparative analysis of two fundamentally different approaches to defuzzification of IT2 Fuzzy Sets (FSs) - the deterministic Karnik-Mendel Iterative Procedure (KMIP) and the stochastic sampling defuzzifier. As previously demonstrated by other researchers, these defuzzification algorithms do not always compute identical output values. In the presented work, the concept of centroid density of an IT2 FS is introduced in order to explain such discrepancies. It was demonstrated that the stochastic sampling defuzzification method converges towards the center of gravity of the proposed centroid density function. On the other hand, the KMIP method calculates the midpoint of the interval centroid obtained according to the extension principle. Since the information about the centroid density is removed via application of the extension principle, the two methods produce inevitably different results. As further demonstrated, this difference significantly increases in case of non-symmetric IT2 FSs.

(PS03) Poster Session III

Wednesday, June 29, 2:30PM-4:30PM, Room: Grand Ballroom II

P501 *Statistical Scheme via AIC for Evaluating the Optimal Cut Off Level in Fuzzy Clustering* [#370]

Shuya Kanagawa	Tokyo City University, Japan
Kimiaki Shinkai	Tokyo Kasei Gakuin University, Japan
Hsunhsun Chung	Waseda University, Japan
Kenichi Nagashima	Waseda University, Japan

In this paper we show a new statistical scheme to evaluate the optimal cut off level in fuzzy clustering. Deterministic algorithms which seek a certain equilibrium cut off level have been used in the past. Since such algorithms have essential disadvantage in principle, We focus in it and propose a statistical scheme via AIC.

P502 *Genetic Algorithm Based Fully Automated and Adaptive Fuzzy Logic Controller* [#371]

Pintu Shill	University of Fukui, Japan
Kishore Pal	Khulna University, Bangladesh

Faijul Amin
Kazuyuki Murase

University of Fukui, Japan
University of Fukui, Japan

In this paper, an integration of fuzzy logic controller (FLC) and genetic algorithm (GA) is developed with a view to make the design process fully automatic, without requiring any human expert knowledge. Here, GA is used in two stages simultaneously: the first stage involves selection and definition of fuzzy rules, while the second stage performs an optimal selection of membership function types associated to the fuzzy rules. It is argued that the performance of an FLC greatly depends on the fuzzy rules as well as the types of membership functions associated to the fuzzy sets. Thus, the aforementioned two-stage GA is a viable solution for designing an efficient FLC system. In order to evaluate performance, the proposed approach is applied to a well-known benchmarking controller design task, "backing up a truck reversing system". The simulation result exhibits superior performance and thereby validates the proposed integrated GA and FLC system.

P503 *A Comparison of Distance-based Semi-Supervised Fuzzy c-Means Clustering Algorithms* [#373]

Daphne Teck Ching Lai
Jonathan M. Garibaldi

University of Nottingham, United Kingdom
University of Nottingham, United Kingdom

There are many issues to be considered in the design of distance-based fuzzy semi-supervised clustering (FSSC) algorithms. To identify these issues, we compare the performance of four such algorithms. We describe the properties of these algorithms, highlighting their key differences, and then experimentally compare their performance on common datasets. Several experimental conditions are investigated. Firstly, two forms of initialisation of the membership values of unlabelled patterns are used; $1/c$ and 0 . Secondly, the algorithms are run with varying proportions of labelled patterns in the datasets, ranging from 2% to 40%. We find that no algorithm outperforms the others in all the datasets. We also observe that small modifications in similar objective functions can improve clustering, and that most of the algorithms perform slightly better with zero initialisation of unlabelled patterns. An interesting observation is that the increase in labelled patterns does not always improve clustering. From these results, we conclude that the number and scale of dimensions in the data set, initial partition matrix, distance metrics and objective functions, together, affect clustering results. In addition, we conclude that not all initially labelled patterns are good candidates for supervision.

P504 *Applying MDL in PSO for Learning Bayesian Networks* [#382]

Shu-Ching Kuo
Hung-Jen Wang
Hsiao-Yi Wei
Chih-Chuan Chen
Sheng-Tun Li

Taiwan Shoufu University, Taiwan
Taiwan Shoufu University, Taiwan
National Cheng Kung University, Taiwan
Taiwan Shoufu University; National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan

Since learning Bayesian networks from data is difficult, a new approach is proposed. The particle swarm optimization (PSO) and minimum description length (MDL) are combined to obtain a suitable Bayesian network. MDL is the fitness function in this learning algorithm to evaluate the goodness of the network. By adopting MDL, the balance between simplicity and accuracy is assured, which enables the optimal solution for complex models to be found in reasonable time. Base on the MDL principle, the PSO is used to enhance the structure learning in Bayesian networks. Moreover, conditional probabilities associated with the Bayesian networks are then statistically derived from these data. In the end, the Stroke data set is used for testing the efficiency and effectiveness of the stable network. Experimental results show that the proposed approach has a good accuracy than the comparative methods.

P505 *Relational Structure Analysis of Fuzzy Node Fuzzy Graph and its Application* [#385]

Hiroaki Uesu
Kenichi Nagashima
Hsunhsun Chung
Ei Tsuda

Tokyo City University, Japan
Waseda University, Japan
Waseda University, Taiwan
Kokugakuin Senior High School, Japan

Generally, we could efficiently analyze the inexact information and investigate the fuzzy relation by applying the fuzzy graph theory. We would extend the fuzzy graph theory, and propose a fuzzy node fuzzy graph. Since a fuzzy node fuzzy graph is complicated to analyze, we would transform it to a simple fuzzy graph by using T-norm family. In addition, to investigate the relations between nodes, we would define the fuzzy contingency table.

P506 *On another approach to the definition of an L-fuzzy valued integral* [#419]

Vecislavs Ruza
Svetlana Asmuss

University of Latvia, Latvia
University of Latvia, Latvia

We continue to develop a construction of an L-fuzzy valued measure extending a crisp measure defined on a s -algebra of crisp sets to an L-fuzzy valued measure defined on a \mathcal{T} -tribe. We describe two equivalent approaches to define an L-fuzzy valued integral of non-negative measurable functions.

P507 *Evolving Fuzzy Image Segmentation* [#422]

Ahmed Othman
Hamid Tizhoosh

University of Waterloo, Canada
University of Waterloo, Canada

Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label are connected and meaningful, and share certain visual characteristics. Pixels in a region are similar with respect to some features or property, such as color, intensity, or texture. Adjacent regions may be significantly different with respect to the same characteristics. Therefore, it is difficult for a static (nonlearning) segmentation

technique to accurately segment different images with different characteristics. In this paper, an evolving fuzzy system is used to segment medical images. The system uses some training images to build an initial fuzzy system which then evolves online as new images are encountered. Each new image is segmented using the evolved fuzzy system and may contribute to updating the system. This process provides better segmentation results for new images compared to static paradigms. The average of segmentation accuracy for test images is calculated by comparing every segmented image with its gold standard image prepared manually by an expert.

P508 On spline methods of approximation under L-fuzzy information [#430]

Svetlana Asmuss
Alexander Sostak

University of Latvia, Latvia
University of Latvia, Latvia

This work is closely related to our previous papers on algorithms of approximation under L-fuzzy information. In the classical theory of approximation central algorithms were worked out on the basis of usual, that is crisp splines. We describe central methods for solution of linear problems with balanced L-fuzzy information and develop the concept of L-fuzzy splines.

P509 Local Non-Quadratic H-infinity Control For Continuous-Time Takagi-Sugeno Models [#440]

Miguel Bernal
Adolfo Soto-Cota
Joaquin Cortez
Jose Luis Pitarch
Abdelhafidh Jaadari

Sonora Institute of Technology, Mexico
Sonora Institute of Technology, Mexico
Sonora Institute of Technology, Mexico
Universidad Politecnica de Valencia, Spain
Universite de Valenciennes et du Hainaut-Cambresis, France

This paper extends to H-infinity performance design a recent local approach for non-quadratic stabilization of continuous-time Takagi-Sugeno (TS) models based on the fuzzy Lyapunov function (FLF). The main obstacle for using FLFs altogether with TS models consists in handling the time-derivatives of the membership functions (MFs). By reducing global stability goals via local considerations, the aforementioned impediment has been removed leading to stabilization domains where H-infinity disturbance rejection is guaranteed. Conditions are expressed as linear matrix inequalities (LMIs), thus enabling systematic and efficient solutions which are solved by convex optimization techniques.

P510 Fuzzy Active Contour Models [#451]

Cesar Pereira
Carlos Bastos
Ren Tsang
George Cavalcanti

Federal University of Pernambuco, Brazil
Federal University of Pernambuco, Brazil
Federal University of Pernambuco, Brazil
Federal University of Pernambuco, Brazil

This paper presents a Fuzzy Active Contour Model for image segmentation using three variations. The proposed models are based on the Fuzzy Energy-Based Active Contour model introduced by Krinidis and Chatzis. First, an update criteria that changes only localized membership values at each iteration is introduced. Second, the model is extended to a type-2 fuzzy logic. And finally, a multiple object segmentation schema is applied to the original model. We present some experimental results, showing the performance for each modification and some of its advantages.

P511 Discretization of fuzzy transitive relations [#470]

D. Boixader
J. Recasens

Universitat Politecnica de Catalunya, Spain
Universitat Politecnica de Catalunya, Spain

Fuzzy transitivity is a key property for many fuzzy relational structures, such as Fuzzy Preorders and Equivalences. Theoretical models for practical problems which are based on fuzzy relations make use of continuous scales, mostly the unit interval $[0, 1]$. Practical implementation of these models though, involves their discretization into finite scales, which generally results in some loss of transitivity. In this paper we study if there are any transitivity preserving discretization strategies. Also, we evaluate the loss of transitivity in some commonly used discretization approaches.

P512 Tridimensional Fuzzy Pain Assessment [#476]

Ernesto Araujo
Suzana Miyahira

Universidade Federal de Sao Paulo (Unifesp), Brazil
Hospital Municipal Dr. Jose de Carvalho Florence, Brazil

A tridimensional fuzzy pain assessment for representing professional, social, and sexual aspects concerned to the fifth vital sign of medical condition is proposed in this paper. According to the 3D fuzzy pain assessment herein, pain is not only caused by activity in nociceptive information in the brain. The proposed approach embodies such sensorial information simultaneously that contextualize it within cultural aspects that permeate the human life. This paper extends both previous unidimensional fuzzy pain intensity scale and the accepted professional-social-sexual pain assessment to fuzzy inference systems. The fuzzy professional-social-sexual pain assessment is able to represent the inherent physiological, psychological characteristics by taking into account the emotional, complex perceptual, subjective, and personal phenomenon involving all domains of an individual meanwhile can deal with cultural mechanisms within individual life experience. According to the proposed approach, not only fuzzy set theory but fuzzy systems can also direct and immediately improve medicine and healthcare in general, and pain assessment, in particular, in a subjective and multi-dimensional model.

P513 Integrate Variable Precision Rough Sets and Modified PBMF Index Function for Partitioning and Classifying Complex Datasets [#478]Kuang Yu Huang
Yu-Hsin ChengLing Tung University, Taiwan
Ling Tung University, Taiwan

This study proposes a method for partitioning and classifying complex datasets using a hybrid method based on Fuzzy C-Means (FCM) method, Variable Precision Rough Set (VPRS) theory and a modified form of the PBMF index function (a cluster validity index function). The proposed VPRS index method partitions the attributes within the dataset rather than the data and achieves both the optimal number of clusters and the optimal classification accuracy. The validity of the proposed approach is confirmed by comparing the clustering results obtained from the VPRS method for a hypothetical function and a typical stock market system with those obtained from the conventional RS and PBMF methods, respectively. Overall, the results show that the VPRS index method not only has a better clustering performance than the PBMF method, but also achieves greater classification accuracy, and therefore provides a more reliable basis for the extraction of decision-making rules.

P514 Anti-Swing Control of A New Container Crane With Fuzzy Uncertainties Compensation [#486]Weimin Xu
Wei Gu
Aidi Shen
Jianxin Chu
Wangqiang NiuShanghai Maritime University, China
Shanghai Maritime University, China
Shanghai Maritime University, China
Shanghai Maritime University, China
Shanghai Maritime University, China

A class of new container cranes with eight-link lifting mechanics which can reduce sway efficiently as a result of improved lifting structure have been put to use recently, and both modeling and swing control of such a crane system attracts a lot attention in the field of control technology development. In this paper, dynamics model of the new container crane is investigated, an anti-swing control scheme with fuzzy uncertainty compensation is proposed to ensure the positioning control as well as overall closed-loop system stability. None of the system parameters is required for the controller design a priori. In the proposed control laws, the position error can be driven to a bounded area while the swing angle being also rapidly damped so as to achieve minimal sway of the crane system. Stability analysis of the controller is also given. Finally, simulation results show the performance successfully.

P515 A Robust Method for Image Segmentation of Noisy Digital Images [#492]Prabhjot Kaur
I. M. S. Lamba
Anjana GosainMSIT, Affiliated to GGSIP University, India
Sharda University, India
GGSIP University, India

A robust image segmentation algorithm called Extended Fuzzy C means (EFCM) is presented in this paper which preprocesses the image to reduce the noise effect and then apply FCM algorithm for image segmentation. Preprocessing of image is influenced by the direct eight neighborhood pixels of study pixel of an image under consideration. The advantages of the propose algorithm is: (1) Least execution time compared to other techniques. (2) It yields regions more homogeneous than those of other techniques. (3) It removes noisy spots and is less sensitive to noise. The propose technique is a powerful method for noisy image segmentation with least computation time and convergence rate compared to other image segmentation techniques.

P516 The Fuzzy DEMATEL based Job Accommodation Strategy Definitions for Operators with Hearing Impairments [#534]Chi-Yo Huang
Gwo-Hsiung TzengNational Taiwan Normal University, Taiwan
Kainan University, Taiwan

The embedded memories have already played a very important role in the modern system on a chip (SoC) designs from the aspects of performance enhancement, power reduction, form factor optimization, etc. Meanwhile, embedded memories usually occupied for the major portion of an SoC layout. Thus, how an embedded memory IP (intellectual property) provider can differentiate the product to maximize the value of that IP has already become a key factor for profit maximization. However, very few scholars tried to resolve such problems. The product and service differentiation problem of memory IPs is in nature a multiple attribute decision making (MADM) problem. Moreover, the differentiators of an embedded memory IP usually interact with each other. Furthermore, evaluations of customers' needs and wants, which are vague, are often required for such a product marketing strategy definition problem. Thus, a fuzzy DEMATEL based multiple criteria decision making (MCDM) framework will be proposed for maximizing the value of an embedded memory IP. The value driver for differentiating an embedded memory IP will first be derived by literature review. The most influential value drivers will be selected. Then, strategies will be proposed for maximizing the value through the most influential value drivers. An empirical study based on an embedded memory IP being provided by an SOC design service provider will be used for verifying the feasibility of the framework. Based on the empirical study results, both power consumption as well as the area of the embedded memory core are the most important value drivers. The proposed product marketing strategies can also be used for maximizing the value of the embedded IP.

P517 A Fuzzy MCDM method to select the best company based on Financial Report Analysis [#527]Jung-Yuan Kung
Tzung-Nan Chuang
Minh Ky ChauChinese Naval Academy Kaohsiung, Taiwan
National University of Tainan, Taiwan
National University of Tainan, Taiwan

In this paper, based on financial report analysis, a multi-criteria decision-making approach for supporting decision is presented. There are five companies are evaluated by proposed method. Fuzzy AHP (Analytic Hierarchy Process) is utilized to evaluate weights of criteria for selecting company and fuzzy TOPSIS (technique for order preference by similarity to ideal solution) is used to determine the most suitable alternative with respect to various considered criteria. A numerical example is also included to demonstrate the proposed approach.

P518 Improve Observation-Based Discrete Hidden Markov Model by Fuzzy Vector Quantization -- An example on electroencephalogram (EEG) signal recognition [#572]

Shing-Tai Pan
Sheng-Fu Liang
Tzung-Pei Hong
Jian-Hong Zeng

National University of Kaohsiung, Taiwan
National Cheng Kung University, Taiwan
National University of Kaohsiung, Taiwan
National University of Kaohsiung, Taiwan

This paper applies fuzzy vector quantization (FVQ) to the modeling of observation-based Discrete Hidden Markov Model (DHMM) and then to improve the recognition rate for the EEG signal on sleep staging. Vector quantization based on a codebook is a fundamental process to recognize the EEG signal by DHMM. A codebook will be first trained by K-means algorithms. Then, based on the trained codebook, the signal features are quantized by the fuzzy sets defined on each vectors of the codebook. Subsequently, the quantized signal features are statistically applied to train the model of DHMM for the sleep stage recognition. All the signal features to be recognized should go through the FVQ based on the fuzzy codebook before being fed into the DHMM model for recognition. Experimental results in this paper shows that the recognition rate can be improved by using FVQ algorithm to train the model of DHMM.

P519 Design of Interval Type-2 Fuzzy Logic Systems Using Prior Knowledge via Optimization Algorithms [#92]

Tiechao Wang
Jianqiang Yi

Chinese Academy of Sciences, China
Chinese Academy of Sciences, China

The paper presents the methods of integrating prior knowledge with a single-input single-output (SISO) first-order Interval Type-2 Takagi-Sugeno-Kang (TSK) Fuzzy Logic System (IT2FLS) for function approximation under noisy circumstances. First, sufficient conditions on the antecedent and the consequent parameters of the IT2FLS are given to ensure that three kinds of prior knowledge - monotonicity, symmetry and special points, can be embedded in the IT2FLS. And then, we use three optimization algorithms - constrained least squares algorithm, active-set algorithm and hybrid learning algorithm to design the IT2FLS, respectively. The effectiveness of the three algorithms and the comparisons of their performance are demonstrated by simulation examples.

P520 Fuzzy Reinforcement Learning for System of Systems (SOS) [#34]

Hamid Berenji
Mo Jamshidi

IIS Corp, United States
University of Texas at San Antonio, United States

The System of Systems (SOS) technology is an advanced technology for Intelligent Systems that is developed with multiple intelligent systems. Recently, there has been a growing interest in a class of complex systems (robotic swarm as an example) whose constituents are themselves complex. Performance optimization, robustness and reliability among an emerging group of heterogeneous systems in order to realize a common goal have become the focus of various applications including military, security, aerospace, space, manufacturing, service industry, environmental systems, and disaster management, to name a few. In this paper, we discuss how Fuzzy Reinforcement Learning (FRL) can be used in SOS.

(SS20) Special Session: Universal Contents Creation/Distribution and Intelligent System

Wednesday, June 29, 2:50PM-4:30PM, Room: Swan, Chair: Katsuhiko Honda

2:50PM Partially Exclusive Condition for Sequential Fuzzy Co-cluster Extraction [#48]

Katsuhiko Honda
Akira Notsu
Hidetomo Ichihashi

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Sequential fuzzy co-cluster extraction has been proved to be useful for collaborative filtering tasks by extracting user-item co-clusters, in which promising items are connected to the corresponding users in each co-cluster. Because some popular items can be shared by multiple clusters in collaborative filtering problems, exclusive conditions, which forces objects to belong to only one cluster, were used only for users. In this paper, it is demonstrated that such user-only exclusive conditions may cause poor clustering results, and partially exclusive conditions, in which a part of items are also forced to be exclusive, are introduced. Additionally, some connections with neural approaches for co-clustering are discussed, in which co-clustering problems are identified with a modified model of principal component analysis.

3:10PM DEA based Hierarchical Structure Evaluation and Visualization Method [#323]

Kazushige Inoue
Takeo Ichinotsubo
Shingo Aoki

Osaka Prefecture University, Japan
Osaka Prefecture University, Japan
Osaka Prefecture University, Japan

Data Envelopment Analysis (DEA) is a method for evaluating the management efficiency of Decision Making Units (DMUs) relatively. However, when the number of inputs and outputs items is increased, the results of evaluation value are similar regrettably. In order to evaluate Japanese universities which have various activities, this study proposed the hierarchical structure DEA model which is divided into some activities (finance, achievement, attractiveness, research, and education). Hierarchical structure has constructed by some layers based on the theory that the efficiencies of lower layer can not exceed the ones of upper layer. In addition, this paper proposed the visualization method that the analyst can visually understand which field is strong or weak. Using proposed DEA model and visualizing method, the numerical study showed us to be able to understand the feature of each university.

3:30PM *Group Decision Focusing on Outliers* [#115]

Tomoe Entani

Kochi University, Japan

This paper investigates a group decision problem focusing on outliers in a group. The group decision in this paper is considered as approximation of all individual opinions, which are given normalized crisp or interval values. The difference of an individual opinion from the group opinion represents his/her compromise in order to reach a consensus so that it should be minimized. The first step is to detect outliers in a group and assign outlier degree to individual. The outlier degree is distance of an individual from the group of others and defined as the reduction of compromise by excluding him/her from the group. The outlier degree of a unique individual is more than those of other general individuals. Similarly to outlier degree, inlier degree is closeness of others to an individual and defined as the compromise of the group without him/her. The second step is to approximate individual opinions so as to be a group opinion. The weighted sum of compromises of all individuals is minimized introducing the outlier degrees as the weights of individuals. In this model, outliers are considered positively into account for a group opinion. Therefore, based on compromises of individuals, the models to define outlier degree and to obtain group opinion by approximating individual opinions are proposed in this paper.

3:50PM *PCA-guided k-Means Clustering With Incomplete Data* [#15]

Katsuhiro Honda

Osaka Prefecture University, Japan

Ryoichi Nonoguchi

Osaka Prefecture University, Japan

Akira Notsu

Osaka Prefecture University, Japan

Hidetomo Ichihashi

Osaka Prefecture University, Japan

This paper considers k-Means clustering of incomplete data sets including missing values. Although the essential purpose of k-Means clustering is to partition samples into several homogeneous clusters by minimizing within-cluster errors, it was shown that a relaxed solution of k-Means can be recovered by a PCA-guided manner. In this paper, the PCA-guided k-Means procedure is extended to a situation where some observations are missing. Principal component scores, which can be identified with a rotated solution of cluster indicators of k-Means clustering, are estimated in an iterative process without imputation. Besides solving the eigenvalue problem of covariance matrices, k-Means-like partitions are derived through lower rank approximation of data matrix ignoring missing elements. Several experimental results demonstrate that the PCA-guided process is more robust to initialization problems even though it is also based on the iterative optimization principle like as k-Means.

4:10PM *Proposed Particle-Filtering Method for Reinforcement Learning* [#53]

Akira Notsu

Osaka Prefecture University, Japan

Katsuhiro Honda

Osaka Prefecture University, Japan

Hidetomo Ichihashi

Osaka Prefecture University, Japan

We propose a novel action-search particle-filtering algorithm for reinforcement learning processes. This algorithm is designed to perform search domain reduction and heuristic space segmentation. In this method, each action space is divided into several new segments using particles. Appropriate search domain reduction can minimize learning time and enable the recognition of the evolutionary process of learning. In a numerical experiment, the proposed filtering method is applied to a single-pendulum simulation in order to demonstrate the adaptability of this simulation model.

(SS03) Special Session: Uncertainty and the Semantic Web

Wednesday, June 29, 2:50PM-4:30PM, Room: Peacock, Chair: Fernando Bobillo

2:50PM *Formalizing Object Membership in Fuzzy Ontology with Property Importance and Property Priority* [#298]

Yi Cai

South China University of Technology, China

Ho-fung Leung

Chinese University of Hong Kong, Hong Kong

In this paper, we formalize the object membership in fuzzy ontology with property importance and property priority, while previous models lack building blocks to handle the importance and priority of properties. A formal mechanism used to measure object memberships in concepts is proposed. Such a mechanism can measure object memberships in concepts defined by properties with importance or priority well. We show that our model is more reasonable in measuring object memberships in concepts than previous models by examples and experiments.

3:10PM Aggregation Operators and Fuzzy OWL 2 [#142]

Fernando Bobillo
Umberto Straccia

University of Zaragoza, Spain
ISTI - CNR, Italy

Fuzzy Description Logics (Fuzzy DLs) are logics that allow to deal with structured knowledge affected by fuzziness. Fuzzy DLs are at the heart of Fuzzy OWL 2, a fuzzy version of the standard ontology language OWL 2. Although a relatively important amount of work has been carried out in the last years, fuzzy DLs are open to be extended with several features worked out in other fields. In particular, the integration of aggregation operators (AOs) in fuzzy DLs has received little attention so far. In this work, we show how to support aggregation operators in fuzzy DLs. We provide syntax and semantics of a fuzzy DL extended with AOs, and provide a calculus for a family of AOs (weighted sum, OWA and quantifier-guided OWA). We also show how to encode them into our proposal for Fuzzy OWL 2.

3:30PM Are Fuzzy Description Logics with General Concept Inclusion Axioms Decidable? [#310]

Franz Baader
Rafael Penaloza

TU Dresden, Germany
TU Dresden, Germany

This paper concentrates on a fuzzy Description Logic with product t-norm and involutive negation. It does not answer the question posed in its title for this logic, but it gives strong indications that the answer might in fact be "no." On the one hand, it shows that an algorithm that was claimed to answer the question affirmatively for this logic is actually incorrect. On the other hand, it proves undecidability of a variant of this logic.

3:50PM Fuzzy Concept Lattice Construction: A Basis for Building Fuzzy Ontologies [#454]

Valerie Cross
Meenaskhi Kandasamy

Miami University, United States
Miami University, United States

Fuzzy concept lattices are being used as the basis for creating fuzzy ontologies. Fuzzy formal contexts serve as the starting point for which a variety of proposed methods have been used to create fuzzy concept lattices from them. This paper reviews two of these methods: the one-sided threshold approach and the fuzzy closure operator approach and presents the first comparison between these two approaches. Some simple examples are used and then bioinformatics data, specifically several gene annotation data files. The results show that the fuzzy closure approach produces huge numbers of concepts as compared to the threshold approach, and the extents produced by the threshold approach are a subset of the extents produced by the fuzzy closure approach.

4:10PM Fuzziness, OWA and Linguistic Quantifiers for Web Selection Processes [#420]

Ronald R. Yager
Marek Z. Reformat
Giray Gumrah

Iona College, United States
University of Alberta, Canada
University of Alberta, Canada

The Internet becomes an enormous source of information containing billions of documents. Users deal with an overwhelming number of alternatives, and continuously make decisions anytime they want to obtain meaningful information. The paper describes an approach for a simple yet effective selection of the most suitable information that fits user's needs. The novelty of the approach is twofold: the concept of lexicographical-like preferences used for a multi-criteria decision-making with elements of fuzziness and OWA operator; a simple fuzzy number based mechanism for estimating user's degrees of acceptance of criterion satisfaction. The lexicographic preferences allow for mimicking user's attitude that some criteria should be satisfied before other criteria are considered. The acceptance of criterion satisfaction levels are defined with a single threshold that represents a boundary value between acceptable and unacceptable values of attributes of alternatives. The paper includes results of a simple case study performed on a prototype of a web selection system built using the proposed approach.

(SS04) Special Session: Soft Computing for Operations Research and Optimization

Wednesday, June 29, 2:50PM-4:30PM, Room: Phoenix, Chair: Takashi Hasuike

2:50PM Visual Stability Improvement of SOM's Feature Map by Initial Value Assignment [#502]

Shinji Momoi
Tsutomu Miyoshi

Ryukoku University, Japan
Ryukoku University, Japan

In SOM learning, learning result depends on initial value of feature map and the location of the node or the distance between nodes on feature map is important factor to determine feature of individual data. For example, in data detection of hematopoietic tumors, given data is detected by location of the feature map. In this paper, we focused on visual stability of SOM feature map, and we proposed new initialization method of SOM feature map. The purposes of proposed method are improvement of visual stability of SOM feature map, and utilization of generalization ability of SOM. By experiments, proposed method is visually stable than conventional method in the point of feature map location, and the computational complexity of proposed method is greatly reduced.

3:10PM Study of morphogenesis of a large-span roof that satisfies its form design requirements [#61]

Yuya Takeda
Kazutoshi Tsutsumi

Shibaura Institute of Technology, Japan
Shibaura Institute of Technology, Japan

1. Purpose The computer performance is improving, and the various system optimizations by using the evolutionary computing are developed in recent years. We developed an idea support morphogenesis system

that satisfies the designer's image and proposes the form with a high mechanical rationality, by using the Genetic Algorithm. However, the form that can be proposed by the existing research is limited in a symmetric form, and the proposed form does not have a guarantee that satisfies the designer's image. To solve these problems, and to develop a more effective system, the improvements of this study are as follows; 1) To enable the input of asymmetric form image 2) To propose Pareto solutions as two purpose optimization problem of "Image" and "Equivalent stress", and to develop the system to which the designer can decide the final form. 3) To obtain the design knowledge concerning a morphological change necessary to improve the mechanical rationality.

3:30PM *Multiobjective Two-Level 0-1 Programming through Distributed Genetic Algorithms* [#86]

Keiichi Niwa
Tomohiro Hayashida
Masatoshi Sakawa

Hiroshima University of Economics, Japan
Hiroshima University, Japan
Hiroshima University, Japan

In this paper we focus on a multiobjective two-level 0-1 programming problem in which the decision maker at the upper level has an objective function and the decision maker at the lower level has multiple objective functions. We assume that there is not coordination between the decision maker at the upper level and the decision maker at the lower level. The decision maker at the upper level must take account of multiple rational responses of the decision maker at the lower level in the problem. We examine two kinds of situations based on anticipation of the decision maker at the upper level; an optimistic anticipation and a pessimistic anticipation. We show mathematical programming problems for obtaining the Stackelberg solutions based on two kinds of anticipation and propose computational methods using genetic algorithms for obtaining the Stackelberg solutions. In order to demonstrate feasibility and effectiveness of the proposed computational methods through genetic algorithms, we plan to conduct numerical experiments.

3:50PM *Optimal Static Output Feedback Control of Fuzzy-Model-Based Control Systems* [#12]

Wen-Hsien Ho
Shinn-Horng Chen
Chou Jyh-Horng
Chun-Chin Shu

Kaohsiung Medical University, Taiwan
National Kaohsiung University of Applied Sciences, Taiwan
National Kaohsiung First University of Science and Technology, Taiwan
National Kaohsiung First University of Science and Technology, Taiwan

By integrating the stabilizability condition, the orthogonal-functions approach (OFA), and the hybrid Taguchi-genetic algorithm (HTGA), an integrative method is presented in this paper to design the stable and quadratic-optimal static output feedback parallel-distributed-compensation (PDC) controller such that (i) the Takagi-Sugeno (TS) fuzzy-model-based control system can be stabilized, and (ii) a quadratic integral performance index for the TS-fuzzy-model-based control system can be minimized. In this paper, the stabilizability condition is proposed in terms of linear matrix inequalities (LMIs). A design example of stable and quadratic-optimal static output feedback PDC controller for a nonlinear inverted pendulum system controlled by a separately excited direct-current (DC) motor is given to demonstrate the applicability of the proposed new integrative approach.

4:10PM *An Interactive Satisficing Method for Multiobjective Random Fuzzy Programming Problems through the Possibility-Based Probability Model* [#197]

Hideki Katagiri
Masatoshi Sakawa
Takeshi Matsui

Hiroshima University, Japan
Hiroshima University, Japan
Hiroshima University, Japan

This paper considers multiobjective linear programming problems where each coefficient of the objective functions is expressed by a random fuzzy variable. A new decision making model is proposed in order to maximize both of possibility and probability with respect to the objective function values. An interactive algorithm is constructed to obtain a satisficing solution for a decision maker from among a set of Pareto optimal solutions.

(SS01) Special Session: Fuzzy Ontologies and FML Applications

Wednesday, June 29, 2:50PM-4:30PM, Room: Crane, Chair: Giovanni Acampora

2:50PM *Improving Ontology Alignment through Memetic Algorithms* [#307]

Giovanni Acampora
Pasquale Avella
Vincenzo Loia
Salerno Saverio
Autilia Vitiello

University of Salerno, Italy
University of Sannio, Italy
University of Salerno, Italy
University of Salerno, Italy
University of Salerno, Italy

Born primarily as means to model knowledge, ontologies have successfully been exploited to enable knowledge exchange among people, organizations and software agents. However, because of strong subjectivity of ontology modeling, a matching process is necessary in order to lead ontologies into mutual agreement and obtain the relative alignment, i.e., the set of correspondences among them. The aim of this paper is to propose a memetic algorithm to perform an automatic matching process capable of computing a suboptimal alignment between two ontologies. To achieve this aim, the ontology alignment problem has been formulated as a minimum optimization problem characterized by an objective function depending on a fuzzy similarity. As shown in the led experiments,

the memetic approach results more suitable for ontology alignment problem than other evolutionary techniques such as genetic algorithms.

3:10PM *Genetic Fuzzy Markup Language for Diet Application* [#468]

Chang-Shing Lee
Mei-Hui Wang
Zhi-Wei Chen
Chin-Yuan Hsu
Su-E Kuo
Hui-Ching Kuo
Hui-Hua Cheng
Akio Naito

National University of Tainan, Taiwan
National University of Tainan, Taiwan
National University of Tainan, Taiwan
Institute for Information Industry, Taiwan
National Cheng Kung University Hospital, Taiwan
National Cheng Kung University Hospital, Taiwan
National Cheng Kung University Hospital, Taiwan
Osaka Prefecture University, Japan

In this paper, the genetic fuzzy markup language (GFML) is presented to describe the knowledge base and rule base of the diet domain, including ingredients and the contained servings of six food categories of some common food. The domain experts first define the nutrient facts of the common food to construct the fuzzy food ontology. Meanwhile, the involved Taiwanese students of National University of Tainan (NUTN) record their daily meals for a constant period of time. Then, based on the built fuzzy food ontology, a GFML-based learning mechanism combined the genetic learning mechanism with the fuzzy markup language (FML) is carried out to infer the possibility of dietary healthy level for one-day meals. From the experimental results, it is known that the proposed GFML-based learning mechanism is workable for the diet-domain healthcare applications.

3:30PM *A Hierarchical Approach to Assess Keyword Dependencies in Fuzzy Keyword Ontologies* [#124]

Christer Carlsson
Robert Fuller
Mario Fedrizzi

Abo Akademi University, Finland
Abo Akademi University, Finland
University of Trento, Italy

The Knowledge Mobilization project (KNOWMOBILE) has been a joint effort by Institute for Advanced Management Systems Research, Abo Akademi University and VTT Technical Research Centre of Finland. Its goal was to better "mobilize" knowledge stored in heterogeneous databases for users with various backgrounds, geographical locations and situations. The working hypothesis of the project was that fuzzy mathematics combined with domain-specific data models, in other words, fuzzy ontologies, would help manage the uncertainty in finding information that matches the user's needs. In this way, KNOWMOBILE places itself in the domain of knowledge management. In this paper we describe an industrial demonstration of fuzzy ontologies in information retrieval in the paper industry where problem solving reports are annotated with keywords and then stored in a database for later use. Furthermore, using Belmann-Zadeh's principle to fuzzy decision-making we will show a method for identifying keyword dependencies in the keyword taxonomic tree.

3:50PM *Improving Disease Prediction Using ICD-9 Ontological Features* [#148]

Mihail Popescu
Mohammed Khalilia

University of Missouri, United States
University of Missouri, United States

Disease prediction has become important in a variety of applications such as health insurance, tailored health communication and public health. Disease prediction is usually performed using publically available datasets such as HCUP, NHANES or MDS that were initially designed for reporting or cost evaluation but not for prediction. In these datasets, medical diagnoses are traditionally arranged in "diagnose-related groups" (DRGs). In this paper we compare the disease prediction based on crisp DRG features with the results obtained employing a new set of features that consist of the fuzzy membership of patient diagnoses in the DRG groups. The fuzzy membership features were computed using an ICD-9 ontological similarity approach. The prediction results obtained on a subset of 30,000 patients from the 2005 HCUP data representing three diseases (diabetes, atherosclerosis and hypertension) using two classifiers (random forest and SVM) show significant (about 10%) improvement as measured by the area under the ROC curve (AROC).

(SS42-2) Special Session: Fuzzy Cognitive Maps-Theory and Applications

Wednesday, June 29, 2:50PM-4:30PM, Room: Egret, Chair: Chair: Elpiniki I. Papageorgiou and Sebastian Lozano

2:50PM *Software Maintenance Scenarios Simulation with Fuzzy Cognitive Maps* [#514]

Cristina Lopez
Jose L. Salmeron
Sebastian Lozano

University Pablo de Olavide, Spain
University Pablo de Olavide, Spain
University of Seville, Spain

Successful performance of software, and indeed Enterprise Resource Planning (ERP), depends on proper system maintenance. For this reason, firms should follow a maintenance process that drives the ERP system toward success. However, in general terms, ERP maintenance managers do not know what conditions they should target to successfully maintain their ERP systems. Moreover, numerous risks threaten ERP maintenance, but they are normally dealt trusting on experience. To address this requirement, we have built a Fuzzy Cognitive Map-based tool that helps ERP teams to simulate the impact of risks on ERP maintenance.

3:10PM Train Fuzzy Cognitive Maps by Gradient Residual Algorithm [#262]

Huiliang Zhang
Zhiqi Shen
Chunyan Miao

Nanyang Technological University, Singapore
Nanyang Technological University, Singapore
Nanyang Technological University, Singapore

Fuzzy Cognitive Maps (FCM) is a popular technique for describing dynamic systems. A FCM for a dynamic system is a signed graph consisted of relevant concepts and causal relationships/weights between the concepts in the system. With suitable weights defined by experts in the related areas, the inference of the FCM can provide meaningful modeling of the system. Thus correctness of the weights is crucial to the success of a FCM system. Normally the weights are set by experts in the related areas. Considering the possible inefficiency and subjectivity of experts when judging the weights, it is an appealing idea to generate weights automatically according to the samples obtained through observation of the system. Some training algorithms were proposed. However, to our best knowledge, no learning algorithm has been reported to generate weight matrix based on sample sequences with continuous values. In this paper, we introduce a new learning algorithm to train the weights of FCM. In the proposed algorithm, the weights are updated by gradient descent on a squared Bellman residual, which is an accepted method in machine learning. The experiment results show that given sufficient training samples, the correct weights can be approximated by the algorithm. The algorithm proposes a new way for FCM research and applications.

3:30PM Causal Modeling Approximations In The Medical Domain [#556]

Lawrence Mazlack

University of Cincinnati, United States

Studies in the health sciences often seek to discover cause-effect relationships among observed variables of interest, for example: treatments, exposures, preconditions, and outcomes. Consequently, causal modeling and causal discovery are central to medical science. In order to algorithmically consider causal relations, the relations must be placed into a representation that supports manipulation and discovery. Knowledge of at least some causal effects is inherently imprecise or approximate. The most widespread causal representation is directed acyclic graphs (DAGs). However, DAGs are limited in what they can represent. Another graph methodology, fuzzy cognitive maps (FCMs) holds promise as a model that overcomes some of the difficulties found in other approaches. This paper considers causality and suggests fuzzy cognitive maps as a useful causal representation methodology.

3:50PM Interactive fuzzy programming through possibility measures and probability maximization for two-level linear programming problems involving fuzzy random variable coefficients [#163]

Masatoshi Sakawa
Hideki Katagiri
Takeshi Matsui

Hiroshima University, Japan
Hiroshima University, Japan
Hiroshima University, Japan

In this research, focusing on two-level linear programming problems involving fuzzy random variables, we propose a new decision making model through possibility measures. Taking into account vagueness of judgments of decision makers for each objective function, fuzzy goals are introduced. Noting that the degree of the possibility fluctuates stochastically, we propose a probability maximization model in stochastic programming. Through probability maximization, the transformed stochastic two-level programming problem can be reduced to a deterministic one. Interactive fuzzy programming to derive a satisfactory solution for the decision maker at the upper level in consideration of the cooperative relation between decision makers is presented.

(SS21-2) Special Session: Fuzzy Control in Industrial and Application

Wednesday, June 29, 2:50PM-4:30PM, Room: Swallow, Chair: Shun-Hung Tsai, Chin-Sheng Chen and Ming-Ying Hsiao

2:50PM Decentralized Fuzzy Fault Tolerant Control for Multiple Satellites Attitude Synchronization [#265]

Junquan Li
K. D. Kumar

Ryerson University, Canada
Ryerson University, Canada

This paper presents a decentralized adaptive approximation design to achieve attitude tracking control for decentralized formation flying in presence of control input saturation, model uncertainties, external disturbances and reaction wheel faults. A nonsingular fast terminal sliding mode control is designed for finite time distributed cooperative attitude synchronization. In the proposed control scheme, a fuzzy logic system (FLS) is introduced to approximate unknown individual satellite attitude dynamics on-line due to the actuators fault. In order to achieve the capability of fault management without the involvement of ground station operators, the proposed control laws do not require an explicit fault detection and isolation mechanism. In the attitude control system of each satellite four reaction wheels are placed in a pyramid configuration, numerical simulation results including actuator dynamics and initial conditions' uncertainties show that the proposed strategy with FLS can compensate for the fault and the system continues to operate satisfactorily with wheel voltage or wheel speed faults and the closed loop distributed tracking control system is stochastically stable. Several simulation examples compared with the existing decentralized fault tolerant controller are presented for illustrating the effectiveness of the proposed fault tolerant control methodology.

3:10PM T-S Fuzzy Tracking and Synchronous Control in a Gantry Stage [#128]

Chin-Sheng Chen

National Taipei University of Technology, Taiwan

Chao-Feng Lee
Po-Huan Chou
Faa-Jeng Lin
Shun-Hung Tsai

National Taipei University of Technology, Taiwan
National Dong Hwa University, Taiwan
National Central University, Taiwan
National Taipei University of Technology, Taiwan

In this paper, we propose a T-S fuzzy model based controller for the H-type gantry stage. The synchronized error, which is caused by mismatch quality and friction, is an important control problem for the H-type gantry stage. Utilizing a Lagrangian equation, all states can be formulated as a state equation. Furthermore, the T-S fuzzy model based controller is designed to reduce velocity error, and the position error can also be obtained through internal transformation. Moreover, by utilizing additional transformations, the stabilization problem can be transformed into a linear matrix inequalities (LMIs) problem. Finally, numerical simulation and experimental results are illustrated to demonstrate that the control scheme can effectively reduce synchronized error and tracking error of a gantry stage.

3:30PM Observer-Based Adaptive FNN Control of Robot Manipulators: PSO-SA Self Adjust Membership Approach [#181]

Kai-Shiuan Shih
Tzuu-Hseng S. Li
Shun-Hung Tsai

National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan
National Taipei University of Technology, Taiwan

In this paper, a novel observer-based adaptive fuzzy-neural network control scheme for robotic systems is proposed for tracking performance and to suppress the effects caused by state uncertainties, and disturbances. A PSO-SA based adaptive FNN system is used to approximate an unknown system from the manipulation of the model following tracking errors. The proposed scheme uses an observer, which allows for the inclusion of identifying the state of an unknown state in the system, simultaneously. It is shown that the proposed control scheme can guarantee parameter estimation convergence and stability robustness of the closed-loop system with tracking performance for the overall system without a priori knowledge of the upper bounds. Simulations are given to show the validity and confirm the performance of the proposed scheme.

3:50PM Design of Digital Battery Charger System Based on PV-Module [#137]

Ta-Tau Chen
Ming-Ying Hsiao
Shun-Hung Tsai
Che-Nan Lin

Kun Shan University, Taiwan
Fortune Institute of Technology, Taiwan
National Taipei University of Technology, Taiwan
Kun Shan University, Taiwan

This paper aims at to realize the solar cell charged systems of 120W PV module with the dsPIC30F4011 control chip. All of the control schemes are written and accomplished with the C language. In the power converter, a single-ended primary inductance converter (SEPIC) is adopted which has the features including the buck-boost operating mode, no polarity inversion, low input current pulsation, and wide input voltage range, so, it is very suitable for the conversion of solar cell. In order to obtain the high efficient solar cell energy conversion, a fuzzy maximum power point tracking (MPPT) control is adopted if the solarization is insufficient. The fuzzy controller is to maintain a charged current so as the battery voltage reach to desired value. The effectiveness of the proposed methods is demonstrated with the experimental result.

4:10PM Fuzzy Approaches for Multiobjective Stochastic Linear Programming Problems Considering Both Probability Maximization and Fractile Optimization [#217]

Hitoshi Yano

Nagoya City University, Japan

In this paper, we propose two kinds of fuzzy approaches to obtain a satisfactory solution for multiobjective stochastic linear programming problems, in which the criteria of probability maximization and fractile optimization are considered simultaneously. In the first approach, a probability maximization model is applied to multiobjective stochastic linear programming problems, where the decision maker is required to specify not permissible objective levels but the corresponding membership functions which represent fuzzy goals for permissible objective levels. By adopting the fuzzy decision to integrate both the membership functions for permissible objective levels and the ones for the probability functions, a probability maximization model is transformed to the maxmin problem without permissible objective levels as parameters. Similarly, in the second approach, a fractile optimization model is applied to multiobjective stochastic linear programming problems, where the decision maker is required to specify not permissible probability levels but the corresponding membership functions which represent fuzzy goals for permissible probability levels. By adopting the fuzzy decision to integrate both the membership functions for permissible probability levels and the ones for the objective functions, a fractile optimization model is transformed to the maxmin problem without permissible probability levels as parameters. It is shown that such two fuzzy approaches are same.

(PS04) Poster Session IV

Wednesday, June 29, 4:30PM-7:00PM, Room: Grand Ballroom II

P701 Performance Enhancement of Hierarchical Document Signature: A Comprehensive Study [#497]

Sukanya Manna
Tom Gedeon

Australian National University, Australia
Australian National University, Australia

Hierarchical Document Signature (HDS) has been successfully applied in document computing to find similarity between different pieces of text; for example sentence-sentence similarity, sentence-phrase similarity. HDS is application specific, it is dependent on different features at different levels. This paper hence presents a comprehensive study of enhancement of the performance of HDS to find semantic sentence similarity by tuning some of its significant features. The experimental results support this and show the optimal conditions at which HDS performs similarly to humans.

P702 Sliding Adaptive Fuzzy Control for a Class of Time-Delayed Chaotic Systems [#509]

Negin Farzbod

Hassan Zarabadipour

Mahdi Aliyari Shoorehdeli

Faezeh Farivar

IK International University of Qazvin, Iran

IK International University of Qazvin, Iran

K. N. Toosi University of Technology, Iran

Islamic Azad University, Iran

In this study, sliding adaptive fuzzy control (SAFC) is proposed to chaos control for a class of time-delayed chaotic systems. An adaptation law based on Gradient Descent (GD) method is utilized to determine the parameters of fuzzy controller. The first derivation of Lyapunov function is considered as the cost function which must be minimized, so the stability of proposed method is guaranteed with Lyapunov stability theory. Moreover, the changes of parameters and delay time are investigated. Simulation results show that the proposed method is appropriate to chaos control and it is robust with respect to changes of parameters. Also it is illustrated that the performance of proposed method is better than the performance of sliding mode controller.

P703 Estimating Missing Value in Microarray Gene Expression Data [#515]

Amit Paul

Jaya Sil

St. Thomas College Of Engineering and Technology, India

Bengal Engineering and Science University, India

Microarray experiments usually generate data sets with multiple missing value due to several reasons. In the paper a robust method has been proposed to estimate the missing value of microarray experimental data. Missing values are imputed using fuzzy similarity measure by identifying the genes having similar characteristics to that of the gene with missing values. In this approach, biological knowledge of the gene is extracted using fuzzy relation and based on that knowledge, missing value is predicted and optimized. The estimation accuracy of the proposed method is compared with the existing K-nearest neighbour (KNN) based missing value imputing method. The result demonstrates that the proposed method outperforms the KNN based method.

P704 Interval Fuzzy Modeling Applied to Model Based Fault Detection of an Active Suspension System [#537]

Tayebe Sadat Ghiasi

Hassan Zarabadipour

Mahdi Aliyari Shoorehdeli

Imam. Khomeini international University of Ghazvin, Iran

Imam. Khomeini international University of Ghazvin, Iran

K. N. Toosi University of Technology Tehran, Iran

This paper presented an investigation on fault detection of an active suspension system using interval fuzzy modeling. A well known nonlinear classical controller called back-stepping method is used to simulate dynamic response of a half-car suspension. Confidence bands for the system input- outputs data is approximated using an interval fuzzy model. Fault detection is then done by the use of these confidence bands. Simulation results depict that the proposed fault detection is highly effective in evaluating the performance of an active suspension system. Keywords: Active Suspension System, Fault Detection, Interval Fuzzy Modeling

P705 Uncertainty Management in Type-2 Fuzzy Face-Space for Emotion Recognition [#541]

Rajshree Mandal

Anisha Halder

Pavel Bhowmik

Aruna Chakraborty

Amit Konar

Atulya K. Nagar

Jadavpur University, India

Jadavpur University, India

Jadavpur University, India

St. Thomas' College of Engineering and Technology, India

Jadavpur University, India

Liverpool Hope University, United Kingdom

Manifestation of a given emotion on facial expression is not always unique, as the facial attributes in different instances of similar emotional experiences may vary widely. When a number of facial attributes are used to recognize the emotion of a subject, the variation of individual attributes together makes the problem more complicated. This variation is the main source of uncertainty in the emotion recognition problem, which has been addressed here in two steps using type-2 fuzzy sets. First a type-2 fuzzy face-space is constructed with the background knowledge of facial features of different subjects for different emotions. Second, the emotion of the unknown subject is determined based on the consensus of the measured facial features with the fuzzy face-space. The face-space comprises both primary and secondary membership distributions. The primary membership distributions here have been constructed based on the highest frequency of occurrence of the individual attributes. Naturally, the membership values of an attribute at all except the point of highest frequency of occurrence suffer from inaccuracy, which has been taken care of by secondary memberships. An algorithm for the evaluation of the secondary membership distribution from its type-2 primary counterpart has been proposed. The uncertainty management policy adopted using general type-2 fuzzy set has a classification accuracy of 96.67% in comparison to 88.67% obtained by interval type-2 counterpart only.

P706 Generation of Takagi-Sugeno Fuzzy Systems with Minimum Rules in Modeling and Identification [#549]

Feng Wan

University of Macau, Macau

Chenglin Hu

University of Macau, Macau

An improvement is presented for the tunnel algorithm introduced in [17] for determining the minimum number of rules required by a fuzzy system for modeling and identification in the SISO case. The original tunnel algorithm can deal with only Mamdani type fuzzy systems, while the Testing Point algorithm proposed in this paper, can be used to construct Takagi-Sugeno type fuzzy systems with consequent parts of any order and has the potential to be further extended to the MISO case. Numerical examples are given to illustrate the idea and improvement.

P707 Maximum Power Point Tracker for a PV Cell using a Fuzzy Agent adapted by the Fractional Open Circuit Voltage Technique [#551]

Moustafa Adly
Hisham El-Sherif
Mohamed Ibrahim

German University in Cairo, Egypt
German University in Cairo, Egypt
Heilbronn University, Germany

The Photovoltaic cells have P-V characteristics which indicate that there is only one point that produces a maximum output power. The point of the maximum power lies at the knee of the I-V curve. Tracking this point is a very important issue concerning the energy yield of the PV systems. One of the efficient tracking techniques is based on the Fuzzy agents which are able of fine tuning the cell operating voltage and current to keep the maximum possible output power. In this paper, a fuzzy agent with two input parameters enhanced by the fractional open circuit voltage technique will be used to track the MPP in a fast and accurate manner that is better than the traditional techniques. Assigning different weights for the two inputs of the fuzzy agent adapts the power response to achieve fast settling and accurate tracking of the cell maximum output power even under extreme variable atmospheric conditions in an efficient manner with better performance than conventional fuzzy MPPT technique.

P708 Improvement of Digital Image Motion Compensation by Fuzzy Inference [#597]

Sheng-Che Hsu

Ta Hwa Institute of Technology, Taiwan

In this paper, a fuzzy inference digital image stabilization method is proposed to adaptively determine better motion compensation method through the selection of two different motion compensation methods. The experimental results show the good performance. It solves the problem of lag and overshoot of motion trajectory.

P709 A Semisupervised Feature Extraction Method Based on Fuzzy-type Linear Discriminant Analysis [#598]

Hui-Shan Chu
Cheng-Hsuan Li
Bor-Chen Kuo
Chin-Teng Lin

National Taichung University of Education, Taiwan
National Chiao Tung University, Taiwan
National Taichung University of Education, Taiwan
National Chiao Tung University, Taiwan

Linear discriminate analysis (LDA) is a commonly used feature extract (FE) method to resolve the Hughes phenomenon for classification. The Hughes phenomenon (also called the curse of dimensionality) is often encountered in classification when the dimensionality of the space grows and the size of the training set is fixed, especially in the small sampling size problem. Recent studies show that the spatial information can greatly improve the classification performance. Hence, for hyperspectral image classification, it is not only necessary to use the available spectral information but also to exploit the spatial information. In this paper, a semisupervised feature extraction method which is based on the scatter matrices of the fuzzy-type LDA and uses the semi-information is proposed. The experimental results on two hyperspectral images, the Washington DC Mall and the Indian Pine Site, show that the proposed method can yield a better classification performance than LDA in the small sampling size problem.

P710 The Emotion Recognition System with Heart Rate Variability and Facial Image Features [#599]

Pei-Yang Hsieh
Chiun-Li Chin

Chung Shan Medical University, Taiwan
Chung Shan Medical University, Taiwan

Amid the rapid advance of technologies in recent years, people live at fast paces and suffer invisible pressures in family, at workplace as well as in school. Emotional undulation tends easily to lead to melancholy. Statistically, the number of bipolar disorder sufferers in the last three years was 40 times that in the past 10 years. What should be more attended to is that 90 percent of suicide cases involved a history of "depression" or "bipolar disorder". Currently, to assess the mental pressure on an individual, questionnaires or interviews are applied and determination is made by physician's personal experiences. The development of a more viable quantitative method for assessing individual psychological pressure would facilitate self-management of health. This paper thus aims to CCD-capture human face, measure user's physiological data using BtECG and determine his/her emotional status by using the fuzzy theory based on the analysis of human face, eyes and Heart Rate Variability. The features of measurements and the determination are also fed to database, which can serve as reference for doctors in consulting related psychological disorders in future. Keywords-component: Bipolar Disorder, Fuzzy Inference, Heart Rate Variability, BtECG, Emotion State

P711 Fuzzy Control of a Bi-directional Inverter with Nonlinear Inductance for DC Microgrids [#610]

Gwo-Ruey Yu

National Chung Cheng University, Taiwan

This paper proposes the fuzzy control of a bi-directional converter with variable inductance for dc microgrids. The nonlinear inductance model is developed and taken into consideration in the controller design of the bi-directional inverter to promote the performance. A novel fuzzy control strategy is proposed to increase the

magnetizing voltage such that the current distortion is reduced. Simulated results demonstrated the effectiveness of the design.

P712 *The Development of the Automatic Lane Following Navigation System for the Intelligent Robotic Wheelchair* [#611]

Wen-Chang Cheng
Chia-Ching Chiang

Chaoyang University of Technology, Taiwan
Chaoyang University of Technology, Taiwan

In this paper, we constructed an intelligent robotic wheelchair equipped with automatic tracking function in barrier-free environment of campus; the system used video paint line detection as the basis of automatic tracking navigation; since the barrier-free environment of campus includes indoor and outdoor environment and the outdoor environment includes gentle slopes, sidewalk and etc, we proposed a paint line detection method, which showed color distribution and judgment of paint line using Gaussian mixture models; the input image completed paint line detection and parameters calculation with this method and then input them into the fuzzy logic controller of wheelchair and in this way, the tracking navigation control of wheelchair was performed; the system was actually tested on barrier-free paths in campus, including straight and curve barrier-free paths; the result showed that the system could make the wheelchair keep moving on the paint line correctly and the mean deviation was kept within 10 cm, which proved the navigation of intelligent robotic wheelchair could be realized automatically and successfully on barrier-free paths in campus.

P713 *The Prediction of Trust Rating Based on the Quality of Services Using Fuzzy Linear Regression* [#614]

M. Hadi Mashinchi
Lei Li
Mehmet Orgun
Yan Wang

Macquarie University, Australia
Macquarie University, Australia
Macquarie University, Australia
Macquarie University, Australia

With the advent of service-oriented computing, the issue of trust and Quality of Service (QoS) have become increasingly important. In service-oriented environments, when there are a few service providers providing the same service, a service client would be keen to know the trustworthiness of each service provider in the forthcoming transaction. The trust rating of a delivered service from a service provider can be predicted according to a set of advertised QoS data collected by the trust management authority. Although trust and QoS are qualitative by nature, most data sets represent trust and QoS in the ordinal form for the sake of simplicity. This paper introduces a new approach based on Fuzzy Linear Regression Analysis (FLRA) to extract qualitative information from quantitative data and so use the obtained qualitative information for better modeling of the data. For verification purposes, the proposed approach can be applied for the trust prediction in the forthcoming transaction based on a set of advertised QoS in service-oriented environments.

P714 *Observer-based Hybrid Fuzzy CMAC Controller for a Class of Uncertain Chaotic Systems* [#616]

Chun-Sheng Chen

China University of Science and Technology, Taiwan

This paper presents an observer-based hybrid fuzzy cerebellar model articulation controller (CMAC) neural network control with a supervisory controller for a class of uncertain chaotic systems. This proposed control system is integrating sliding mode control (SMC) theory and CMAC neural network into fuzzy controller design. The total states of the chaotic system are not assumed to be available for measurement. A state observer is used to estimate unmeasured states of the systems. The supervised control is appended to assure that the fuzzy CMAC controller achieve a stable closed-loop system through Lyapunov stability theory. Finally, simulation results show that the effect of the approximation error on the tracking error can be attenuated efficiently by the proposed method.

P715 *Automated Boundary Extraction and Visualization System for Coronary Plaque in IVUS Image by Using Fuzzy Inference-based Method* [#271]

Takanori Koga
Eiji Uchino
Noriaki Suetake

Tokuyama College of Technology, Japan
Yamaguchi University, Japan
Yamaguchi University, Japan

We propose a fully automatic plaque boundary extraction system for an intravascular ultrasound (IVUS) image aiming at practical use in clinic. The IVUS image, which is commonly used for a diagnosis of acute coronary syndromes (ACS) in the field of cardiology, has coarse-grained texture due to heavy speckle noise. A medical doctor's interpretation of the IVUS image is disturbed frequently by the heavy speckle noise. In the proposed system, the heavy speckle noise is reduced firstly by using an anisotropic diffusion filter. Secondly, the plaque boundary is extracted by using the Takagi-Sugeno (T-S) type fuzzy inference with a weighted separability measure and some heuristic rules. Extraction of plaque boundary is achieved fully automatically. The proposed system substantially reduces the workload of medical doctors. The effectiveness of the proposed system has been verified by the experiments using the real IVUS images.

P716 *Multi-source Knowledge Based Unnormalized Interval Type-2 Fuzzy Logic Systems Design* [#154]

Tiechao Wang
Jianqiang Yi
Chengdong Li

Chinese Academy of Sciences, China
Chinese Academy of Sciences, China
Shandong Jianzhu University, China

In this paper we propose an effective method to design a Single-Input Single-Output (SISO) Unnormalized Interval Type-2 Takagi-Sugeno-Kang (TSK) Fuzzy Logic System (UIT2FLS) for noisy regression problems based on multi-source knowledge which includes here the information from sample data and the prior knowledge of bounded range, symmetry and monotonicity. The sufficient conditions are given which ensure that the prior knowledge can be embedded into the UIT2FLS, and then the UIT2FLS is designed so that the target function can be approached as accurately as possible via constrained least squares algorithm. The performance of the UIT2FLS is verified through comparisons with unnormalized type-1 Fuzzy Logic Systems (FLSs) and normalized interval type-2 FLSs under three different noisy circumstances. Simulation results verify the correctness of the sufficient conditions, and demonstrate that the UIT2FLS has the best overall performance.

P717 On the Properties of SIRMs Connected Type-1 and Type-2 Fuzzy Inference Systems [#264]

Chengdong Li
Guiqing Zhang
Jianqiang Yi
Tiechao Wang

Shandong Jianzhu University, China
Shandong Jianzhu University, China
Chinese Academy of Sciences, China
Liaoning University of Technology, China

This paper tries to show some important properties of the single input rule modules (SIRMs) connected fuzzy inference systems (FIS), including both type-1 (T1) and interval type-2 (IT2) FISs. Three kinds of properties - continuity, monotonicity and robustness - are explored. First, conditions on the parameters are derived to ensure that the SIRMs connected FISs are continuous and monotonic. Then, a methodology for the robustness analysis of the SIRMs connected FISs are presented. At last, an example is given to show the correctness of the theorems on the continuity and monotonicity and to demonstrate the effectiveness of the proposed methodology for robustness analysis. These results can not only deepen our understanding of the SIRMs connected FISs, but also provide us guidelines for the design of the SIRMs connected FISs.

P718 Digital controller design for fuzzy systems with packet loss: intelligent digital redesign approach

[#333]

Geun Bum Koo
Jin Bae Park
Young Hoon Joo
Hyoung Seok Jeon

Yonsei University, Republic of Korea
Yonsei University, Republic of Korea
Kunsan National University, Republic of Korea
Kunsan National University, Republic of Korea

In this paper, a novel digital controller is proposed for the nonlinear systems with packet loss using the intelligent digital redesign (IDR). For the fuzzy controller, the nonlinear system is represented by a Takagi-Sugeno (T-S) fuzzy model. The IDR technique is to convert a pre-designed analog controller into an equivalent digital controller. For this technique, the discretized models of the analog and digital closed-loop system are presented, respectively. The digital control gain is obtained to minimize the norm error between the state of the analog and digital closed-loop systems and stabilize the digital closed-loop system. Its sufficient conditions are derived in terms of linear matrix inequalities (LMIs). Finally, a numerical example is provided to verify the effectiveness of the proposed technique.

P719 Mixed-Time T-S Fuzzy Optimal Estimator for Target Tracking [#517]

Sun Young Noh
Jin Bae Park
Young Hoon Joo

Yonsei University, Republic of Korea
Yonsei University, Republic of Korea
Kunsan National University, Republic of Korea

This paper is concerned with the mixed-time fuzzy optimal estimator for the target tracking. The proposed method takes account of behaviour for target motion in continuous time and system measurement in discrete time. The overall dynamic of system in continuous-time is discretised by using Takagi-Sugeno(T-S) fuzzy models. Based on the fuzzy model the fuzzy estimation is studied. Then the error state of the filtering process is means square bounded. A basis dependent Lyapunov function approach is developed to design the fuzzy filter and a filter gain is minimized by using some linear matrix inequalities(LMIs) constraints. A numerical example is provided to demonstrate various aspects of theoretical results.

P720 Generalized Projective Synchronization of Time-Delayed Chaotic Systems via Sliding Adaptive Fuzzy Control [#540]

Negin Farzbod
Hassan Zarabadipour
Mahdi Aliyari Shoorehdeli
Faezeh Farivar

IK International University of Qazvin, Iran
IK International University of Qazvin, Iran
K. N. Toosi University of Technology, Iran
Islamic Azad University, Iran

In this paper, generalized projective synchronization (GPS) of two time-delayed chaotic systems using sliding adaptive fuzzy control (SAFC) is investigated. The proposed method combines the advantages of the adaptive control, fuzzy systems and sliding mode control theory. Lyapunov stability theory is employed to guarantee the stability of error dynamics. Assuming that the parameters of the chaotic drive system are unknown, recursive least square (RLS) method is applied to estimate these unknown parameters. Simulation results show the validity and effectiveness of the proposed method for synchronization of two identical and nonidentical time-delayed chaotic systems.

(SS40) Special Session: Fuzzy Approach for Information Security Management

Wednesday, June 29, 5:00PM-7:00PM, Room: Peacock, Chair: Che-Hung Liu

5:00PM Knowledge Management, Education and Firm's Performance [#416]Yen-Tzu Chen
Yun-Chia Yan
Hsiao-Wen Huang
Hua-Wei HuangNational University of Tainan, Taiwan
University of New Orleans, United States
Chang Jung Christian University, Taiwan
State University of New York at Old Westbury, United States

In this paper, we examine how new CIO's education affects the association between knowledge management and firm's operating performance. Using OLS regression analysis, we find that the positive relationship between the effectiveness of knowledge management and firm's operating performance is more prominent when the firm's new CIO has a PHD degree. Our results therefore provide evidence that CIO's education facilitates the application of knowledge management.

5:20PM Expert decision making method based on uncertain linguistic variables [#525]Tzung-Nan Chuang
Jung-Yuan Kung
Yin-Fang Lin
Hsiang-Chun KuNational University of Tainan, Taiwan
Naval Academy, Taiwan
National University of Tainan, Taiwan
National University of Tainan, Taiwan

In the past, experts usually adopt the single-choice method when they use the linguistic variable to express their opinions of criteria. It means that experts choose one item from all linguistic variables for expression. However, in real life, due to time pressure and lack of sufficient information, it is unavoidable that experts can only provide uncertain linguistic information. Therefore, through giving experts the flexibility of evaluation, they can choose two items of linguistic variables by the multiple-choice method, with an interval range of uncertain linguistic variables to express their real thinking. Compared with single-choice, the flexible approach reflects individual thinking more closely. On the other hand, providing flexible evaluation will result in too wide range of individual opinions of experts or too large differences between expert opinions. In order to deal with the uncertain linguistic variables and to resolve the above problems, we will propose an expert decision making method. We hope that the new method can capture the opinions of experts better, integrate the opinions of all experts appropriately, and make more accurate decisions for decision makers.

5:40PM Applying FML and Fuzzy Ontologies to Malware Behavioural Analysis [#575]Hsien-De Huang
Giovanni Acampora
Vincenzo Loia
Chang-Shing Lee
Hung-Yu KaoNational Applied Research Laboratories, Taiwan
University of Salerno, Italy
University of Salerno, Italy
National University of Tainan, Taiwan
National Cheng Kung University, Taiwan

Antimalware applications represent one of the most important research topics in the area of information security threat. Indeed, most computer network issues have malwares as their underlying cause. As a consequence, enhanced systems for analyzing the behavior of malwares are needed in order to try to predict their malicious actions and minimize eventual computer damages. However, because the environments where malwares operate are characterized by high levels of imprecision and vagueness, the conventional data analysis tools lack to deal with these computer safety applications. This work tries to bridge this gap by integrating semantic technologies and computational intelligence methods, such as the Fuzzy Ontologies and Fuzzy Markup Language (FML), in order to propose an advanced semantic decision making system that, as shown by experimental results, achieves good performances in terms of malicious programs identification.

6:00PM Applying Fuzzy AHP to Study the KSFs of Information Security Management [#401]Jen-Sheng Wang
Che-Hung Liu
Joseph Z. Shyu
Hsiao-Wen HuangNational Chiao-Tung University, Taiwan
National University of Tainan, Taiwan
National Chiao-Tung University, Taiwan
Chang Jung Christian University, Taiwan

The launch of the digital era has made information security management a most significant and critical issue. However, perfect information security management requires certain factors for complete success. This study aims to collect Key Success Factors (KSFs) for information security management through literature review and design of a questionnaire survey. This comprises four major aspects: (1) External dimension, (2) Internal dimension, (3) Technology dimension, and (4) Execution dimension. Based on these, we proceed with categorization and analysis using Fuzzy Analytic Hierarchy Process (Fuzzy AHP or FAHP), which was applied to this study to overcome the seeming failure of general Analytical Hierarchy Process (AHP) in dealing with respondents' impersonal differences in paired comparison. The ordered ranking of objectives under each aspect is: system, human resource, security function, organization, performance, operation, market, and legislation. The results sifted from the FAHP approach suggest five top key success factors: "Training Plan", "MIS Staffing", "System Structure", "Regulation", and "Maintain Service".

6:20PM An Extension of a Fuzzy Ontology for Flexible Querying [#6]Nouredine Tamani
Ludovic LietardIRISA/ENSSAT/Univ. Rennes 1, France
IRISA/IUT/Univ. Rennes 1, France

Daniel Rocacher

IRISA/ENSSAT/Univ. Rennes 1, France

In this paper, we propose a personalized approach for flexible querying of information systems. This approach consists in the combination of the reasoning capabilities of the fuzzy DLR-Lite ontology and the expressivity of the SQLf language. The interpretation of the gradual inclusion (subsumption) axioms of the ontology is based on the Godel fuzzy implication. Its generalization to a tree of inclusions is also proposed. This tree and its property of propagation of degrees are the basic theoretical elements of our application, which consists in querying of a multimodal transport information system which is embedded in a mobile terminal characterized by limited storage and processing capabilities.

6:40PM *A Computational Linguistic Approach for the Identification of Translator Stylometry using Arabic-English Text* [#329]

Heba El-Fiqi

University of New South Wales, Australia

Eleni Petraki

University of Canberra, Australia

Hussein A. Abbass

University of New South Wales, Australia

Translator Stylometry is a small but growing area of research in computational linguistics. Despite the research proliferation on the wider research field of authorship attribution using computational linguistics techniques, the translator stylometry problem is more challenging and there is no sufficient literature on the topic. Some authors even claimed that this problem does not have a solution; a claim we will challenge in this paper. We present an innovative set of translator stylometric features that can be used as signatures to detect and identify translators. The features are based on the concept of network motifs: small graph local substructures which have been used successfully in characterizing global network dynamics. The text is transformed into a network, where words become nodes and their adjacencies in a sentence are represented through links. Motifs of size 3 are then extracted from this network and their distribution is used as a signature for the corresponding translator. We then investigate the impact of sample size, method of normalization and imbalance dataset on classification accuracy. We also adopt the Fuzzy Lattice Reasoning Classifier (FLR) among others, where FLR achieved the best performance with a classification accuracy reaching the 70% mark.

(SS38) Special Session: Fuzzy Knowledge Discovery and Its Applications

Wednesday, June 29, 5:00PM-7:00PM, Room: Phoenix, Chair: Rung-Ching Chen

5:00PM *Genetic-Fuzzy Association Rules for Network Intrusion Detection Systems* [#364]

Ming-Yang Su

Ming Chuan University, Taiwan

Chun-Yuen Lin

Ming Chuan University, Taiwan

Sheng-Wei Chien

Ming Chuan University, Taiwan

Han-Chung Hsu

Ming Chuan University, Taiwan

A network intrusion detection system (NIDS) based on genetic-fuzzy association rules is presented in the paper, which mines rules in an incremental manner in order to meet the real-time requirement of a NIDS. More precisely, the proposed NIDS adopts the incremental mining of fuzzy association rules from network traffic, in which membership functions of fuzzy variables are optimized by a genetic algorithm. The proposed online system belongs to anomaly detection, not misuse detection. Some denial-of-service (DoS) attacks were experimented in this study to show the performance of the proposed NIDS. The results show that the proposed NIDS can detect DoS attacks in both effectiveness and efficiency.

5:20PM *Personalized Recommendation for Web-based Learning Based on Ant Colony Optimization with Segmented-goal and Meta-Control Strategies* [#459]

Feng-Hsu Wang

Ming Chuan University, Taiwan

Personalized web-based learning has become an important learning form in the 21st century. An earlier research result showed that a fuzzy knowledge extraction model can be established to extract personalized recommendation knowledge by discovering effective learning paths from an access database through an ant colony model. However, critical limitations arose when considering its applications in real world situations. In this paper, the aim is to improve the model by devising more efficient algorithms that requires a reasonable number of learners and training cycles to find satisfying good results. The key approaches to resolving the practical issues include revising the global update policy, an adaptive search policy and a segmented-goal training strategy. Based on simulation results, it is shown that these new ingredients added to the original knowledge extraction algorithm result in more efficient ones that can be applied in practical situations.

5:40PM *A novel fuzzy recommendation system integrated the experts' opinion* [#461]

Li Chen Cheng

Soochow University, Taiwan

Hua An Wang

Soochow University, Taiwan

Collaborative Filtering (CF) has been applied to many commercial systems successfully, such as IMDB, Netflix and son on. The basic idea of a CF system is to generate recommendations based on the experiences of past similar users. The users' option can be categorized into objective and subject information. The former was furnished by the common users and the later represents solicit opinions provided by experts (such as film critics). Both information types are valuable and important for the CF system. This study attempts to propose a novel collaborative filtering framework based on fuzzy set theory which integrates the subjective and objective

information. The new methodology not only provides a comprehensive result but also solve the problems of traditional CF system, new user and new item. Finally, an experiment is performed, and the result indicates that the proposed methodology produces high-quality recommendations.

6:00PM Fuzzy Rule-Based Stock Trading System [#464]

I-Cheng Yeh
Che-hui Lien

Chung-Hua University, Taiwan
Thompson Rivers University, Canada

Our study investigates the generalization capability of fuzzy rule-based trading systems and conducted an empirical study on Taiwan's stock market during 1991/1/1-2010/12/31. The empirical conclusions are as follows (1) The investment performance in the training period is much better than that in the testing period, which exhibits over-learning. (2) The symmetry rules approach demonstrates that the pure price trend trading system is better than the pure volume trend trading system and hybrid price-volume trend trading system. The pure volume trend trading system is the poorest system. (3) The asymmetry rules approach demonstrates that the trading system optimized in one period may be performed poorer in another period. The pure price trend buy-rule combined with the pure volume trend sell-rule has good performance in 1991-2000 but acts poorly in 2001-2010.

6:20PM Towards Application of FML in Suspicion of Non-Common Diseases [#582]

Giovanni Acampora
Tatiana Kiseliova
Karaman Pagava
Autilia Vitiello

University of Salerno, Italy
Ivane Javakhishvili Tbilisi State University, Georgia
Tbilisi Medical State University, Georgia
University of Salerno, Italy

In this paper we present the preliminary results of application of Fuzzy Markup Language (FML) to suspect a non-common disease. Under non-common diseases we understand rare diseases. From the broad point of view this problem belongs to the computer-assisted decision support in medical diagnostics and can be supported by fuzzy logic controllers. We can use conventional methods to diagnose a rare disease if it can be exhibited by outstanding symptoms. For example, there are several search machines and data banks that allows to find a rare disease clearly exhibited by a patient's symptoms/signs. But it is very difficult to diagnose a rare disease if it masks as a common disease. Diagnostic of rare diseases is connected with lack, uncertainty and imprecision of knowledge, medical mistake and even medical failure. Additionally, very often a common disease is also established with some degree of belief, thus, the expressions such as "it is possible that a patient has a particular disease" rather often present in the daily medical practice. It is clear that if we would know the common diseases, then deviations from them can be considered as a sign of non-common diseases. In this paper we investigate such deviations with the help of FML. We show how FML mechanism can be adjusted to suspect a rare disease, and discuss the appropriateness of the available operators.

6:40PM Linguistic summarization of long-term trends for understanding change in human behavior [#296]

Maria Ros
Derek Anderson
James Keller
Manuel Pegalajar
Miguel Delgado
Amparo Vila
Mihail Popescu

University of Granada, Spain
University of Missouri, United States
University of Missouri, United States
University of Granada, Spain
University of Granada, Spain
University of Granada, Spain
University of Missouri, United States

In this paper, we propose a linguistic summarization procedure for describing long-term trends of change in human behavior. Our objective consists of defining methods that provide information to elders, caregivers, social workers or even family in an understandable language. We adapt a measure that we defined in previous work on soft cluster partition similarity for comparing behaviors that are adapted over time. From that measure, we are able to produce a time series that numerically describes change in behavior over time. In this article, the resulting time series is partitioned and linguistically summarized depending on a user's (caregiver, social worker, etc.) desired time resolution. Simulated resident behavior is used in order to explore a range of different scenarios and the response of the proposed linguistic summarization process is investigated.

(SS39) Special Session: Fuzzy Based Computation on Biomedical Systems

Wednesday, June 29, 5:00PM-7:00PM, Room: Crane, Chair: Shing-Tai Pan

5:00PM Fuzzy Knowledge Approach to Automatic Disease Diagnosis [#281]

Giuseppe Fenza
Vincenzo Loia
Carmen De Maio
Mariacristina Gallo
Roberto Linciano
Aldo Morrone

Universita' degli studi di Salerno, Italy
Universita' degli studi di Salerno, Italy
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Azienda Ospedaliera San Camillo- Forlanini, Italy
Azienda Ospedaliera San Camillo- Forlanini, Italy

Applying best available evidences to clinical decision making requires medical research sharing and (re)using. Recently, computer assisted medical decision making is taking advantage of Semantic Web technologies. In particular, the power of ontologies allows to share medical research and to provide suitable support to the

physician's practices. This paper describes a system, named ODINO (Ontological Disease kNOWLEDge), aimed at supporting medical decision making through semantic based modeling of medical knowledge base. The system defines an ontology model able to represent relations between medical disease and its symptomatology in a qualitative manner by using fuzzy labels. Medical knowledge is defined according with physician experts members of INMP1 (National Institute for Health Migration and Poverty). The main aim of ODINO is to provide an effective user interface by using ontologies and controlled vocabularies and by allowing faceted search of diseases. In particular, this work mashes the capabilities of Description Logic reasoners and information retrieval techniques in order to answer to physician's requests. Some experimental results are given in the field of dermatological diseases.

5:20PM Predicting Laboratory Testing in Intensive Care using Fuzzy and Neural Modeling [#349]

Federico Cismondi
 Andre Fialho
 Susana Vieira
 Joao Sousa
 Shane Reti

Massachusetts Institute of Technology, United States
 Massachusetts Institute of Technology, United States
 Technical University of Lisbon, Portugal
 Technical University of Lisbon, Portugal
 Harvard Medical School, United States

Laboratory testing is a frequent activity for patients in intensive care units (ICU). Recent studies demonstrate that frequent laboratory testing does not necessarily relate to better outcomes. We hypothesize that unnecessary laboratory testing can be reduced by predicting which tests are unlikely to influence clinical management. Reducing unnecessary tests could reduce morbidity and hospitalization costs. We analyzed an ICU database containing 26,665 patient records at Beth Israel Deaconess Medical Center, Boston, and selected a subset of patients with gastrointestinal bleeding. Database knowledge discovery was applied involving data preprocessing, feature selection, and classification. Conventional soft computing tools such as fuzzy models and neural networks were utilized in this work, combined with statistical and mathematical tools. The input variables included bedside monitor trends, lab tests, arterial/ central catheter information, urine collections, transfusions, indexes and scores calculated for the patients. The outcome variable was a binary classification based on falling levels of hematocrit. Feature selection was performed by a bottom-up strategy, maximizing the AUC, the integrated discrimination improvement and a multiobjective function primarily pondering the sensitivity of the models. A leave-one-out cross validation process was used to evaluate the overall models' performance, as well as the additional predictive value of the variables selected. Urine output was selected by all models as the best predictor of useful hematocrit testing. Our results show that it is possible to correctly classify the usefulness of a hematocrit lab test up to 81% of the time by using fuzzy models and neural networks.

5:40PM A fuzzy inference system for sleep staging [#109]

Liang Sheng-Fu
 Chen Ying-Huang
 Kuo Chih-En
 Chen Jyun-Yu
 Hsu Sheng-Che

National Cheng Kung University, Taiwan
 National Cheng Kung University, Taiwan
 National Cheng Kung University, Taiwan
 National Cheng Kung University, Taiwan
 Ta Hwa Institute of Technology, Taiwan

In this paper, a fuzzy inference system for sleep staging was developed. Nine input variables including temporal and spectrum analyses of the EEG, EOG, and EMG signals were extracted and normalization was applied to these variables to reduce the effect of individual variability. A fuzzy inference system contains fourteen fuzzy rules was designed to classify the 30-s sleep epochs as five sleep stages. Finally, a smoothing process was applied to the scoring results for fine-tuning. The average accuracy of the proposed method applied to 16 all-night polysomnography (PSG) recordings compared with the manual scorings can reach 87 %. This method can integrate with various PSG systems for sleep monitoring in clinical or homecare applications.

6:00PM Fusion of Fuzzy Logic and PD Control for a Five-Fingered Smart Prosthetic Hand [#485]

Cheng-Hung Chen
 D. Subbaram Naidu

Idaho State University, United States
 Idaho State University, United States

A hybrid of soft control technique of adaptive neuro-fuzzy inference system (ANFIS) and fuzzy logic (FL) and hard control technique of proportional-derivative (PD) for a five-fingered, smart prosthetic hand is presented. The ANFIS is used for inverse kinematics and FL is used for tuning the PD parameters with two input layers (error and error change) using 7 triangular membership functions and 49 fuzzy logic rules. Simulation results with FL-tuned PD controller exhibit superior performance compared to the PD and PID control alone.

6:20PM Hierarchical-interpolative Fuzzy System Construction by Genetic and Bacterial Programming Algorithms [#414]

Krisztian Balazs
 Laszlo T. Koczy

Budapest University of Technology and Economics, Hungary
 Szechenyi Istvan University, Hungary

In this paper a method is proposed for constructing hierarchical-interpolative fuzzy rule bases in order to model black box systems defined by input-output pairs, i.e. to solve supervised machine learning problems. The resulting hierarchical rule base is the knowledge base, which is constructed by using evolutionary techniques, namely, Genetic and Bacterial Programming Algorithms. Applying hierarchical-interpolative fuzzy rule bases is an advanced way of reducing the complexity of the knowledge base, whereas evolutionary methods ensure a relatively efficient learning process. This is the reason of the investigation of this combination.

6:40PM Study on Various Defuzzification Methods for Fuzzy Clustering Algorithms to Improve ROIs Detection in Lung CTs [#140]

Alberto Rey
Bernardino Arcay
Alfonso Castro

University of A Coruna, Spain
University of A Coruna, Spain
University of A Coruna, Spain

The detection of pulmonary nodules is one of the most studied areas and challenging task in the field of medical image analysis, due the current relevance of the lung carcinoma. The difficulty and complexity of this task has led to the development of CAD systems for the automated detection of lung nodules in CT scans, which provides valuable assistance for radiologists and could improve the detection rate. A common phase of these systems is the detection of regions of interest (ROIs) that could be marked as nodules, in order to reduce the searching space problem. In this paper, we evaluate and compare the combination of various approaches of supervised vector machines (SVMs) with different kinds of fuzzy clustering algorithms, so as to improve the detection and segmentation of ROIs that could represent lung nodules in high resolution CT scans. These images are provided by the LIDC database (Lung Internet Database Consortium).

(SS17-2 & SS15) Special Session: Practical and Applications Aspects of Type-2 Fuzzy Logic Systems & Type-2 Fuzzy Logic Theory

Wednesday, June 29, 5:00PM-7:00PM, Room: Egret, Chair: Hani Hagrais and Christian Wagner

5:00PM Comparison and Practical Implementation of Type-Reduction Algorithms for Type-2 Fuzzy Sets and Systems [#24]

Dongrui Wu
Maowen Nie

GE Global Research, United States
National University of Singapore, Singapore

Type-reduction algorithms are very important for type-2 fuzzy sets and systems. The earliest one, and also the most popular one, is the Karnik-Mendel Algorithm, which is iterative and computationally intensive. In the last a few years researchers have proposed several other more efficient type-reduction algorithms. In this paper we also propose a new algorithm which improves over the latest results. Experiments show that it is the most efficient one to use in practice. Particularly, when the number of elements in type-reduction is smaller than 100, which is true in most practical type-reduction computations, our proposed algorithm can save over 50% computational cost over the Karnik- Mendel Algorithms. We also give the Matlab implementation of our most efficient algorithm in the Appendix. It includes preprocessing steps to eliminate numerical problems, and also improved testing criteria to prevent possible infinite loops. This program will be very helpful in promoting the popularity of type-2 fuzzy sets and systems.

5:20PM Interpreting Fuzzy Set Operations and Multi Level Agreement in a Computing with Words Context [#602]

Christian Wagner
Hani Hagrais

University of Essex, United Kingdom
University of Essex, United Kingdom

Computing with Words (CWW) aims to investigate the possibility of imitating the unique ability of humans for approximate reasoning on the basis of approximately defined classes and concepts in the form of words. Type-2 fuzzy sets have been used to provide an adequate modeling basis for words in a fuzzy logic context. In the context of type-2 fuzzy sets employed as part of CWW, a variety of research efforts have been made to investigate approaches to model the meaning of specific words using type-2 fuzzy sets. In this paper we start by focusing on the interpretation of classical set-theoretical operations (complement, union and intersection) for crisp and type-1 fuzzy sets. We proceed by extending the interpretations to the results of the union and intersection operations of interval type-2 fuzzy sets, specifically indicating their effect on the uncertainty representation in the sets. We note the impact of the choice of t-norms and t-conorms in particular in the context of CWW applications where the interpretation of the resulting sets and its resemblance to the human intuitive meaning of the concept or word is essential. Finally, we provide the interpretation and reasoning behind the Multi Level Agreement (MLA) operation based on zSlices which was previously introduced and discuss the requirement for the selection of the right operations for the amalgamation of individual fuzzy sets and the potential for investigating this choice in particular in a CWW context.

5:40PM An Adaptive Type-2 Fuzzy Logic Controller for Dynamic Positioning [#211]

Xue Tao Chen
Woei Wan Tan

National University of Singapore, Singapore
National University of Singapore, Singapore

This paper presents an indirect adaptive type-2 fuzzy logic controller (FLC) for dynamic positioning (DP) vessels with attached thrusters under various time- varying hydrodynamic disturbances. Approximation-based adaptive control technique in combination with type-2 fuzzy logic system (FLS) is employed in the design of the control. The stability of the design is demonstrated through Lyapunov analysis where globally asymptotical convergence of the regulation error is guaranteed. Rigorous analysis shows the resultant closed-loop system is passive. The proposed adaptive type-2 FLC is able to reject the hydrodynamic disturbances without exact information on them. Comparative simulations with linear proportional derivative (PD) controller and adaptive type-1 FLC are carried out. The proposed technique is found to be effective, robust, and has better performance.

6:00PM Interval Type-2 Recurrent Fuzzy Neural System Design via Stable Simultaneous Perturbation Stochastic Approximation Algorithm [#269]Feng-Yu Chang
Ching-Hung LeeYuan Ze University, Taiwan
Yuan Ze University, Taiwan

This paper proposes a new type fuzzy neural systems, denotes IT2RFNS-A (interval type-2 recurrent fuzzy neural system with asymmetric membership function), for nonlinear systems control. To enhance the performance and approximation ability, the TSK-type consequent part is adopted for IT2RFNS-A. The gradient information of the IT2RFNS-A is not easy to obtain due to the asymmetric membership functions and interval valued sets. The corresponding stable learning is derived by simultaneous perturbation stochastic approximation (SPSA) algorithm which guarantees the convergence and stability of the closed-loop systems. Simulation and comparison on the control of Chua's chaotic circuit is done to show the feasibility and effectiveness of proposed method.

6:20PM Efficient centroid computation of general type-2 fuzzy sets with linear secondary membership function [#145]

Liu Xinwang

Southeast University, China

This paper provides root finding methods for the centroid computation of interval type-2 fuzzy sets and general type-2 fuzzy sets with linear secondary membership function. When the FOU's of the type-2 fuzzy sets are provided, the centroid computation methods in this paper is accurate and computational efficient, which provide new methods for the type-2 fuzzy systems computation.

6:40PM Type-2 Fuzzy Airplane Altitude Control: A Comparative Study [#283]Sheir Afsen Zaheer
Jong-Hwan KimKAIST, Republic of Korea
KAIST, Republic of Korea

The standard fuzzy logic controllers, also known as type-1 fuzzy logic controllers, have often been criticized for their inability to handle uncertainties in the control processes. Therefore, a lot of attention is being focused on type-2 fuzzy logic controllers, especially, the interval type-2 fuzzy logic controllers. This paper aims at developing both type-1 and type-2 fuzzy logic controllers for an airplane altitude control problem and comparing their performances. Both the controllers have similar knowledge bases, and both of them are tested in two simulation setups, an ideally modeled setup and a setup with uncertainties. The results show that the type-2 fuzzy logic controller outperforms the type-1 fuzzy logic controller, especially, in the environment with uncertainties. Therefore, this research seems to validate the superiority of type-2 fuzzy logic control in making the controllers independent of uncertainties in intricate model details.

(SS30 & SS43) Special Session: Fuzzy Inference Systems-Theory and Applications & Fuzzy Systems of Unknown Nonlinear Complex Systems

Wednesday, June 29, 5:00PM-7:00PM, Room: Swallow, Chair: Chi-Hsu Wan and Shih-Yu Li

5:00PM Solving Zadeh's Magnus Challenge Problem on Linguistic Probabilities via Linguistic Weighted Averages [#436]Mohammad Reza Rajati
Jerry Mendel
Dongrui WuUniversity of Southern California, United States
University of Southern California, United States
GE Global Research, United States

In this paper, we present a solution to Zadeh's Magnus challenge problem on linguistic probabilities. First, we implement Zadeh's solution to this problem. Then, we use the intersection-product syllogism and a syllogism based on the entailment principle to interpret the problem so that it can be solved via Linguistic Weighted Averages. We show that the problem can be solved by calculation of pessimistic (lower) and optimistic (upper) probabilities via Linguistic Weighted Averages. Then, we choose vocabularies for quantifiers and linguistic probabilities that are involved in the problem statement. The vocabularies are modeled using interval type-2 fuzzy sets. We calculate optimistic (upper) and pessimistic (lower) probabilities, which naturally would be interval type-2 fuzzy sets. Finally, we map the pessimistic and optimistic probabilities to linguistic probabilities present in the vocabularies, so that the results can be comprehended by a human.

5:20PM Linguistic Weighted Power Means: Comparison with the Linguistic Weighted Average [#68]John T. Rickard
Janet Aisbett
Ronald R. Yager
Greg GibbonDistributed Infinity Inc., United States
University of Newcastle, Australia
Iona College, United States
University of Newcastle, Australia

We have introduced the linguistic weighted power mean and its computation via a generalization of the Karnick-Mendel algorithm. This new family of aggregation operators admits interval type-2 fuzzy membership functions for both its inputs and its weights to account for imprecise knowledge of these quantities. The simplest member of this family, the linguistic weighted average, is the primary instantiation of a "perceptual computing" engine in Mendel and Wu's recent book by this title. This paper presents a comparison of the linguistic weighted power mean and the linguistic weighted average on one of the examples they describe in detail—the "investment

judgment advisor". Our results illustrate the flexibility and range of logical inference provided by this very versatile aggregation operator for computing with words applications.

5:40PM *Finding the Capacity of Fuzzy Neural Networks (FNNs) via Its Equivalent Fully Connected Neural Networks (FFNNs) [#241]*

Jing Wang
Chi-Hsu Wang
C. L. Philip Chen

University of Macau, Macau
National Chiaotung University, Taiwan
University of Macau, Macau

The capacity of Fuzzy Neural Network (FNN) is explored in this paper. The FNN is first transformed into an equivalent fully connected three layer neural network, or FFNN, via a new approach proposed in this paper. Then the lower and upper bounds of FNN can be found. To check the validity of the theoretical bounds, an example is illustrated with the trainings to yield excellent capacity matching with the theoretical bounds. This new finding has its emerging values in all engineering applications using FNN, such as intelligent adaptive control, pattern recognition, and signal processing,...., etc.

6:00PM *On the Classification of Cancer Cell Gene via Expressive Value Distance (EVD) Algorithm and Its Comparison to the Optimally Trained ANN Method [#589]*

Tong Zhang
Sik Chung Tam
Chi-Hsu Wang
C.L. Philip Chen

University of Macau, Macau
University of Macau, Macau
National Chiaotung University, Taiwan
University of Macau, Macau

In recent years, cancer can be detected and recognized by analyzing the sample's expression profile. The cancer gene expression data are high dimensional, high variable dependent, and very noisy. The dimension reduction method is often used for processing the high dimensional data. In this study, a new statistical dimension reduction method called Expressive Value Distance (EVD) is developed and proposed for the practical high-dimensional gene expression cancer data. The feature genes data extracted by EVD are arranged for training the optimally trained Artificial Neural Network (ANN). The trained ANN is then used to classify whether the unseen gene data is cancer or not. In comparison of ANN classification with and without EVD, it is found that both of the ANN can classify the cancer data in good accuracy. With the EVD method, the great amount of data (2000 genes) can be effectively reduced to 16 genes. Therefore, EVD is an effective dimension reduction method. Even the EVD method is not used, the optimally trained ANN is also an advanced method for classifying the high dimensional and complicated cancer data. Briefly, it proves that optimally trained ANN is a very robust classification technique.

6:20PM *Adaptive Neural-Fuzzy Inference System for Classification of Rail Quality Data with Bootstrapping-Based Over-Sampling [#592]*

Yong Yao Yang
Mahdi Mahfouf
George Panoutsos
Steve Thornton
Qian Zhang

The University of Sheffield, United Kingdom
The University of Sheffield, United Kingdom
The University of Sheffield, United Kingdom
Tata Steel Europe, United Kingdom
The University of Sheffield, United Kingdom

An iterative bootstrapping-based data over-sampling strategy is presented in this paper together with an adaptive neural-fuzzy inference system (ANFIS) to deal with a severely imbalanced data modelling problem. As real industrial data are often very large, containing hundreds of process variables and a huge number of data records, the selection of a compact set of input variables becomes critical for any successful modelling and analysis operations. Significant efforts have been devoted to identifying the most relevant input variables through correlation analysis and neural network based forward input selection. An optimal majority to minority class data ratio, which controls the level of data imbalance for model training, is then determined through the iterative bootstrapping process such that the combined sensitivity and specificity performance is optimised. The iterative bootstrapping ANFIS modelling strategy is then applied to a real industrial case study for rail quality classification, with the original data being provided by Tata Steel Europe. Preliminary results show a good overall performance through the iterative bootstrapping data over-sampling ANFIS modelling.

6:40PM *Passive Fuzzy Control for Uncertain Nonlinear Stochastic Inverted Pendulum Robot System [#219]*

Wen-Jer Chang
Sin-Sian Jheng
Cheung-Chieh Ku

National Taiwan Ocean University, Taiwan
National Taiwan Ocean University, Taiwan
National Taiwan Ocean University, Taiwan

This paper presents a passive fuzzy controller design method for stabilizing the uncertain nonlinear stochastic inverted pendulum robot system. Through Takagi-Sugeno (T-S) fuzzy modeling approach, the complex nonlinear properties can be described by combining several linear sub-systems and determined membership functions. The Ito stochastic differential equation is employed to represent dynamics of systems in this paper. Applying the modeling approach, the T-S fuzzy model with multiplicative noise can be built for describing the nonlinear stochastic system. Besides, the uncertainties of the controlled system are considered in this paper for dealing with modeling errors and varying parameters. Hence, the robust control problem is also discussed and investigated in this paper. Finally, the numerical simulations are proposed to show the effectiveness of the present design approach.

Thursday, June 30

(SS23) Special Session: Industrial Applications of Evolving Fuzzy Systems

Thursday, June 30, 8:00AM-10:20AM, Room: Swan, Chair: Kit Yan Chan

8:00AM *Economic Load Dispatch using Intelligent Optimization with Fuzzy Control* [#105]

Johnny C.Y. Lai
Frank H. Leung
S. H. Ling
Edwin C. Shi

The Hong Kong Polytechnic University, Hong Kong
The Hong Kong Polytechnic University, Hong Kong
University of Technology, Sydney, Australia
The Hong Kong Polytechnic University, Hong Kong

In this paper, Differential Evolution (DE) that incorporates fuzzy control and k-nearest neighbors algorithm is proposed to tackle the economic load dispatch problem. To provide the self-terminating ability, a technique called Iteration Windows (IW) is introduced to govern the number of iteration in each searching stage during the optimization. The size of IW is controlled by a fuzzy controller, which uses the information provided by the k-nearest neighbors system to analyze the population during the searching process. The controller keeps controlling the IW till the end of the searching process. A wavelet based mutation process is embedded in the DE searching process to enhance the searching performance. The weight F of DE is also controlled by the fuzzy controller to further speed up the searching process. The proposed method is employed to solve the Economic Load Dispatch with Valve-Point Loading (ELD-VPL) Problem. It is shown empirically that the proposed method can terminate the searching process with a reasonable number of iteration and performs significantly better than the conventional methods in terms of convergence speed and solution quality.

8:20AM *Hypoglycemia Detection using Fuzzy Inference System with Genetic Algorithm* [#28]

Sai Ho Ling
Hung Nguyen
F.H.F Leung

University of Technology, Sydney, Australia
University of Technology, Sydney, Australia
The Hong Kong Polytechnic University, Hong Kong

In this paper, we develop a genetic algorithm based fuzzy inference system to recognize hypoglycemic episodes based on heart rate and corrected QT interval of the electrocardiogram (ECG) signal. Genetic algorithm is introduced to optimize the membership functions and fuzzy rules. A practical experiment based on data from 15 children with T1DM is studied. All the data sets are collected from the Department of Health, Government of Western Australia. To prevent the phenomenon of overtraining (over-fitting), a validation strategy that may adjust the fitness function is proposed. Thus, the data are organized into a training set, a validation set, and a testing set randomly selected. The classification results in term of sensitivity, specificity, and receiver operating characteristic (ROC) analysis show that the proposed classification method performs well.

8:40AM *An Approach for Stability Analysis of Polynomial Fuzzy Model-Based Control Systems* [#280]

Mohammad Narimani
Hak-Keung Lam
Kaspar Althoefer
Reza Shams Dilmaghani
Charles Wolfe
Christian Deters

King's College London, United Kingdom
King's College London, United Kingdom
King's College London, United Kingdom
King's College London, United Kingdom
King's College London, United Kingdom
King's College London, United Kingdom

Stability analysis of polynomial fuzzy model-based (PFMB) control systems under the parallel distributed compensation (PDC) design technique is investigated. A new polynomial fuzzy controller (PFC) is introduced to release conservativeness in the existing approaches. Compared to the conventional (PFC), the controller under consideration in this paper has a favorable property which introduces some more variables in the stability conditions such that, the solution of the derived stability conditions can be explored in a larger group of potential solutions. This property may lead to further relax stability conditions. However, the stability conditions will not be in the form of SOS conditions. Hence, particle swarm optimization (PSO) is employed to explore the solution of the derived stability conditions which are in the form of state-dependent BMI. It is shown that the conventional PFC is a special case of that of proposed one. Finally, a simulation example is given to illustrate the effectiveness of the proposed approach.

9:00AM *A Distributed Smart Routing Scheme for Terrestrial Sensor Networks with Hybrid Neural Rough Sets* [#588]

Frank Jiang
Steve Ling

The University of New South Wales, Australia
University of Technology, Australia

The limited power consumption, as a major constraint, presents challenges in improving the network throughput for Wireless Sensor Networks (WSNs). Due to the limited computational power, the applications of WSNs in Terrestrial Networks require the capability to pre-process the observation data so as to remove irrelevant features or factors from multi-dimensional dataset. This paper proposes a intelligent distributed energy efficient routing algorithm inspired from natural learning and adaptation process with the aid of hybrid Neural Rough Sets theory, which is used to efficiently reduce the dimensionality of input dataset. The algorithmic implementation and experimental validation are described in this paper. Details of the algorithm and its testing procedures are

presented in comparison with the other power-aware protocols, e.g., mini-hop. The validation of the proposed model is carried out via a wireless sensor network test-bed implemented in Castalia Simulator. The experimental results show the network performance measurements such as delay, throughput and packet loss that have been greatly improved as the outcome of applying this integration with Neural Rough Sets.

9:20AM P2P Traffic Identification and Optimization Using Fuzzy C-means Clustering [#435]

Duo Liu

Carleton University, Canada

Chung-Hong Lung

Carleton University, Canada

Accurate identification of P2P traffic is critical for efficient network management and reasonable utilization of network resources, as P2P applications have been growing dramatically. Fuzzy clustering is more flexible than hard clustering and is practical for P2P traffic identification because of the natural treatment of data using fuzzy clustering. Fuzzy c-means clustering (FCM) is an iteratively optimal algorithm normally based on the least square method to partition data sets, which has high computational overhead. This paper proposes modifications to the objective function and the distance function that greatly reduces the computational complexity of FCM while keeping the clustering accurate. The proposed FCM clustering technology can be incorporated into a Fuzzy Inference System (FIS) to implement real-time network traffic classification by updating training dataset continuously and efficiently.

9:40AM Determination Of Process Conditions Of Epoxy Dispensing Processes Using A Genetic Algorithm Based Neural Fuzzy Networks [#30]

K. Y. Chan

Curtin University of Technology, Australia

T. S. Dillon

Curtin University of Technology, Australia

S. H. Ling

University of Technology, Sydney, Australia

C. K. Kwong

The Hong Kong Polytechnic University, Hong Kong

Determination of process condition for epoxy dispensing process of microchip encapsulation is a highly skilled task, which is usually based on engineers' knowledge and intuitive sense acquired through long-term experience rather than on a theoretical and analytical approach. In the face of global competition, the current trial-and-error approach is inadequate. In this paper, process conditions of epoxy dispensing processes are determined by the proposed genetic algorithm based neural fuzzy networks, which consists of two tasks: a) the approach of neural fuzzy networks, which was shown to be better than the other existing approaches, is proposed to develop models in relating between process parameters and quality characteristics for the epoxy dispensing processes; b) the approach of genetic algorithm is used to determine process parameters with respect to pre-defined quality requirements based on the developed neural fuzzy network models. The results indicate that, based on the proposed genetic algorithm based neural fuzzy network, estimated process parameters can achieve specified requirements of microchip encapsulations with high and robust qualities.

10:00AM Manufacturing Modeling Using An Evolutionary Fuzzy Regression [#31]

K. Y. Chan

Curtin University of Technology, Australia

T. S. Dillon

Curtin University of Technology, Australia

S. H. Ling

University of Technology, Sydney, Australia

C. K. Kwong

The Hong Kong Polytechnic University, Hong Kong

Fuzzy regression is a commonly used approach for modeling manufacturing processes in which the availability of experimental data is limited. Fuzzy regression can address fuzzy nature of experimental data in which fuzziness is not avoidable while carrying experiments. However, fuzzy regression can only address linearity in manufacturing process systems, but nonlinearity, which is unavoidable in the process, cannot be addressed. In this paper, an evolutionary fuzzy regression which integrates the mechanism of a fuzzy regression and genetic programming is proposed to generate manufacturing process models. It intends to overcome the deficiency of the fuzzy regression, which cannot address nonlinearities in manufacturing processes. The evolutionary fuzzy regression uses genetic programming to generate the structural form of the manufacturing process model based on tree representation which can address both linearity and nonlinearities in manufacturing processes. Then it uses a fuzzy regression to determine outliers in experimental data sets. By using experimental data excluding the outliers, the fuzzy regression can determine fuzzy coefficients which indicate the contribution and fuzziness of each term in the structural form of the manufacturing process model. To evaluate the effectiveness of the evolutionary fuzzy regression, a case study regarding modeling of epoxy dispensing process is carried out.

(MFI & RWA) Medical, Financial, Industrial and Other Real World Applications

Thursday, June 30, 8:00AM-10:20AM, Room: Peacock, Chair: James Keller

8:00AM A Heuristic Search and its Roughness [#153]

Chun-Hung Tzeng

Ball State University, United States

Fu-Shing Sun

Ball State University, United States

This paper introduces an abstract model of heuristic search for handling uncertainty. In the search, heuristic information and evaluation are precisely defined mathematically. As special cases, the model includes a previous probabilistic game-tree search and a pattern search. This paper also considers the relationship between the

model and the rough set approach. Each rough set formulation can be reformulated as a special case of the abstract model.

8:20AM Linguistic description of adult skeletal age-at-death estimations from fuzzy integral acquired fuzzy sets [#164]

Derek Anderson	University of Missouri, United States
Melissa Anderson	Self employed, United States
James Keller	University of Missouri, United States
Daniel Wescott	Florida International University, United States

Previously, we introduced a novel method to estimate adult skeletal age-at-death using the Sugeno fuzzy integral (FI). Specifically, we took a multi-hypothesis testing approach to make the classical FI yield a fuzzy set (FS)-valued result, which is not guaranteed to be normal or convex, based on interval-valued sources of information (aging methods). We showed quantitative results for summarizing the FS and comparing the single decision to a known age-at-death. In this article, we extend our prior work and present formulas to measure the uncertainty in the resultant FSs. We generate linguistic descriptions to establish domain standardization for the goal of assisting forensic and biological anthropologists. Specifically, we introduce fuzzy class definitions for age-at-death FSs and we present an OWA contrast approach to measure the degree of specificity in age-at-death FSs.

8:40AM Moving Pattern-based Approach to Modeling of a Class of Complex Production Processes [#491]

Zhengguang Xu	University of Science and Technology Beijing, China
Changping Sun	University of Science and Technology Beijing, China

For a class of complex production processes, based on the actual running status data, a new modeling approach based on moving pattern is presented by constructing pattern moving space and defining moving variable-pattern class variable in it. The dynamics of a class of complex production processes is characterized by the movement of pattern class variable in pattern moving space. For characterizing pattern class variable quantitatively, in this paper, interval number is used as its metric form, and our previous proposed interval T-S fuzzy model (ITSFM) is adapted to model its movement in pattern moving space. Experimental results are then presented that indicate the validity and applicability of the proposed approach.

9:00AM Multiple Characterisation Modelling of Friction Stir Welding Using a Genetic Multi-objective Data-driven Fuzzy Modelling Approach [#596]

Qian Zhang	The University of Sheffield, United Kingdom
Mahdi Mahfouf	The University of Sheffield, United Kingdom
George Panoutsos	The University of Sheffield, United Kingdom
Kathryn Beamish	TWI Ltd, United Kingdom
Ian Norris	TWI Ltd, United Kingdom

Friction Stir Welding (FSW) is a relatively new solid-state joining technique, which is versatile, environment friendly, and energy and time efficient. For a comprehensive understanding of the effects of process conditions, such as tool rotation speed and traverse speed, on characterisations of welded materials, it is essential to establish prediction models for different aspects of the materials' behaviours. Because of the high complexity of the FSW process, it is often difficult to derive accurate and yet transparent enough mathematical models. In such a situation, a systematic data-driven fuzzy modelling approach is developed and implemented in this paper to model FSW behaviour relating to AA5083 aluminium alloy, consisting of microstructural features, mechanical properties, as well as overall weld quality. This methodology allows constructing transparent fuzzy models considering both accuracy and interpretability attributes of fuzzy systems. The elicited models proved to be accurate, interpretable and robust and can be further applied to facilitate the optimal design of process parameters, with the aim of finding the optimal combinations of process parameters to achieve desired welding properties.

9:20AM Fuzzy Modeling to Predict Administration of Vasopressors in Intensive Care Unit Patients [#429]

Andre Fialho	Massachusetts Institute of Technology, United States
Federico Cismondi	Massachusetts Institute of Technology, United States
Susana Vieira	Instituto Superior Tecnico, Portugal
Joao Sousa	Instituto Superior Tecnico, Portugal
Shane Reti	Beth Israel Deaconess Medical Centre, United States
Leo Celi	Beth Israel Deaconess Medical Center, United States
Michael Howell	Harvard Medical School, United States
Stan Finkelstein	Massachusetts Institute of Technology, United States

Vasopressors belong to a powerful class of drugs used in the management of systemic shock in ill patients. The administration of a vasopressor involves the non-trivial process of inserting a central venous catheter. This procedure carries with it inherent risks which are increased when done under urgency such as in the case of unexpected systemic shock. The ability to predict the transition to vasopressor dependence could be expected to improve overall outcomes associated with the procedure. We use three different approaches combining fuzzy modeling with bottom-up (BU), top-down (TD) and ant feature selection (AFS), to classify requirements for vasopressors in shock. We observe that fuzzy models combined with BU feature selection return higher values of sensitivity; fuzzy models with no feature selection and fuzzy models with TD feature selection return higher

values of AUC and specificity; features most commonly selected to classify impending use of vasopressors in pancreatitis patients include levels of Sodium and White Blood Cell counts, while for pneumonia patients include levels of Lactid Acid and White Blood Cell Count; and finally, fuzzy models combined with BU and fuzzy models combined with AFS demonstrate the lowest number of selected variables with no significant loss in accuracy.

9:40AM *Probing Performance Evaluation for NPD Process by Using MCDM Approach* [#354]

Chia-Chun Hsiang
Meng-Jong Kuan
Gwo-Hshiung Tzeng

Kainan University, Taiwan
Kainan University, Taiwan
Kainan University, Taiwan

Due to the rapid changing marketplace, technology, equipment and raw materials, companies pursuit competitiveness by the new product and new product development (NPD) process for the purpose of innovation, high quality, and speed to the market. It is a gradual trend that the product life cycle is becoming shorter. The product manager intends to achieve the highest customer satisfaction, product value and product continuity. Therefore, to evaluate performance of NPD becomes a critical issue on the NPD process selection which is considered in many different uncertain aspects. Thus, this situation can be regarded as a fuzzy multiple criteria decision-making (FMCDM) problem, so the vagueness and uncertainty of subjective perception could be considered. In this paper, the non-additive (called super-additive) fuzzy integral is used to deal with evaluation of fuzzy MCDM problems particularly while there is dependence among the selected criteria. We can evaluate the quality performance of NPD process according to the result of empirical analysis. Consequently, DEMATEL is used to explore the relevance for the selected criteria of NPD process which is used to find the directions of problem-solving. The results of this study will provide NPD project team a guidance to satisfy the customer needs and create the value of enterprise business.

10:00AM *Application of Adaptive Self-Organizing CMAC_GBF to Aircraft Landing System* [#221]

Jih-Gau Juang

National Taiwan Ocean University, Taiwan

This paper presents an intelligent control scheme that uses an adaptive self-organizing cerebellar model articulation controller with general basis function (CMAC_GBF) in aircraft automatic landing system (ALS). During landing phase if the flight condition is out of the desired or preset environments, such as encountering severe turbulence, the ALS is disabled. The proposed intelligent controller can act as an experienced pilot and guide the aircraft landed safely in the serious condition. Lyapunov theory is applied to obtain adaptive learning rule and stability analysis is also provided. The performance of the proposed controller is better than conventional CMAC_GBF.

(FSM & IS) Fuzzy Systems Modeling and Intelligent Systems

Thursday, June 30, 8:00AM-10:20AM, Room: Phoenix, Chair: Honghai Liu

8:00AM *Optimal Necessary Conditions for General SISO Mamdani Fuzzy Systems as Function Approximators within a Given Accuracy* [#522]

Fuchun Sun
Jin Yang
Minnan Luo
Huaping Liu

Tsinghua University, China
Tsinghua University, China
Tsinghua University, China
Tsinghua University, China

In this paper, necessary conditions are investigated for a single input/single output (SISO) Mamdani fuzzy systems as function approximators of continuous functions within a given accuracy. Since general SISO Mamdani fuzzy systems are monotonic on subintervals, the optimal configuration of fuzzy systems is that the number of division points is at least the times of its monotonicity changes. Thus with the extreme of the desired continuous function, necessary conditions are obtained through generating intervals that contain division points and pruning redundant intervals. Furthermore, a dynamically constructive method is proposed to show the conditions are optimal. It has been shown that existing results concerning necessary conditions are only special cases of our results. Finally, simulation examples are given to illustrate the conclusions, the strength of the fuzzy systems as function approximators are analyzed.

8:20AM *A fuzzy stochastic programming approach to solve the capacitated lot size problem under uncertainty* [#493]

Navid Sahebjamnia
S.Ali Torabi

College of Engineering University of Tehran Tehran, Iran
College of Engineering University of Tehran Tehran, Iran

This paper develops a fuzzy stochastic multi-objective linear programming (FSMOLP) model for a multi-level, multi-item capacitated lot sizing problem (CLSP) in a multi assembly shop. The proposed model attempts to minimize the total cost consisting of total production variation cost, inventory cost, backlog cost and total setup cost while maximizing the resource utilization simultaneously. To cope with the uncertainty associated with the most of the input data, e.g., the demand and process-related parameters they are treated as fuzzy stochastic parameters with identical stochastic membership function during the planning horizon. To show the usefulness of the proposed solution method, a numerical example is first solved. Then, the usefulness of the proposed model is validated over a set of randomly generated test problems.

8:40AM Look-ahead intelligent energy management of a parallel hybrid electric vehicle [#278]

Behnam Ganji
 Abbas Z. Kouzani
 Hamid Khayyam

Deakin University, Australia
 Deakin University, Australia
 Deakin University, Australia

Improving fuel efficiency in vehicles can reduce the energy consumption concerns associated with operating the vehicles. This paper presents a model for a parallel hybrid electric vehicle. In the model, the flow of energy starts from wheels and spreads toward engine and electric motor. A fuzzy logic based control strategy is implemented for the vehicle. The controller manages the energy flow from the engine and the electric motor, controlling transmission ratio, adjusting speed, and sustaining battery's state of charge. The controller examines the vehicle speed, demand torque, slope difference, state of charge of battery, and engine and electric motor rotation speeds. It then determines the best values for continuous variable transmission ratio, speed, and torque. A slope window method is formed that takes into account the look-ahead slope information, and determines the best vehicle speed. The developed model and control strategy are simulated using real highway data relating to Nowra-Bateman Bay in Australia, and SAE Highway Fuel Economy Driving Schedule. The simulation results are presented and discussed. It is shown that the use of the proposed fuzzy controller reduces the fuel consumption of the vehicle.

9:00AM Dynamic Window with Fuzzy Controller in Wireless Sensor Networks for Elliptic Curve Cryptography [#38]

Xu Huang
 Dharmendra Sharma
 Pritam Gajkumar Shah

University of Canberra, Australia
 University of Canberra, Australia
 University of Canberra, Australia

Elliptic curve cryptosystem (ECC) was proposed by Miller [10] and Koblitz [9] which relies on the difficulty of elliptic curve discrete logarithmic problem (ECDLP). It is gaining wide acceptance as an alternative to the conventional public key cryptosystem such as RSA [24], DSA [25], DH [26]. Also it is noted that the wireless sensor networks (WSN) based on the rapid progress of wireless communications and embedded micro electro mechanical systems technologies are becoming important part in our daily life. The security of the WSN becomes one of the major concerns in its applications. Even ECC prominently offers great potential benefits for WSN security there is still a lot of work needs to be done due to WSN has very restraint running conditions such as limited energy source, capability of computing, etc. It is well known that scalar multiplication operation in ECC accounts for about 80% of key calculation time on wireless sensor network nodes. In this paper we present an optimized dynamic window based on our previous research works. The whole quality of service (QoS) has been improved under this algorithm in particularly the power consuming is more efficiently. The simulation results showed that the average calculation time, due to fuzzy conditions decreased from previous 26 to current 9 as a whole the calculation time, decreased by approximately 18% in comparison to our previous algorithms in an ECC wireless sensor network [23].

9:20AM Regulation for Wind Generation System Using Ant System Based Takagi Sugeno Fuzzy PID [#260]

Ahmad Besheer
 Abdo Tamer

University of Tabuk, Saudi Arabia
 Cairo University, Egypt

This paper introduces a new tuning technique for the PID control scheme that is adopted for regulating the magnitude and frequency of the wind energy conversion system (WECS) output voltage which presents interesting control demands and exhibits intrinsic non-linear characteristics. The developed technique is stem from blending the ant system optimization method with Takagi Sugeno fuzzy system approach. The optimum relationship between the PID controller gains and the parameters of fuzzy modules is explored using Ant system algorithm; hence a satisfactory dynamic performance of the WECS is obtained.

9:40AM Actuator Delayed Active Vehicle Suspension Control: A T-S Fuzzy Approach [#396]

Hongyi Li
 Honghai Liu
 Huijun Gao

University of Portsmouth, United Kingdom
 University of Portsmouth, United Kingdom
 Harbin Institute of Technology, China

This paper focuses on fuzzy H_∞ controller design for uncertain active suspension systems with actuator delay based on Takagi-Sugeno (T-S) model approach. This dynamic system is presented by taking into account the sprung and unsprung mass variations, the actuator delay, and the suspension performance. The fuzzy H_∞ controller is designed such that the resulting T-S fuzzy system is asymptotically stable and guarantees H_∞ performance, and simultaneously satisfying the constraint performance. The existence condition of fuzzy H_∞ control is obtained in terms of linear matrix inequalities (LMIs) and can be solved by using the standard software. A quarter-car suspension model is provided to validate the effectiveness of the proposed design procedures.

10:00AM Hinf Disturbance Attenuation of Fuzzy Large-Scale Systems [#66]

Mehdi Hosseinzadeh
 Nasser Sadati
 Iman Zamani

Sharif University of Technology, Iran
 Sharif University of Technology, Iran
 Amirkabir University of Technology, Iran

This paper is concerned with the disturbance attenuation problem of fuzzy large-scale systems which consist of N interconnected subsystems which are represented by Takagi- Sugeno fuzzy models. Using Lyapunov function and linear matrix inequalities (LMIs), a criterion is proposed to have a prescribed level of disturbance attenuation. A numerical example is given to illustrate the control design procedure and its effectiveness.

(FST & GC) Fuzzy Set Theory and Granular Computing

Thursday, June 30, 8:00AM-10:20AM, Room: Crane, Chair: Gwo-Hshiung Tzeng

8:00AM Dualities between Indistinguishabilities and Related Concepts [#518]Gabriel Mattioli
Jordi RecasensUniversitat Politècnica de Catalunya, Spain
Universitat Politècnica de Catalunya, Spain

Given a T-indistinguishability operator, the corresponding set H_E of extensional sets and the operators ϕ_E and ψ_E that provide upper and lower approximations of a fuzzy subset by extensional ones can be obtained. Reciprocally, given any of these, the initial indistinguishability operator can be retrieved. In order to understand in depth how this relation works, it will be shown that there is an isomorphism between the corresponding lattices and how this isomorphism acts over the operations and orderings of the lattices will be studied.

8:20AM Graded equipollence and fuzzy c-measures of finite fuzzy sets [#559]

Michal Holcapek

University of Ostrava, Czech Republic

In the classical set theory, there is the well known correspondence between the equipollence of finite sets and the equality of natural numbers expressing their cardinalities. In the fuzzy set theory, an equivalent correspondence between the equipollence of finite fuzzy sets and the equality of generalized cardinals has been proposed in [1]. This paper is devoted to the situation when we consider the mentioned relations to be graded, that means, the crisp equipollence of fuzzy sets is replaced now by the graded equipollence of fuzzy sets and the equality of fuzzy sets by their similarity.

8:40AM On monotonicity of type $\langle 1,1 \rangle$ fuzzy quantifiers determined by fuzzy measures [#437]Antonin Dvorak
Michal HolcapekUniversity of Ostrava in Ostrava, Czech Republic
University of Ostrava in Ostrava, Czech Republic

In this contribution, we study a very important semantic property of generalized quantifiers called the monotonicity for fuzzy quantifiers of type $\langle 1,1 \rangle$ defined using fuzzy measures and Sugeno type of fuzzy integrals. We show that fuzzy integrals can ensure under some natural conditions the monotonicity of fuzzy quantifiers. Finally, we propose the concept of concave fuzzy quantifiers and prove that each concave fuzzy quantifier is expressible as the conjunction of a non-increasing and a non-decreasing fuzzy quantifier.

9:00AM Generalized Fuzzy Imaginary Ideals of Rings [#104]Zuhua Liao
Shu Cao
Qinghe Tian
Miaohan Hu
Yang ZhangJiangnan University, China
Jiangnan University, China
Jiangnan University, China
Jiangnan University, China
Jiangnan University, China

Our aim in this paper is to introduce and study the new type of fuzzy ideals of a ring called generalized fuzzy imaginary right (resp . left) ideals and the direct products of them . The equivalence relation of them is given , besides , the properties of their intersection, union and level sets are discussed . Finally, we also give the properties of their homomorphic preimage.

9:20AM Cellular Fuzzy Networks [#59]Koosha Sadeghi Oskooyee
Mohammad Mansour Riahi Kashani
Mehrdad JangjouIslamic Azad University, North Tehran Branch, Iran
Islamic Azad University, North Tehran Branch, Iran
Islamic Azad University, U.A.E. Branch, United Arab Emirates

A formal representation of the mutual information processing among the cognitive processes of the brain provides a real impression of the mechanisms of a Natural Intelligence (NI) system. The nature of information processing in the human brain is fuzzy. In this article, a new formal model, namely Cellular Fuzzy Networks (CFNs), is introduced to model the real characteristics of NI-Systems and especially the human mind. CFNs can effectively manipulate the interactions among natural concepts in an NI-system. The detailed definitions of CFNs and related theorems are provided. Then, CFNs are exploited to model a feasibility analysis of the human brain in the cognitive process of decision making. Finally, it is posited that CFNs have great potential to be applied in modeling the complex interrelationships in large-scale natural systems.

9:40AM Expatriate Manager Selection for an Overseas Manufacturing Site by Using FMCDM Methods [#568]Chi-Yo Huang
Chih-Wei Wan
Gwo-Hshiung TzengNational Taiwan Normal University, Taiwan
National Taiwan Normal University, Taiwan
Kainan University, Taiwan

The human resources is playing a daily important role in modern globalized firms. Appropriate staffing strategies are critical for coordinating and controlling international human resource management related issues across widely distributed business units or subsidiaries over various geographic areas. However, very few researchers tried to uncover how the expatriate managers can be selected, especially when the evaluation criteria influence each other. Thus, this research aims to develop a decision framework for selecting appropriate expatriate managers. A multiple criteria decision making (MCDM) framework consisting of the Decision Making Trial and Evaluation Laboratory (DEMATEL) for structuring the decision problem, the Analytical Network Process (ANP) for deriving weights versus each criterion, and finally, the VlseKriterijumska Optimizacija I Kompromisno Resenje

(VIKOR) for ranking the alternatives have been proposed. An empirical study based on a globalized high technology firm will be leveraged for verifying the usefulness of this proposed analytic framework on staff selections.

10:00AM *On the Geometry of Join and Meet Calculations for General Type-2 Fuzzy Sets* [#8]

Jerry Mendel

University of Southern California, United States

The union and intersection of general type-2 fuzzy sets (T2 FSs) are fundamental computations for such FSs. In the past, algorithms were developed for the union and intersection computations using vertical-slice and horizontal-slice representations of T2 FSs. The vertical-slice representation of a T2 FS traces its origins back to Zadeh [32] and requires computing the join or meet, whereas the horizontal-slice representation of a T2 FS is very recent, traces its origins to Liu [14], and requires computing the join and meet only for interval T2 FSs that are raised to level alpha, for which closed-form formulas are available [15]. In this paper, by studying the join and meet geometrically for general T2 FSs, we show that for many situations closed-form formulas exist for them. We also show that the formulas for computing the union and intersection of general T2 FSs that were derived from the horizontal-slice representation of a T2 FS [19] can also be obtained directly from geometrical interpretations of formulas that were derived by Karnik and Mendel [12] for the vertical-slice representation of a T2 FS.

(SS36-1) Special Session: Fuzzy Systems on Renewable Energy

Thursday, June 30, 8:00AM-10:20AM, Room: Egret, Chair: Faa-Jeng Lin

8:00AM *A Fuzzy-Based Output Power Smoothing of WECS using Short-Term Ahead Prediction of Wind Speed* [#97]

Yuya Izumi

University of the Ryukyus, Japan

Alok Pratap

University of the Ryukyus, Japan

Yoshihisa Kinjyo

University of the Ryukyus, Japan

Akie Uehara

University of the Ryukyus, Japan

Endusa Billy Muhando

University of Alaska Fairbanks, United States

This paper presents a fuzzy-based output power smoothing method for a wind energy conversion system (WECS) using short-term ahead prediction of wind speed. The WECS is based on a permanent magnet synchronous generator (PMSG) and transmits its electrical power to an AC grid through an IGBT pulse-width modulation (PWM) converter. The power converter controls the torque of the PMSG according to the torque command, which is determined by using the fuzzy logic. The inputs of the fuzzy logic are the predicted wind speed and the difference between the wind turbine torque and the generator torque. By means of the proposed method, the generator torque is smoothed and the kinetic energy stored by the inertia of the wind turbine can be utilized to smooth the output power fluctuations of the PMSG. In addition, the wind turbine's shaft stress is mitigated compared to a conventional maximum power point tracking (MPPT) control. The effectiveness of the proposed method is verified by numerical simulations.

8:20AM *Frequency and Voltage Control by Decentralized Controllable Loads with Fuzzy Control* [#332]

Yoshihisa Kinjyo

University of the Ryukyus, Japan

Tomonobu Senjyu

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Atsushi Yona

University of the Ryukyus, Japan

Nomitsu Urasaki

University of the Ryukyus, Japan

Toshihisa Funabashi

Meidensha Corporation, Japan

In recent years, amount of renewable energy facilities using wind turbine generator and photovoltaic power system have been increased due to natural environment and resource depletion. Moreover, all electrification apartment houses or residences and electric vehicles have been increased. However, due to the fluctuating power from renewable energy sources and loads, fluctuations of grid frequency and voltage become problematic. This paper presents a methodology of control system frequency and voltage by distributed controllable loads such as heat pump and electric vehicles. By applying power consumption controller using distributed fuzzy control for HP and H-infinity control for battery, fluctuations of grid frequency and voltage are suppressed around a desired value. In order to verify the effectiveness of the proposed system, MATLAB/Simulink is used for computed simulations.

8:40AM *Short-Term Load Forecasting Via Fuzzy Neural Network With Varied Learning Rates* [#27]

Rong-Jong Wai

Yuan Ze University, Taiwan

Yi-Chang Chen

Yuan Ze University, Taiwan

Yung-Ruei Chang

Atomic Energy Council, Taiwan

Due to the lack of natural resources, the majority of energy in many countries must depend on import, and the corresponding cost is expensive and affected by international market fluctuation and control. In recent years, an intelligent micro-grid system composed of renewable energy sources is becoming one of the interesting research topics. The forecasting of short-term loads enables the intelligent micro-grid system to manipulate an optimized loading and unloading control by measuring the electrical supply each hour for achieving the best economical and power efficiency. Therefore, this study investigates a fuzzy neural network (FNN) with varied learning rates

for the short-term load forecasting (STLF), and compares its better forecasting performance with a conventional neural network (NN) by numerical simulations of a real case in Taiwan campus.

9:00AM A Fuzzy Control Maximum Power Point Tracking Photovoltaic System [#133]

Irwan Purnama
Lo Yu-Kang
Chiu Huang-Jen

National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan
National Taiwan University of Science and Technology, Taiwan

Conventional maximum power point tracking (MPPT) methods, e.g. perturbation and observation (P and O) and incremental conductance (INC), have the drawbacks such as oscillation at the MPP during power fast tracking and power divergence under rapidly changing atmospheric condition. Thus, a fuzzy logic controller (FLC) is implemented in the PV system to avoid the conventional problem. FLC method has not only fast response under rapidly changing atmospheric conditions but also small oscillation at the maximum power point (MPP). However, FLC presents difficulty of modification and tuning of control rules. The FLC disadvantages can be reduced using single-fuzzy logic controller (S-FLC) without degrading performance. Furthermore, the control algorithm on DSP can be simplified. The experimental results are shown to verify the studied S-FLC MPPT method.

9:20AM Fuzzy Control of MW-class PV Generation to Reduce Frequency and Tie-line Power Fluctuations in Three Control Area Power System [#391]

Manoj Datta
Tomonobu Senjyu
Atsushi Yona
Toshihisa Funabashi

University of the Ryukyus, Japan
University of the Ryukyus, Japan
University of the Ryukyus, Japan
Meidensha Corporation, Japan

This paper presents a fuzzy based frequency control strategy by grid-connected MW class PV generation. The frequency control is proposed from the view point of the frequency fluctuation problem produced by the large penetration of PV power. The fuzzy control has three inputs: average insolation, change of insolation and system frequency deviation. Following these three inputs, a frequency control system of the PV inverters is proposed. For the case of different insulations, a coordinated inverter and battery control method is presented. The proposed method is simulated in three control area power system by considering dual power and information flows between supply and demand sides and is found satisfactory to provide frequency control and to reduce tie-line power fluctuations.

9:40AM A Fuzzy-Rule Based Power Restoration Approach for a Distribution System with Renewable Energies [#327]

Hong-Tzer Yang
Jian-Tang Liao
Xiang-He Su

National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan

Based on heuristic fuzzy rules, a new power restoration approach is presented in this paper. The restoration approach developed can be used to deal with different fault cases in a distribution system (DS) with sources of renewable energies. This paper introduces "Load Path" as the main framework for restoration. The proposed strategy can achieve the advantages of simple decision criterions, balance of backup feeders, fast computational time, and applicability for different fault cases. Depending on fault situations, the number of load paths is different. With more than two load paths existing, the proposed fuzzy rules infer the best restoration strategy (main load path) for the specific case. To consider the distributed generations (DGs) of renewable energies, the proposed approach has been validated in a test system adapted from Taipower distribution system for different scenario studies.

10:00AM Neuro-Fuzzy Predictive Model for PV Energy Production based on Weather Forecast [#539]

Francesco Grimaccia
Marco Mussetta
Riccardo E. Zich

Politecnico di Milano, Italy
Politecnico di Milano, Italy
Politecnico di Milano, Italy

This paper introduces an evolutionary optimization algorithm as a tool for training an Artificial Neural Network used for production forecasting of solar energy PV plants. This optimized procedure essentially represent a bio-inspired heuristic search technique which is used to solve complex forecasting problems modeled on the concepts of biological neurons. Some simulation results are reported to highlight advantages and drawbacks of the proposed method in order to suitably apply this algorithm to a neuro-fuzzy system application in solar energy production. The weather forecast data related to the PV plants are supplied by the airport service close to the production site and relative data are pre-processed using Fuzzy Logic techniques.

(FS & FDM) Fuzzy Clustering and Fuzzy Data Mining

Thursday, June 30, 8:00AM-10:20AM, Room: Swallow, Chair: Tzung-Pei Hong

8:00AM Fuzzy Clustering Approach for Star-Structured Multi-Type Relational Data [#165]

Jian-Ping Mei
Lihui Chen

Nanyang Technological University, Singapore
Nanyang Technological University, Singapore

Recently, mining interrelated data among multiple types of objects attracts a lot of attention due to its importance in many real-world applications. Despite of extensive study on fuzzy clustering of vector space data and homogeneous relational data, very limited exploration has been made on fuzzy clustering of relational data involving several object types. In this paper, we propose FC-SMR, a fuzzy approach for clustering star-structured multi-type relational data, where the central type is related to multiple attribute types. In FC-SMR, objects of the central type are clustered based on the rankings of objects of different attribute types. We formulate the clustering problem as a constrained maximization problem and give an efficient algorithm for finding local solutions of the defined objective function. Experimental studies conducted on real-world document data show the effectiveness of the new approach.

8:20AM Predicting Septic Shock Outcomes in a Database with Missing Data using Fuzzy Modeling [#427]

Ruben Pereira	Technical University of Lisbon; and Massachusetts Institute of Technology, Portugal
Andre Fialho	Technical University of Lisbon; and Massachusetts Institute of Technology, Portugal
Federico Cismondi	Technical University of Lisbon; and Massachusetts Institute of Technology, Argentina
Susana Vieira	Universidade Tecnica de Lisboa, Portugal
Joao Sousa	Universidade Tecnica de Lisboa, Portugal
Rui Almeida	Erasmus University Rotterdam, Netherlands
Uzay Kaymak	Erasmus University Rotterdam; and Eindhoven University of Technology, Netherlands
Shane Reti	Harvard Medical School, United States
Michael Howell	Harvard Medical School, United States
Stan Finkelstein	Massachusetts Institute of Technology, United States

Real-world databases often contain missing data and existing correction algorithms deliver varying performance. Also, most modeling techniques are not suitable to deal with them automatically. In this study we examine different approaches to predicting septic shock in the presence of missing data. Some pre-processing techniques for managing missing data include disregarding data, or replacing it with information that by design introduces bias. In this study, we show that predictive performance improves by employing a minimum pre-processing technique, the Zero-Order-Hold (ZOH) method, by applying a Fuzzy C-Means clustering technique based on the partial distance calculation strategy (FCM- PDS) and by computing the final classification regarding the samples from each patient. Performance improvements continue to occur where up to approximately 60% of the data is missing, though for higher percentage the classification performance still is statistically improved. We further validate this approach by making comparisons with previous studies.

8:40AM A normalized soft window-based similarity measure to extend the Rand index [#405]

Romain Quere	University of La Rochelle, France
Carl Frelicot	University of La Rochelle, France

This article addresses the problem of the construction of concordance measures between two crisp, fuzzy and possibilistic partitions from their coincidence matrices. Two existing approaches are reviewed and their advantages and drawbacks are exhibited so that a new Rand index taking profits of both is proposed. Numerous experimental results show that it outperforms other extensions of the Rand index.

9:00AM Fuzzy Clustering With Learnable Cluster Dependent Kernels [#149]

Ouiem Bchir	University of Louisville, United States
Hichem Frigui	University of Louisville, United States

We propose a new relational clustering approach, called Fuzzy clustering with Learnable Cluster dependent Kernels (FLeCK), that learns multiple kernels while seeking compact clusters. A Gaussian kernel is learned with respect to each cluster. It reflects the relative density, size, and position of the cluster with respect to the other clusters. These kernels are learned by optimizing both the intra-cluster and the intercluster similarities. Moreover, FLeCK is formulated to work on relational data. This makes it applicable to data where objects cannot be represented by vectors or when clusters of similar objects cannot be represented efficiently by a single prototype. The experiments show that FLeCK outperforms several other algorithms. In particular, we show that when data include clusters with various inter and intra cluster distances, learning cluster dependent kernel is crucial in obtaining a good partition.

9:20AM The Interval Autoregressive Time Series Model [#236]

Xun Wang	Beijing University of Technology, China
Shoumei Li	Beijing University of Technology, China

This paper mainly suggests a new type of interval time series: interval autoregressive (IAR) model. Firstly we state why we should introduce the interval time series models. Then we give necessary definitions about random intervals and interval time series. Thirdly, we introduce some methods of efficiency evaluation for forecasting of interval time series. And then we discuss parameter estimation and forecasting in IAR model, in which the methods of parameter estimation are based on the evaluation forecasting for interval data. Furthermore, we give the simulation results and apply it to real data from Shanghai Stock Index, which is to illustrate our modeling methodology. This model makes it possible for decision makers to forecast the best and worst possible situations based on interval-valued observations.

9:40AM Feature Evaluation Based Fuzzy C-Mean Classification [#229]

Mostafa A. Salama	British University in Egypt, Egypt
Aboul Ella Hassanien	Cairo University, Egypt

Aly A. Fahmy

Cairo University, Egypt

Fuzzy C-means Clustering, FCM, is an iterative algorithm whose aim is to find the center or centroid of data clusters that minimize an assigned dissimilarity function. The degree of being in a certain cluster can be defined in terms of the distance to the cluster-centroid. The domain knowledge is used to formulate an appropriate measure. However the Euclidean distance is considered as a general measure for such value. The calculation of the Euclidean distance doesn't take into consideration the degree of relevance of each feature to the classification model. In this paper, scoring methods like ChiMerge and Mutual information are used in the FCM model to improve the calculation of the Euclidean distance. Experimental results demonstrate the better performances of the improved FCM on UCI benchmark data sets rather than the ordinary FCM, where the ordinary FCM uses in classification either all features or the most important features while the improved FCM uses all the features but the Euclidean Distance will be calculated according to the relevance degree of each feature.

10:00AM *A Clustering Method for Geometric Data based on Approximation using Conformal Geometric Algebra* [#386]

Minh Tuan Pham
Kanta Tachibana
Tomohiro Yoshikawa
Takeshi Furuhashi

Nagoya University, Japan
Kogakuin University, Japan
Nagoya University, Japan
Nagoya University, Japan

Clustering is one of the most useful methods for understanding similarity among data. However, most conventional clustering methods do not pay sufficient attention to the geometric properties of data. Geometric algebra (GA) is a generalization of complex numbers and quaternions able to describe spatial objects and the relations between them. This paper uses conformal GA (CGA), which is a part of GA, to transform a vector in a real vector space into a vector in a CGA space and presents a proposed new clustering method using conformal vectors. In particular, this paper shows that the proposed method was able to extract the geometric clusters which could not be detected by conventional methods.

(HA) Hybrids and Other Applications

Thursday, June 30, 8:00AM-10:20AM, Room: Magpie, Chair: Bor-Sen Chen

8:00AM *Improving Estimation Accuracy of the COCOMO II Using an Adaptive Fuzzy Logic Model* [#237]

Iman Attarzadeh
Siew Hock Ow

University of Malaya, Malaysia
University of Malaya, Malaysia

Software development time and cost estimation are the process of estimating the most realistic use of time and cost required for developing a software. It is one of the biggest challenges in the area of software engineering and project management, in the last decades. The software estimates are difficult to obtain due to incomplete software information is available in the early phase of software development process. Insufficient software information causes inaccuracy in software attributes. Thus, the vagueness and uncertainty of the software attributes is the main reason of inaccuracy of software estimates. Software cost estimation models such as regression model, expert judgement, SLIM, and COCOMO require accurate software attributes and long term estimation process, which are not completely achievable in early phase of software development process. Soft computing techniques such as fuzzy logic can reduce the vagueness and uncertainty of software attributes. This research aims to utilise an adaptive fuzzy logic model to improve the accuracy of software time and cost estimation. Using advantages of fuzzy set and fuzzy logic can produce accurate software attributes which result in precise software estimates. The evaluation of the obtained results, using Mean of Magnitude of Relative Error (MMRE) and PRED(25%) evaluation techniques, showed that the FL-COCOMO II produced the MMRE less than the original COCOMO and the value of PRED(25%) in the Fuzzy-COCOMO II is higher than the original COCOMO. Furthermore, the FL-COCOMO II showed 8.03% improvement in terms of estimation accuracy using MMRE when compared with the original COCOMO.

8:20AM *Fuzzy-Rough Set based Semi-Supervised Learning* [#259]

Neil Mac Parthalain
Richard Jensen

Aberystwyth University, Wales
Aberystwyth University, Wales

Much work has been carried out in the area of fuzzy-rough sets for supervised learning. However, very little has been accomplished for the unsupervised or semi-supervised tasks. For many real-world applications, it is often expensive, time-consuming and difficult to obtain labels for all data objects. This often results in large quantities of data which may only have very few labelled data objects. This paper proposes a novel fuzzy-rough based semi-supervised self-learning or self-training approach for the assignment of labels to unlabelled data. Unlike other semi-supervised approaches, the proposed technique requires no subjective thresholding or domain information. An experimental evaluation is performed on artificial data and also applied to a real-world mammographic risk assessment problem with encouraging results.

8:40AM *An Application of Genetic Fuzzy Systems for Wireless Sensor Networks* [#418]

Liliam Leal
Marcus Lemos

University of Fortaleza, Brazil
University of Fortaleza, Brazil

Raimir Holanda
Ricardo Rabelo
Fabbio Borges

University of Fortaleza, Brazil
Unified Teaching Center of Teresina, Brazil
Unified Teaching Center of Teresina, Brazil

Wireless sensor networks (WSNs) are composed of sensor nodes in order to detect and transmit features from the physical environment. Generally, the sensor nodes transmit information to a special node called sink. Some recent researches have led to the selection of routes in sensor networks with multiple sink nodes. The approach proposed by this paper presents the application of Genetic Fuzzy System (GFSs) for the selection of routes in WSNs, in order to make the communication between multiple sensor nodes and sink nodes. The results obtained through simulations demonstrated a sensor network with a longer lifetime, through the choice of the adequate sink used for sending packets through the network in order to find the best routes.

9:00AM On Predicting Learning Styles in Conversational Intelligent Tutoring Systems using Fuzzy Classification Trees [#304]

Keeley Crockett
Annabel Latham
Zuhair Bandar
James O'Shea
David Mclean

Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom
Manchester Metropolitan University, United Kingdom

Oscar is a conversational intelligent tutoring system (CITS) which dynamically predicts and adapts to a student's learning style throughout the tutoring conversation. Oscar aims to mimic a human tutor to improve the effectiveness of the learning experience by leading a natural language tutorial and adapting material to suit an individual's learning style. Prediction of learning style is undertaken through capturing independent variables during the conversation. The variable with the highest value determines the individual's learning style. This paper proposes a new method which uses a fuzzy classification tree to build a fuzzy predictive model using these variables which are captured through natural language dialogue. Experiments have been undertaken on two of the learning style dimensions: perception (sensory-intuitive) and understanding (sequential-global). Early results show the model has substantially increased the predictive accuracy of the Oscar CITS and discovered some interesting relationships amongst these variables.

9:20AM Signal Transduction Ability Measurement of Signaling Pathways in Intracellular Communication via Fuzzy Method [#501]

Chia-Chou Wu
Bor-Sen Chen

National Tsing Hua University, Taiwan
National Tsing Hua University, Taiwan

Signal transduction plays an important role in biological organisms. Here, we proposed a method to access the information of the signal transduction ability of signal transduction pathway in the cells. Due to the nonlinear signal transduction pathway model, we have to solve the Hamilton-Jacobi inequalities (HJIs) to get the measurement. Instead of directly solving HJIs, fuzzy interpolation method was employed such that we can systematically measure signal transduction ability by solving the linear matrix inequalities (LMIs). The measurement will provide an insight to the characteristics of the signal transduction networks.

9:40AM Long-term business cycle forecasting using intuitionistic fuzzy least-squares support vector regression [#348]

Kuo-Ping Lin
Kuo-Chen Hung
Ming-Chang Wu

Lunghwa University of Science and Technology, Taiwan
National Defense University, Taiwan
Lunghwa University of Science and Technology, Taiwan

Long-term business cycle forecasting is a very important issue in economic evaluation. This study presents a novel intuitionistic fuzzy least-squares support vector regression (IFLS-SVR) model for accurately forecasting long-term index of business cycle. Traditional support vector regression (SVR) and least-squares support vector regressions (LS-SVR) have been successfully applied in forecasting problems especially complex/nonlinear system. In this paper, the prediction model adopts two least-squares support vector regressions with intuitionistic fuzzy sets to approach fuzzy upper and lower bounds respectively, and then approach the crisp predict values. Genetic algorithms (GAs) are also employed in order to select two parameters of IFLS-SVR models. In this study, IFLS-SVR, LS-SVR and SVR are employed for the Taiwan business index forecasting. Empirical results indicate that the IFLS-SVR has better performance in terms of forecasting accuracy. Therefore, the IFLS-SVR model can efficiently provide credible long-term prediction for the Taiwan business index forecasting.

(FOD) Fuzzy Optimization and Design

Thursday, June 30, 1:30PM-2:30PM, Room: Swan, Chair: Chia-Feng Juang

1:30PM Production Planning with Uncertain Demands [#35]

Guillaume Romain
Kobylanski Przemyslaw
Zielinski Pawel

Universite de Toulouse-IRIT, France
Wroclaw University of Technology, Poland
Wroclaw University of Technology, Poland

The paper deals with a single-item production planning problem with uncertain demands modeled by fuzzy intervals whose membership functions are possibility distributions for the values of the uncertain demands.

Optimization criteria, in the setting of possibility theory, that lead to choose robust production plans under fuzzy demands are given. Algorithms for determining optimal robust production plans with respect to the proposed criteria are provided and some computational experiments are presented.

1:50PM *Min-Max and Two-Stage Possibilistic Combinatorial Optimization Problems* [#69]

Kasperski Adam
Zielinski Pawel

Wroclaw University of Technology, Poland
Wroclaw University of Technology, Poland

This paper deals with a class of combinatorial optimization problems with uncertain element costs. The uncertainty is modeled by specifying a scenario set containing a finite number of possible realizations of the costs called scenarios. Additionally, a possibility distribution on the scenario set can be defined. Two robust models, namely the min-max and two-stage, for hedging against uncertainty of the costs in the possibilistic setting are considered. A general framework for solving the problems is proposed. For the linear sum objective a mixed integer programming formulation is shown. For the bottleneck objective, an algorithm is constructed which runs in polynomial time if the deterministic problem, i.e. the one with a single scenario, is polynomially solvable.

2:10PM *A Fuzzy Concept for Climate Management in Preventive Conservation* [#146]

Christian Arnold
Steven Lambeck
Christoph Ament

University of Applied Sciences Fulda, Germany
University of Applied Sciences Fulda, Germany
Technical University of Ilmenau, Germany

Especially for air conditioning tasks with applications in the area of preventive conservation, requirements can only be described by using vague and incomplete information. In this field of application a fuzzy formulation, which considers stationary, dynamical and economy demands of climate values, turned out to be appropriate. The presented paper describes an unifying approach of formulating fuzzy setpoints as well as using fuzzy decision making, in order to develop a automated climate management system for the best possible preventive conservation.

(FO & FEC) Fuzzy Optimization and Fuzzy Emotional Computing

Thursday, June 30, 1:30PM-2:30PM, Room: Peacock, Chair: Chuan-Yu Chang

1:30PM *Fuzzy Bipolar Conditions of Type "or else"* [#33]

Ludovic Lietard
Nouredine Tamani
Daniel Rocacher

IRISA/IUT Univ. Rennes 1, France
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Previously studied fuzzy bipolar conditions of type "and if possible" are made of a mandatory condition c and an optional condition w . They allow expressing complex preferences of a conjunctive nature. We define in this paper, a new kind of fuzzy bipolar conditions of the form "or else" which express complex preferences of a disjunctive nature. We show that the "or else" form can be used as a negation operator of the "and if possible" form and vice versa. We also show that these both forms are compatible and, therefore, fuzzy bipolar conditions of both types can be used together in the same bipolar query.

1:50PM *Fuzzy Optimization Model Based Tolerance Approach to Timetable Rescheduling for High Speed Railway in China* [#130]

Yong Qin
Li Wang
Huan Lian
Xuelei Meng
Xuwen Li
Fugui Shi
Limin Jia

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Beijing Institute of Technology, China
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Beijing Institute of Technology, China
Beijing Jiaotong University, China

A fuzzy optimization model based tolerance approach is proposed to handle timetable rescheduling in high speed railway during speed restriction period. As the limited speed and headway time are not crisp figures in practice especially when some natural hazards happen or some equipment failure, tolerance approach is introduced with the fuzzy membership functions of the original objective and soft constraints to find an new optimal objective with little slack of constraints. The original objective is treated in the same manner as the soft constraints, so the model is symmetric. The proposed fuzzy rescheduling model is simulated on the busiest part of a high speed railway line in China. The entire case study shows the significance of fuzzy optimization in case of speed restriction. The results shed light on how we could choose a better limited speed and headway time, so that the number of seriously impacted trains can be reduce greatly with little cost and risk.

2:10PM *Online Neuro-Fuzzy CANFIS Hidden-Node Teaching* [#402]

Eiji Mizutani
Jing-Yun Fan

National Taiwan University of Science and Technology, Taiwan
Zoran Corporation, Taiwan

On-line first-order backpropagation (BP) has been widely employed for optimizing a multi-layer neural network and a fuzzy neural network. When BP is applied to a TSK fuzzy system, the interpretability of fuzzy rules may be lost. We describe a simple and effective remedy for the loss by casting the posed optimization problem into a

general Bolza-type optimal-control mold so as to include stage costs on top of the terminal cost; this is what we called the (on-line) hidden-node teaching. Our on-line learning scheme turns out to be useful not only in optimizing a large model, a so-called CANFIS neuro-fuzzy modular network, but also in enhancing its generalization capacity. The fundamental concept is that each (local) expert network is supervised individually by hidden-node teaching for minimizing a stage cost while all local-expert modules are encouraged to cooperate in reducing the terminal cost simultaneously. Furthermore, we show how to construct a CANFIS modular network in order to alleviate the so-called curse of dimensionality that frequently hampers the design of fuzzy systems. In simulation, our concepts have been demonstrated in the letter recognition benchmark problem as well as in small regression and XOR-classification tasks.

(RS & RDA) Rough Sets and Rough Data Analysis

Thursday, June 30, 1:30PM-2:30PM, Room: Phoenix, Chair: Yo-Ping Huang

1:30PM *Fuzzy Fusion Fairness Relations for the Evaluation of User Preference* [#358]

Mario Koeppen
Jun Okamoto
Aoi Honda

Kyushu Institute of Technology, Japan
NTT Corporation, Japan
Kyushu Institute of Technology, Japan

In this paper, formal representations for user preferences will be provided, which also take fairness in the achievement of probably conflicting goals into account. The analysis of the Bottleneck Flow Control (BFC) algorithm for congestion avoidance in traffic networks will serve as a base to specify extensions of relations among preference sets. In particular, these relations are the lexicographic minimum, the maxmin fairness, and the newly introduced ordered-ordered weighted averaging operator. All of them are shown to become, in a relational sense, maximized by the BFC algorithm. Their further expansion by introducing fuzzy fusion operators in their formal definitions than establishes a comprehensive sets of relations. The application of these relations to the Multiple Relation Analysis (MRA) of subjective video quality evaluation data is demonstrated and gives the conclusion that also fairness criteria are present in such evaluations, at least as a secondary preference criterion.

1:50PM *Multiple Criteria Group Decision Making with Triangular Interval Type-2 Fuzzy Sets* [#409]

Kuo-Ping Chiao

Aletheia University, Taiwan

In this paper, the triangular interval type-2 fuzzy set extension of the Analytic Hierarchy Process is introduced. The priority vectors are elicited from the pairwise comparison matrix with triangular interval type-2 fuzzy sets which represent the linguistic relative importance judged by experts. First, the triangular interval type-2 fuzzy set logarithmic regression function is defined with respect to the pairwise comparison matrix of the criteria. Then, the sets of linear systems corresponding to the end points of the upper and lower membership functions are formulated by minimizing the logarithmic regression function. The non-normalized weights are solved. It is shown in this paper that the sets of linear systems are all dependent. Accordingly, the final normalized weights can be obtained. A quadratic programming model for finding the optimum normalized weights is constructed in the sense of minimizing the fuzziness of the interval type-2 fuzzy weights. Analogously, if the pairwise comparisons are for the alternatives, then the final normalized triangular interval type-2 fuzzy rates are also obtained. The aggregation process of the triangular interval type-2 fuzzy sets is proposed to obtain the overall rate of each alternative. The interval type-2 fuzzy set ranking method is proposed and used to find the final preference of the alternatives. A numerical example about selecting the best professor candidate is examined.

2:10PM *Noise Control in Document Classification Based On Fuzzy Formal Concept Analysis* [#207]

Sheng-Tun Li
Fu-Ching Tsai

National Cheng Kung University, Taiwan
National Cheng Kung University, Taiwan

Document classification is critical due to explosive increasing of text in modern world. However, most of existing document classification algorithms are easily affected by noise data. Therefore, in document classification tasks, the ability of noise control is as important as the ability to classify exactly. In this paper, we propose a novel classification framework based on fuzzy formal concept analysis to moderate the impact from noise. In addition, the well-organized concepts also provide inherent relations, which support knowledge codification and distribution effectively. Experimental results using Reuters 21578 dataset demonstrates significant noise control benefit and superior classification accuracy.

(T2FL) Type-2 Fuzzy Logic

Thursday, June 30, 1:30PM-2:30PM, Room: Crane, Chair: Hao Ying

1:30PM *Deriving the Input-Output Mathematical Relationship for a Class of Interval Type-2 Mamdani Fuzzy Controllers* [#193]

Haibo Zhou
Hao Ying

Central South University, China
Wayne State University, United States

Most fuzzy controllers, type-1 (T1) or type-2 (T2), have been used and treated as black boxes in that their explicit mathematical input-output mappings (i.e., analytical structures) are unknown. Revealing and analyzing the analytical structure is important as it will lay a solid foundation for better understanding, more insightful analysis, and more effective design of fuzzy control systems. We previously developed a general technique to derive the analytical structures of the type-1 fuzzy controllers that employed Zadeh AND operator. We now extend our study to a class of typical interval type-2 fuzzy controller that adopt Zadeh AND operator and the popular Karnik-Mendel iterative center-of-sets type reducer. A novel analytical structure deriving technique is developed. And the resulting input-output mathematical relationship for the controller is received.

1:50PM *Design of Interval of Type-2 Fuzzy Logic Controllers for Flocking Algorithm* [#231]

Seung-Mok Lee
Jong-Hwan Kim
Hyun Myung

KAIST, Republic of Korea
KAIST, Republic of Korea
KAIST, Republic of Korea

This paper presents a novel interval type-2 fuzzy logic control architecture for flocking system when the system has noisy sensor measurements. The traditional type-1 fuzzy logic controller (FLC) using precise type-1 fuzzy sets cannot fully model and handle the uncertainties of sensor data. However, type-2 FLC using type-2 fuzzy sets with a footprint of uncertainty (FOU) produces better performances under noisy environments. In this paper, therefore, we present a reactive control architecture for flocking algorithm that is based on interval type-2 FLC to implement the flocking behaviors consisting separation, obstacle avoidance, and velocity matching behaviors. The type-2 based control system could cope with the uncertainties of noisy sensor measurements and resulted in good performances that outperformed the type-1 FLC.

2:10PM *Is it rational to partition a data set using Kernel-clustering?* [#536]

Kaushik Sarkar
Nikhil R Pal

Narula Institute of Technology, India
Indian Statistical Institute, India

Many interesting papers have been written in the recent past on kernel clustering and many attractive results have also been demonstrated. Here we question the rationality behind such clustering approaches. Using simple data sets we argue and demonstrate that it is not a good idea to find clusters in the kernel space when the objective is to look for clusters in the original data because in the kernel space the data may have a different geometry from that in the original feature space. In particular we demonstrate the following : (1) improper choice of the number of clusters may lead to very counterintuitive clusters (e.g., instead of merging nearby clusters, it may merge clusters that are far from each other) and (2) improper choice of kernel parameters has a significant effect on the extracted clusters and it can even impose arbitrary cluster structures that are undoubtedly absent in the original data. However, we definitely do not imply that kernel clustering can never produce desirable results. In fact, kernel clustering could be useful provided we can choose right kernel parameters. But the process being unsupervised, we do not have a solution to this issue yet. In this study, for illustration, we use one variant of the kernel Fuzzy C-Means (KFCM) clustering algorithm in conjunction with Polynomial kernels.

(SS36-2) Special Session: Fuzzy Systems on Renewable Energy

Thursday, June 30, 1:30PM-2:30PM, Room: Egret, Chair: Faa-Jeng Lin

1:30PM *Fuzzy Quantum Computation Based Thermal Unit Commitment Strategy with Solar-battery System Injection* [#312]

Shantanu Chakraborty
Tomonobu Senjyu
Atsushi Yona
Toshihisa Funabashi

University of the Ryukyus, Japan
University of the Ryukyus, Japan
University of the Ryukyus, Japan
Meidensha Corporation, Japan

This article presents a strategy to solve thermal unit commitment (UC) integrated with an equivalent solar-battery system using Fuzzy based Quantum inspired Evolutionary Algorithm (FQEA). As a renewable power source, solar power is injected stochastically with the model. To handle the uncertainty and intermittency involved while integrating solar power and load forecasting, the trivial crisp problem formulations are modified by fuzzification. An evolutionary algorithm based on the concept and principle of quantum computation is applied to solve the UC problem. The conventional Quantum Evolutionary Algorithm (QEA) is advanced by using several operators such as binary differential operator, mutation and crossover along with trivial rotation operator with a re-defined rotational angle look-up table. The QEA is further modified by introducing multi-population based scheme. The fitness function is formulated by combining the objective function, penalty function and the aggregated fuzzy membership function. The proposed FQEA is applied to UC problem in different scaled power systems up to 100 units. Provided simulation results will show the effectiveness of FQEA.

1:50PM *Control of Doubly-Fed Induction Generator System Using PFNN* [#46]

Faa-Jeng Lin
Kuang-Hsiung Tan
Zong-Han Lu
Yung-Ruei Chang

National Central University, Taiwan
National Defense University, Taiwan
National Central University, Taiwan
Institute of Nuclear Energy Research, Taiwan

An intelligent controlled doubly-fed induction generator (DFIG) system using probabilistic fuzzy neural network (PFNN) is proposed in this study. This system can be applied as a stand-alone power supply system or as the emergency power system when the electricity grid fails for all sub-synchronous, synchronous and super-synchronous conditions. The rotor side converter is controlled using the field-oriented control to produce three-phase stator voltages with constant magnitude and frequency at different rotor speeds. Moreover, the stator side converter, which is also controlled using field-oriented control, is primarily implemented to maintain the magnitude of the DC-link voltage. Furthermore, an intelligent PFNN controller is proposed for both the rotor and stator side converters to improve the transient and steady-state responses of the DFIG system for different operating conditions. The network structure, on-line learning algorithm and convergence analyses of the PFNN are introduced in detail. Finally, the feasibility of the proposed control scheme is verified using some experimental results.

(FDM & DSS-1) Fuzzy Decision Making and Decision Support Systems

Thursday, June 30, 1:30PM-2:30PM, Room: Swallow, Chair: Bao-Rong Chang

1:30PM *Web User Identification with Fuzzy Fingerprints* [#203]

Nuno Homem
Joao Carvalho

INESC-ID, Instituto Superior Tecnico - TULisbon, Portugal
INESC-ID, Instituto Superior Tecnico - TULisbon, Portugal

Fingerprint identification is a well-known technique in forensic sciences. The basic idea of identifying a subject based on a set of features left by the subject actions or behavior can be applied to other domains. Identifying a web user based on a user fingerprint is one such application. This paper considers the problem of extracting fingerprints from web usage logs and matching them with those obtained from a set of known users. It presents an innovative fuzzy fingerprint algorithm based on vector valued fuzzy sets. Accessed sites are used as base features to create the fingerprint. The assumption is that sites accessed by each user remain approximately stable and are distinctive. The paper presents the proposed algorithm and shows some experimental results that validate the approach. The use of fast and compact algorithms is critical due to the possible huge number of users, and allows this method to be used on near real time.

1:50PM *Fuzzy Multiattribute Evaluation of Airport Performance* [#500]

Chung-Hsing Yeh
Yu-Hern Chang
Yu-Liang Kuo

Monash University, Australia
National Cheng Kung University, Taiwan
Monash University, Australia

This paper presents a fuzzy multiattribute decision making approach to evaluating airport performance in terms of the airport operator, the passenger, and the airline dimensions. Assessments for quantitative measures are represented by crisp values, and assessments for qualitative measures and attribute weights are represented by triangular fuzzy numbers, obtained via surveys using linguistic terms. An effective algorithm is developed by using the alpha-cut concept for incorporating the decision-maker's confidence level about respondents' fuzzy assessments on performance ratings and attribute weights. Based on the concept of the degree of optimality, the algorithm obtains a quantitative performance index for each airport evaluated, relative to other comparable airports with respect to each of three evaluation dimensions individually and all three evaluation dimensions as a whole. The performance index obtained would help individual airports understand the comparative level of their performance on measures relating to operational management, airport facilities, and passenger service quality. An empirical study of performance evaluation of 11 Asia-Pacific major international airports is conducted to illustrate how the approach works.

2:10PM *An Intelligent Decision Support Tool Based on Belief Rule-Based Inference Methodology* [#305]

Alberto Calzada
Jun Liu
Hui Wang
Luis Martinez
Kashyap Anil

University of Ulster, United Kingdom
University of Ulster, United Kingdom
University of Ulster, United Kingdom
University of Jaen, Spain
University of Ulster, United Kingdom

Taking into account the need of handling hybrid information with uncertainty in human decision making, a new belief rule-base inference methodology (RIMER) has been recently proposed. RIMER approach and its relevant extensions have proved to be highly positive solving decision problems. However, for an end user it is difficult to implement the methods and algorithms from the raw equations in order to solve a specific problem. This paper presents a decision support tool based on the RIMER approach that facilitates its implementation and use to end-users. The overall structure and main functionalities of the tool are outlined, followed by an example to illustrate the use of this tool for applications.

(HFS) Hybrid Fuzzy Systems

Thursday, June 30, 1:30PM-2:30PM, Room: Magpie, Chair: I-Fang Chung

1:30PM Fuzzy Controller Design Using Group-Crossover Particle Swarm Optimization for Truck Reversing Control [#225]Chia-Feng Juang
Yu-Cheng Chang
Chia-Hung Hsu
I-Fang ChungNational Chung-Hsing University, Taiwan
National Chung-Hsing University, Taiwan
National Chung-Hsing University, Taiwan
National Yang-Ming University, Taiwan

This paper proposes a fuzzy controller (FC) design using group-crossover particle swarm optimization (GCPSO) algorithm. The GCPSO uses a group-based framework for defining particle neighborhood topology and incorporating crossover operation into particle swarm optimization. The GCPSO dynamically forms different groups for selecting parents in crossover operations, particle updates and replacements. The objective of GCPSO is to improve fuzzy control accuracy. Comparisons with different population-based optimizations on truck reversing control problem demonstrate the performance of GCPSO algorithm.

1:50PM Evolving Ensemble of Fuzzy Models [#85]Eng Yeow Cheu
Chai Quek
See Kiong NgInstitute for Infocomm Research, Singapore
Nanyang Technological University, Singapore
Institute for Infocomm Research, Singapore

This paper presents an online learning-based neuro-fuzzy system called evolving Fuzzy Ensemble (eFE). The hierarchical computational structure of eFE is progressively adapted to autonomously support fuzzy data associations in accordance with neurophysiological studies. Activity-dependent synapse with global decay learning rule is incorporated to simulate the retention and active forgetting mechanisms that are involved in memory persistence. Such features incorporated in eFE model make it suitable to address the nonstationary characteristics of real-world problems. This work demonstrates the use of simple mechanisms to accomplish complex form of associative learning, an idea that has been suggested by psychologists for many years but has only recently been verified at the cellular level. The proposed eFE model is evaluated and compared with other modelling techniques in two benchmark time series experiments. The experimental results demonstrate the capabilities, and illustrate the viability of the proposed modelling technique.

2:10PM Long Term Bank Failure Prediction using Fuzzy Refinement-based Transductive Transfer Learning [#467]Vahid Behbood
Jie Lu
Guangquan ZhangUniversity of Technology Sydney, Australia
University of Technology Sydney, Australia
University of Technology Sydney, Australia

machine learning algorithms, which have been considered as robust methods in different computational fields, assume that the training and test data are drawn from the same distribution. This assumption may be violated in many real world applications like bank failure prediction because training and test data may come from different time periods or domains. An efficient novel algorithm known as Fuzzy Refinement (FR) is proposed in this paper to solve this problem and improve the performance. The algorithm utilizes the fuzzy system and similarity concept to modify the instances' labels in target domain which was initially predicted by shift-unaware Fuzzy Neural Network (FNN) proposed by [1]. The experiments are performed using bank failure financial data of United States to evaluate the algorithm performance. The results address a significant improvement in the predictive accuracy of FNN due to applying the proposed algorithm.

(SS29) Special Session: Software Engineering with Computational Intelligence

Thursday, June 30, 2:50PM-4:30PM, Room: Swan, Chair: Nien-Lin Hsueh

2:50PM Developing a Fuzzy Search Engine Based on Fuzzy Ontology and Semantic Search [#107]Lien-Fu Lai
Chao-Chin Wu
Pei-Ying Lin
Liang-Tsung HuangNational Changhua University of Education, Taiwan
National Changhua University of Education, Taiwan
National Changhua University of Education, Taiwan
Mingdao University, Taiwan

Most of existing search engines retrieve web pages by means of finding exact keywords. Traditional keyword-based search engines suffer several problems. First, synonyms and terms similar to keywords are not taken into consideration to search web pages. Users may need to input several similar keywords individually to complete a search. Second, traditional search engines treat all keywords as the same importance and cannot differentiate the importance of one keyword from that of another. Third, traditional search engines lack an applicable classification mechanism to reduce the search space and improve the search results. In this paper, we develop a fuzzy search engine, called Fuzzy-Go. First, a fuzzy ontology is constructed by using fuzzy logic to capture the similarities of terms in the ontology, which offering appropriate semantic distances between terms to accomplish the semantic search of keywords. The Fuzzy-Go search engine can thus automatically retrieve web pages that contain synonyms or terms similar to keywords. Second, users can input multiple keywords with

different degrees of importance based on their needs. The totally satisfactory degree of keywords can be aggregated based on their degrees of importance and degrees of satisfaction. Third, the domain classification of web pages offers users to select the appropriate domain for searching web pages, which excludes web pages in the inappropriate domains to reduce the search space and to improve the search results.

3:10PM *Multi-Agent Automatic Negotiation and Argumentation for Courses Scheduling* [#213]

Jong Yih Kuo
Hsuan-Kueil Cheng
Yong-Yi FanJiang
Shang-Pin Ma

National Taipei University of Technology, Taiwan
National Taipei University of Technology, Taiwan
Fu Jen Catholic University, Taiwan
National Taiwan Ocean University, Taiwan

This paper proposes an argumentation and negotiation mechanism for multi-agent systems. Through argumentations and negotiations, agents obtain more information on the topics of common interests or on those they have odds with. At the inception of the negotiation, agents can hardly understand completely the goals and beliefs other agents have toward related issues. Through argumentations and negotiations, the beliefs evolve, and agents will have better understanding about each other's target needs and preferences. During negotiations, agents can select the proposal that better suits other agents, further improving the chances for the agents to reach a consensus. Lastly, this paper illustrates our proposed methods through a simple course-scheduling negotiating system.

3:30PM *Investment Decision Making by Using Fuzzy Candlestick Pattern and Genetic Algorithm* [#563]

Chiung-Hon Lee
Lindroos Hsu
Yi-Ching Liaw

Nanhua University, Taiwan
Nanhua University, Taiwan
Nanhua University, Taiwan

This paper proposed an approach to extract fuzzy candlestick patterns from financial time series and select a set of patterns for investment decision making. The candlestick chart in stock market is a widely used technical analysis model. The investor observes the candlestick chart and makes investment decisions by identifying patterns in the chart. We use fuzzy linguistic variables to model candlestick chart and extract patterns from the chart. A Genetic algorithm based approach is used to select a set of extracted pattern as the background knowledge in the system for investment decision making. The advantage of the proposed approach is the investment knowledge is comprehensible, editable, and visible. The user can set different range of historical financial time series to extract and select different set of patterns. The experimental results shows that the investment decisions based on selected fuzzy patterns have better investment performance than using original non-fuzzy patterns.

3:50PM *Fuzzy Logic as a Basic for Use Case Point Estimation* [#577]

Jonathan Lee
Wen-Tin Lee
Jong-Yih Kuo

National Central University, Taiwan
National Kaohsiung Normal University, Taiwan
National Taipei University of Technology, Taiwan

Project estimation based on function point or use case point (UCP) methods provide only fixed complexity grades which can not deal with the uncertain and imprecise conditions. This study, therefore, provides a fuzzy size estimation procedure for goal-driven use case model based on UCP using fuzzy theory. We propose a metric to calculate the unadjusted use case points of goal-driven use cases based on the relations between each use cases and goals with the fuzzy membership functions and the fuzzy rules. Furthermore, the technical and environmental factors are considered to calculate the use case points which can be used to estimate the implementation time and effort of the system under development. The proposed approach is illustrated by a benchmark problem domain of a meeting scheduler systems.

4:10PM *Fuzzy Lymphedema Assessment based on Clinical and Functional Criteria* [#524]

Ernesto Araujo
Patricia Vicentini
Maria C. J. Perez

Universidade Federal de Sao Paulo, Brazil
Universidade Federal de Sao Paulo, Brazil
Universidade Federal de Sao Paulo, Brazil

A fuzzy lymphedema clinical and functional assessment for classifying the risk of developing and its severity is proposed in this paper. Different from the previous approach where reversibility, skin infection, and skin alteration were the input variables, this new fuzzy lymphedema clinical assessment takes into account the elements that compose the Brazilian Society of Lymphology (SBL). Such a SBL-based metric not only takes into account pre-clinical cases with risk of worsening and infective-degenerative local complications but also points out functional data of limb edema with the involvement of articular joints. The proposed approach includes both clinical (Pitting, Skin Alterations, Stemmer Signal and Reversibility) and functional criteria (Joint Involvement). The fuzzy lymphedema assessment based on clinical and functional criteria allows establishing therapeutic global rehabilitative programs, degree of assistance necessity of patients, and reduction of the daily living activities.

(SS34) Special Session: Brain and Learning

Thursday, June 30, 2:50PM-4:30PM, Room: Peacock, Chair: Toshihiko Watanabe

2:50PM Decision Making Based on Reinforcement Learning and Emotion Learning for Social Behavior
[#293]Atsushi Matsuda
Hideaki Misawa
Keiichi HorioKyushu Institute of Technology, Japan
Kyushu Institute of Technology, Japan
Kyushu Institute of Technology, Japan

In this paper, we propose a decision making method based on reinforcement learning and emotion learning (DRE) for inducing social behaviors of robots. Emotion of animals has an important role in their social interactions. We attempt to incorporate emotion into decision making of robots. To make a social decision making, the DRE combines a decision based on intrinsic fear emotion with a strategic decision obtained by reinforcement learning. Agents with the DRE learn state values by reinforcement learning and learn emotion values by fear emotion learning. In simulation experiments, the effectiveness of the DRE is verified concerning the emergence of social behaviors and the adaptability to an environmental change through an unmoving target search problem.

3:10PM Analysis of Relationship between Characteristics of Driver's Eye Movements and Visual Scene in Driving Events [#561]Tetsuya Miyoshi
Hidetoshi NakayasuToyohashi Sozo University, Japan
Konan University, Japan

It has been reported in many papers that the number of eye movements increases and the mean fixation durations on individual objects decreases when the road situation becomes more complex. In this paper eye-movement analysis has been used for understanding the mechanism of visual search of drivers. For the aim, two experiments in which the subjects drove the driving simulators have been conducted. We analyzed the relationship between the eye movement of drivers and the characteristics of their front scenes while driving in driving conditions. In the first experiment it was confirmed that the frequency of saccade became higher and fixation time became shorter in case of the turn event condition among three driving events, where the pixel difference extracted as the visual information from the driver's front scene became larger. In the second experiment the same relationship between the characteristics of eye movements and the driver's front scenes were confirmed by considering the three driving events, running straight, turning corners at a crossing and prediction task of hazard in the urban course. The pixel difference of the driver's front scene influenced the eye movements while driving. These results of experiments about driver's cognitive processing while driving suggested that eye movements depends on the amount of information contained in the front scene defined by the pixel difference.

3:30PM Directional Control of an Omni-Directional Walker for Walking Support with Forearm Pressures
[#233]Yinlai Jiang
Shuoyu Wang
Kenji Ishida
Takeshi Ando
Masakatsu G. FujieKochi University of Technology, Japan
Kochi University of Technology, Japan
Kochi University, Japan
Waseda University, Japan
Waseda University, Japan

Walking is a fundamental human ability necessary for everyday life. We have developed an omnidirectional walker (ODW) for walking support to those who have walking disabilities. It is necessary for the ODW to know which direction the user is intending to go during walking support. A novel interface is proposed for the ODW to recognize directional intention according to the user's forearm pressures which are measured by force sensors embedded in the armrest. The relationship between forearm pressures and directional intention was extracted as fuzzy rules and an algorithm is proposed for directional intention identification based on distance type fuzzy reasoning method. In this paper, we conduct walking support experiments with the proposed method. The results show that the algorithm is applicable to directional control in walking support.

3:50PM Construction of Collision Avoidance Behavior Model Induced by Visual Motion [#457]Norifumi Watanabe
Hiroaki Mikado
Takashi OmoriTamagawa University, Japan
Tamagawa University, Japan
Tamagawa University, Japan

We decide and execute our action from many types of environmental information in our daily lives even if we are not conscious of being guided. The human action induced from the opposing person's movement is the collision avoidance of passing each other. In collision avoidance, we chiefly judge the avoidance direction from visual information. Especially, it is important to get the information from oncoming person's body part and avoidance timing in each other. Then, we make an experiment to judge the avoidance direction by watching the masking movie of oncoming person's body part. By evaluating this judgment time, it was clarified oncoming person's body part is leg in collision avoidance. Next, it especially paid attention to oncoming person's leg, and the relation between the walking cycle and leg position in avoidance judgment is evaluated. From this result, the avoidance judgment is possible because the traveling direction can be controlled by the leg when the leg is lifting and landing. It was clarified that oncoming person's walking cycle is important in the action decision in collision avoidance. So we propose the action decision model based at the walking cycle from these results.

4:10PM Instruction Knowledge Acquisition for Reinforcement Learning Scheme by PSO Algorithm [#564]Toru Sawa
Toshihiko WatanabeOsaka Electro-Communication University, Japan
Osaka Electro-Communication University, Japan

In order to realize intelligent agents such as autonomous mobile robots, Reinforcement Learning is one of the necessary techniques in control systems. It is desirable in terms of knowledge or skill acquisition of agents that reinforcement learning is based only upon rewards instead of teaching signals. However, there exist many problems to apply reinforcement learning to real-world tasks. The most severe problem is a huge number of iterations in the learning phase. In order to deal with the problem, the instruction approach for reinforcement learning agents based on sub-rewards and forgetting mechanisms were proposed and shown to be effective. However, the relationship between the instruction and the learning performance of reinforcement learning has not been adequately clarified. In this study, in order to clarify the instruction performance in the reinforcement learning, we propose an instruction knowledge acquisition method for the reinforcement learning scheme by the particle swarm optimization (PSO) algorithm. Through numerical experiments of the mountain car task and the Acrobat task, we show the validness of the proposed approach in terms of learning speed and accuracy.

(SS35) Special Session: Fuzzy Regression Analysis and Its Applications

Thursday, June 30, 2:50PM-4:30PM, Room: Phoenix, Chair: M. Hadi Mashinchi

2:50PM A formula for fuzzy linear regression analysis [#374]

Chi-Tsuen Yeh

National University of Tainan, Taiwan

The purpose of this paper is to deal with the problem of least-squares multiple regression with fuzzy data. The constant regression coefficient is assumed to be symmetric triangular, and other coefficients are real (crisp). By applying symmetric triangular approximations of fuzzy numbers, a new method for computing the regression coefficients is proposed. The new method is efficient and easy to determine the coefficients.

3:10PM Real-Time Analysis of Granular Information: Some Initial Thoughts on a Convex Hull-based Fuzzy Regression Approach [#175]Azizul Azhar Ramli
Witold Pedrycz
Junzo Watada
Nureize ArbaiyWaseda University, Japan
University of Alberta, Canada
Waseda University, Japan
Waseda University, Japan

Regression models are well known and widely used as one of the important categories of models in system modeling. In this paper, we extend the concept of fuzzy regression in order to handle real-time implementation of data analysis of information granules. An ultimate objective of this study is to develop a hybrid of a genetically-guided clustering algorithm called genetic algorithm-Fuzzy C- Means (GA-FCM) and a convex hull-based fuzzy regression approach being regarded as a potential solution to the formation of information granules. It is anticipated that the setting of Granular Computing will help us reduce the computing time, especially in case of real-time data analysis, as well as an overall computational complexity. We propose an efficient real-time granular fuzzy regression analysis based on the convex hull approach in which a Beneath-Beyond algorithm is employed to design a convex hull. In the proposed design setting, we emphasize a pivotal role of the convex hull approach, which becomes crucial in alleviating limitations of linear programming manifesting in system modeling.

3:30PM An Interval-Based Approach to Fuzzy Regression for Fuzzy Input-Output Data [#215]Jalal Chachi
Taheri Seyed Mahmoud
Hojat Rezaei PazhandIsfahan University of Technology, Iran
Isfahan University of Technology, Iran
Maharab Geotechnical, Iran

A novel approach is introduced to construct a fuzzy regression model when the data available of independent and dependent variables are fuzzy numbers. The approach, consisting on the least-squares method, uses the α -level sets of fuzzy observations to estimate the crisp parameters of the model. A competitive study shows the performance and efficiency of the proposed approach with respect to some well-known methods.

3:50PM Study of Dependency between the Input Noise and the Parameter in Fuzzy Linear Regression Model [#372]Hongwei Ge
Shitong Wang
Wei SongJiangnan University, China
Jiangnan University, China
Jiangnan University, China

When noise exists in data, it is a very meaningful topic to reveal the dependency between the parameter h (i.e. the threshold value used to measure degree of fit) in Fuzzy linear regression (FLR) model and the input noise. In this paper, the FLR model is first extended to its regularized version, i.e. regularized fuzzy linear regression (RFLR) model, so as to enhance its generalization capability; then RFLR model is explained as the corresponding equivalent maximum a posteriori MAP problem; finally, the approximately inverse proportional dependency relationships that the parameter h with Laplacian noisy input and Uniform noisy input should follow

are derived, respectively. Our experimental results also confirm this theoretical claim. We believe that this conclusion provides an important reference for us to determine h in FLR model with noisy input.

(SS41) Special Session: Neuro Fuzzy Systems and Their Real World Application

Thursday, June 30, 2:50PM-4:30PM, Room: Crane, Chair: Sungshin Kim

2:50PM Daily Reservoir Inflow Forecasting Using Fuzzy Inference Systems [#542]

Ivette Raymunda Luna Huamani
Rosangela Ballini
Ieda Geriberto Hidalgo
Paulo Sergio Franco Barbosa
Alberto Luiz Francato

IE-UNICAMP, Brazil
IE-UNICAMP, Brazil
FT-UNICAMP, Brazil
FEC-UNICAMP, Brazil
FEC-UNICAMP, Brazil

This paper presents the application of a methodology for daily reservoir inflow forecasting in Brazilian hydroelectric plants. The methodology is based on Fuzzy Inference Systems (FIS) and the technique used for adjusting of the model parameters is an offline version of the Expectation Maximization (EM) algorithm. In order to automate the application of the methodology and facilitate the analysis of the results, a tool that allows managing streamflow forecasting studies and visualizing their information in graphical form was developed. A case study was applied to the data from three Brazilian hydroelectric plants whose operation is under the coordination of the Electric System National Operator. They are located in the Grande basin, a part of the Parana basin with two main rivers: the Grande and the Pardo. The benefits of the model are analyzed using statistics calculations, such as: root mean square error, mean absolute percentage error, mean absolute error and mass curve coefficient. Besides that, graphics that compare the registered and predicted streamflow are presented. The results show an adequate performance of the model, leading to a promising alternative for daily streamflow forecasting.

3:10PM A Study on Hybrid Model of HMMs and GMMs for Mirror Neuron System Modeling using EEG Signals [#289]

Seung-Min Park
Junheong Park
Kwang-Eun Ko
Kwee-Bo Sim

Chung-Ang University, Republic of Korea
Chung-Ang University, Republic of Korea
Chung-Ang University, Republic of Korea
Chung-Ang University, Republic of Korea

For our present life anytime, anywhere access to the network can communicate with the ubiquitous computing. It is essential to human life. We should be able to agree that communication will be enabled. For our present life, anytime, anywhere access to the network can communicate with the ubiquitous computing. Such as the ubiquitous era approached, interaction between the user and the computer has become an important issue. In this paper we use EEG signals to extract the user's intention recognition data, which the Mirror Neuron System Based on HMMs and GMMs to model the convergence of the hybrid model is proposed. This is based on a kind of biological signals using EEG signals to the user's intention recognition techniques have been studied. In addition, EEG signals is generated based on the model, using the user intention recognition method have been studied. The proposed model will be applied in the field of neuro robotics.

3:30PM Optimal Input Selection for Neural Fuzzy Modelling With Application to Charpy Energy Prediction [#601]

Yong Yao Yang
Mahdi Mahfouf
Qian Zhang

The University of Sheffield, United Kingdom
The University of Sheffield, United Kingdom
The University of Sheffield, United Kingdom

Input variables selection plays a critical role in data-driven modelling, especially for complex systems with high dimensionality between the input/output space. In this paper, a new artificial neural network based forward input selection scheme is proposed. The objective of the proposed scheme is to select the smallest number of important variables as model inputs, which will then be used for neural-fuzzy data modelling. The proposed input selection scheme is applied to a case study of Charpy impact energy prediction, with data extracted from an industrial database. Model performance has been compared with previous results where a much larger input set was used. Simulation results show that the number of inputs for the Charpy data model can be significantly reduced with little performance degradation. Also, the performance of the proposed scheme outperforms both the standard correlation analysis and fuzzy clustering based input selection schemes.

3:50PM Stereo Vision-Based Self-Localization System for RoboCup [#555]

Jen-Shiun Chiang
Chih-Hsien Hsia
Hung-Wei Hsu
Chun-I Li

National Taiwan University of Science and Technology, Taiwan
Tamkang University, Taiwan
Tamkang University, Taiwan
Tamkang University, Taiwan

This work proposes a new Stereo Vision-Based Self-Localization System (SVBSLS) for the RoboCup soccer humanoid league rules for the 2010 competition. The humanoid robot integrates the information from the pan/tilt motors and stereo vision to accomplish the self-localization and measure the distance of the robot and the soccer ball. The proposed approach uses the trigonometric function to find the coarse distances from the robot to the

landmark and the robot to the soccer ball, and then it further adopts the artificial neural network technique to increase the precision of the distance. The statistics approach is also used to calculate the relationship between the humanoid robot and the position of the landmark for self-localization. The experimental results indicate that the localization system of SVBSLS in this research work has 100% average accuracy ratio for localization. The average error of distance from the humanoid soccer robot to the soccer ball is only 0.64 cm.

4:10PM *Training Multilayer Perceptron By Using Optimal Input Normalization* [#488]

Xun Cai	Shandong University, China
Kanishka Tyagi	The University of Texas at Arlington, United States
Michael Manry	The University of Texas at Arlington, United States

In this paper, we propose a novel second order paradigm called optimal input normalization (OIN) to solve the problems of slow convergence and high complexity of MLP. By optimizing the non-orthogonal transformation matrix of input units in an equivalent network, OIN absorbs separate optimal learning factor for each synaptic weight as well as the threshold of hidden unit, leading to an improvement in the performance for MLP training. Moreover, by using a whitening transformation of negative Jacobian matrix of hidden weights, a modified version of OIN called optimal input normalization with hidden weights optimization (OIN-HWO) is also proposed. The Hessian matrices in both OIN and OIN-HWO are computed by using Gauss-Newton method. All the linear equations are solved via orthogonal least square (OLS). Regression simulations are performed on several real-life datasets and the results show that the proposed OIN has not only much better convergence rate and generalization ability than output weights optimization-back propagation (OWO-BP), optimal input gains (OIG) and even Levenberg-Marquardt (LM) method, but also takes less computational time than OWO-BP. Although OIN-HWO takes a little expensive computational burden than OIN, its convergence rate is faster than OIN and often close to or rivals LM. It is therefore suggested that OIN-based algorithms are potentially very good choices for practical applications.

(SS25) Special Session: Evolving and Adaptive Fuzzy Systems

Thursday, June 30, 2:50PM-4:30PM, Room: Egret, Chair: Plamen Angelov

2:50PM *Automatic Scene Recognition for Low-Resource Devices using Evolving Classifiers* [#583]

Andreu Javier	Lancaster University, United Kingdom
Dutta Baruah Rashmi	Lancaster University, United Kingdom
Angelov Plamen	Lancaster University, United Kingdom

In this paper an original approach is proposed which makes possible autonomous scenes recognition performed on-line by an evolving self-learning classifier. Existing approaches for scene recognition are off-line and used in intelligent albums for picture categorization/selection. The emergence of powerful mobile platforms with camera on board and sensor-based autonomous (robotic) systems is pushing forward the requirement for efficient self-learning and adaptive/evolving algorithms. Fast real-time and online algorithms for categorisation of the real world environment based on live video stream are essential for understanding and situation awareness as well as for localization and context awareness. In scene analysis the critical problem is a feature extraction mechanism for a quick description of the scene. In this paper we apply a well known technique called spatial envelop or GIST. Visual scenes can be quite different but very often they can be grouped in similar types/categories. One assumption based on which such automatic video classifiers can be build is to pre-train them using a large number of such images from different groups. Variety of possible scenes suggests the limitations of such an approach. Therefore, we originally propose in this paper to use the latest evolving fuzzy rule-based classifier *simpl_eClass* which is self-learning and thus updates its rules and categories descriptions with each new image. In addition, it is fully recursive, computationally efficient and yet linguistically transparent.

3:10PM *Real Time Recognition of Human Activities from Wearable Sensors by Evolving Classifiers* [#415]

Javier Andreu	Lancaster University, United Kingdom
Rashmi Dutta Baruah	Lancaster University, United Kingdom
Plamen Angelov	Lancaster University, United Kingdom

A new approach to real-time human activity recognition (HAR) using evolving self-learning fuzzy rule-based classifier (*eClass*) will be described in this paper. A recursive version of the principle component analysis (PCA) and linear discriminant analysis (LDA) pre-processing methods is coupled with the *eClass* leading to a new approach for HAR which does not require computation and time consuming pre-training and data from many subjects. The proposed new method for evolving HAR (*eHAR*) takes into account the specifics of each user and possible evolution in time of her/his habits. Data streams from several wearable devices which make possible to develop a pervasive intelligence enabling them to personalize/tune to the specific user were used for the experimental part of the paper.

3:30PM *Fuzzy Granular Evolving Modeling for Time Series Prediction* [#210]

Daniel Leite	University of Campinas, Brazil
Fernando Gomide	University of Campinas, Brazil
Rosangela Ballini	University of Campinas, Brazil
Pyramo Costa	Pontifical Catholic University of Minas Gerais, Brazil

Modeling large volumes of flowing data from complex systems motivates rethinking several aspects of the machine learning theory. Data stream mining is concerned with extracting structured knowledge from spatio-temporally correlated data. A profusion of systems and algorithms devoted to this end has been constructed under the conceptual framework of granular computing. This paper outlines a fuzzy set based granular evolving modeling - FBeM - approach for learning from imprecise data. Granulation arises because modeling uncertain data dispenses attention to details. The evolving aspect is fundamental to account endless flows of nonstationary data and structural adaptation of models. Experiments with classic Box-Jenkins and Mackey-Glass benchmarks as well as with actual Global40 bond data suggest that the FBeM approach outperforms alternative approaches.

3:50PM *Combustion Engine Modelling using an Evolving Local Model Network* [#84]

Christoph Hametner
Stefan Jakubek

Vienna University of Technology, Austria
Vienna University of Technology, Austria

In this paper a new evolving parameter estimation algorithm for a local model network under special consideration of combustion engine modelling is presented. For practical applications computational speed, incorporation of prior knowledge and the interpretability of the local models is of great interest. Accordingly, a robust and efficient online training algorithm with a particular focus on computational requirements involved in dynamic system identification of complex nonlinear processes is presented. The incremental construction of the model tree allows to gradually increase the model complexity while a proper initialisation of new model parameters is easily possible. The proposed evolving local model network is validated using real measurement data from a state-of-the-art 4-cylinder EURO5 diesel engine.

4:10PM *Rough Set Approach to User Modeling* [#71]

Binghui Helen Wu

FS Consulting, United States

The intelligence of an interactive system is exhibited through the evolution of its intelligent behaviors, namely, effectiveness in performing tasks and adaptiveness to both variations of task conditions and different users. Having a good user modeling component in any intelligent interactive system becomes crucial to the performance of that system. We have developed a computational approach to building intelligent tutoring systems (ITS) in conjunction with our framework for ITS [1]. This computational approach employs two exploratory AI techniques—a hybrid knowledge representation model as an implementation mechanism of ITS and a rough set [2] approximation approach to user modeling. In this article, we focus on discussing the rough set approach to user modeling of the system in detail. Keywords-rough sets; user modeling; computational approach to knowledge representations; intelligent tutoring systems

(SS24) Special Session: Hybrid Learning for Fuzzy Systems

Thursday, June 30, 2:50PM-4:30PM, Room: Swallow, Chair: Jin-Tsong Jeng

2:50PM *A Rough-based Robust Support Vector Regression Network for Function Approximation* [#212]

Chih-Ching Hsiao
Shun-Feng Su
Chen-Chia Chuang

Kao Yuan University, Taiwan
National Taiwan University of Science and Technology, Taiwan
National Ilan University, Taiwan

Support vector regression (SVR) employs the support vector machine (SVM) to tackle problems of function approximation and regression estimation. SVR has been shown to have good robust properties against noise. However, in SVR, outliers may also possibly be taken as support vectors. Such an inclusion of outliers in support vectors may lead to seriously overfitting phenomena. The rough set theory is successful to deal with imprecise, incomplete or uncertain information system. In this paper, a novel regression approach, termed as the Rough Margin Support Vector Regression (RMSVR) network, is proposed to enhance the robust capability of SVR. The basic idea of the approach is to adopt the concept of rough sets to construct the model obtained by SVR and fine tune it with a robust learning algorithm. Simulation results of the proposed approach have shown the effectiveness of the approximated function in discriminating against outliers.

3:10PM *An Immune Symbiotic Evolution Learning for Compensatory Neural Fuzzy Networks and Its Applications* [#32]

Cheng-Hung Chen
Cheng-Jian Lin
Chin-Teng Lin

National Formosa University, Taiwan
National Chin-Yi University of Technology, Taiwan
National Chiao-Tung University, Taiwan

This study presents an efficient immune symbiotic evolution learning algorithm for the compensatory neural fuzzy network (CNFN). The proposed immune symbiotic evolution learning method (ISEL) includes three major components - initial population, subgroup symbiotic evolution and immune system algorithm. The advantage of the proposed ISEL method are that the subgroup symbiotic evolution method uses the subgroup-based population to evaluate the fuzzy rules locally and the adopted immune system algorithm can accelerate the search and increase global search capacity. Finally, the simulation results have shown that the proposed CNFN-ISEL can outperform other methods.

3:30PM Identification of Time-Delay Chaotic System with Outliers: Fuzzy Neural Networks Using Hybrid Learning Algorithm [#214]

Chia-Nan Ko
 Yu-Yi Fu
 Guan-Yu Liu
 Cheng-Ming Lee

Nan Kai University of Technology, Taiwan
 Nan Kai University of Technology, Taiwan
 Nan Kai University of Technology, Taiwan
 Nan Kai University of Technology, Taiwan

A hybrid learning algorithm is proposed to train fuzzy neural networks (FNNs) for identifying a time-delay chaotic system with outliers. In the proposed algorithm, integrating support vector regression (SVR) and annealing robust time-varying learning algorithm (ARTVLA) to optimize FNNs. In the evolutionary procedure, first, SVR is adopted to determine the number of hidden layer nodes and the initial structure of the FNNs. After initialization, ARTVLA with nonlinear time-varying learning rate is then applied to train FNNs. In ARTVLA, the determination of the learning rate would be an important work for the trade-off between stability and speed of convergence. A computationally efficient optimization method, particle swarm optimization (PSO) method, is adopted to simultaneously find optimal learning rates. Due to the advantages of SVR and ARTVLA (SVR-ARTVLA), the proposed FNNs (SVR-ARTVLA-FNNs) have good performance for identifying a time-delay chaotic system: Mackey Glass system with outliers. Simulation results are illustrated the effectiveness and feasibility of the proposed SVR-ARTVLA-FNNs.

3:50PM A New Framework of Fuzzy Clustering Algorithm [#99]

Hong-Lin Shieh

Saint John's University, Taiwan

In this paper, a novel data clustering algorithm based on the subtractive clustering (SC) algorithm and a new validity index are proposed. The SC algorithm is a simple method for data clustering; however, it has two problems which must be overcome. The first problem is such that the cluster centers found by SC are taken from data with the highest potential values, but that this data may not be the real cluster centers. The second problem is such that the cluster number generated by the SC algorithm is influenced by a predefined parameter. The proposed algorithm is based on distance relations between data and centers and is designed to ascertain the real cluster centers generated by the SC algorithm. In addition, a novel robust cluster index is proposed to identify the real cluster number generated by SC algorithm.

4:10PM Modeling of Fuzzy Integral Based Nonlinear Multi-regressions Systems with QPSO-GS [#270]

You-Min Jau
 Jin-Tsong Jeng

National Yunlin University of Science and Technology, Taiwan
 National Formosa University, Taiwan

A nonlinear multi-regression based on fuzzy integral (NAFI) model that include outliers under inherent interaction among feature attributes is considered in this paper. The modeling of the proposed model is also performed via a modified algorithm based on particle swarm optimization with quantum-behavior (MQPSO) and the high breakdown value estimator, least trimmed squares (LTS). That is, we successfully integrate mechanisms of the genetic algorithm and the simulated annealing into the QPSO algorithm to estimate parameters of the NAFI model; meanwhile, the LTS estimator is also introduced to filter out outliers. From simulation results, the proposed MQPSO algorithm with LTS estimator (named QPSO-GS) readily corrects the deviation caused by outliers and swiftly achieves convergences on estimating the parameters of the proposed NAFI model with outliers.

(SS32) Special Session: Adaptive Fuzzy Logic Control

Thursday, June 30, 2:50PM-4:30PM, Room: Magpie, Chair: Tsung-Chih Lin

2:50PM Direct Adaptive Fuzzy Control for Nonaffine Nonlinear Systems with Unknown Control direction [#20]

Salim Labiod
 Thierry Marie Guerra

University of Jijel, Algeria
 University of Valenciennes, France

This paper deals with direct adaptive fuzzy control for a class of uncertain nonaffine nonlinear systems with unknown control direction. Within this scheme, a fuzzy system is used to generate directly the control input signal without dynamic system estimation. The adjustable parameters in the used fuzzy system are updated using a gradient descent adaptation algorithm that incorporates a Nussbaum-type function to deal with the unknown control direction. The stability of the closed-loop system is performed using a Lyapunov approach. Simulation results are provided to verify the effectiveness of the proposed design.

3:10PM An Observer Based Adaptive Iterative Learning Control for Robotic Systems [#169]

Ying-Chung Wang
 Chiang-Ju Chien

Huafan University, Taiwan
 Huafan University, Taiwan

In this paper, an observer based adaptive iterative learning control is proposed for robotic systems. Due to the joint velocities are assumed to be not measurable, a state observer is introduced to design the iterative learning controller. We first derive an observation error model based on a tracking error observer. Then we apply an averaging filter to design the ILC algorithm. A fuzzy neural learning component using a filtered fuzzy neural network is presented to solve the problem of unknown nonlinearities. A robust learning component using sliding-mode like design is used to overcome the uncertainties, including fuzzy neural approximation error and

the error induced by using state estimation errors. We show that all the adjustable parameters as well as internal signals remain bounded for all iterations. Finally, the norm of output tracking error will asymptotically converge to a tunable residual set as iteration goes to infinity.

3:30PM Synchronization of uncertain fractional order chaotic systems via adaptive interval type-2 fuzzy sliding mode control [#80]

Tsung-Chih Lin
Tun-Yuan Lee
Emilia Balas Valentina

Feng-Chia University, Taiwan
Feng-Chia University, Taiwan
University of Arad, Romania

In this paper, a novel adaptive interval type-2 fuzzy sliding mode control (AITFSMC) is proposed to handle high level uncertainties facing the fuzzy logic controller (FLC) in dynamic fractional order chaotic systems such as uncertainties in inputs to the FLC, uncertainties in control outputs, linguistic uncertainties and uncertainties associated with the noisy training data. Based on the learning algorithm combining Lyapunov approach and sliding mode control, free parameters of the AITSMC can be tuned on line by output feedback control law and adaptive law to synchronize two different uncertain fractional order chaotic systems. Meanwhile, the chattering phenomena in the control efforts can be reduced. During the design procedure, not only the stability and robustness can be guaranteed but also the external disturbance on the synchronization error can be attenuated. The numerical simulation is performed to illustrate the effectiveness of the proposed control strategy.

3:50PM Fractional order chaotic system tracking design based on adaptive hybrid intelligent control [#83]

Tsung-Chih Lin
Chia-Hao Kuo
Emilia Balas Valentina

Feng Chia University, Taiwan
Feng Chia University, Taiwan
University of Arad, Romania

In this paper, an adaptive hybrid fuzzy neural network (FNN) controller is proposed to achieve prescribed tracking performance of fractional order chaotic systems. Based on the trade-off between plant knowledge and control knowledge, a weighting factor can be adjusted by combining the indirect adaptive FNN control effort and the direct FNN adaptive control effort. Nonlinear fractional order chaotic response system is fully illustrated to track the trajectory generated from fractional order chaotic drive system. The numerical results show that tracking error and control effort can be made smaller and the proposed hybrid intelligent control scheme is more flexible during the design process.

(SS22) Special Session: Fuzzy Methods in Machine Learning and Data Mining

Thursday, June 30, 5:00PM-6:00PM, Room: Swan, Chair: Shi-An Chen and Enrique Munoz

5:00PM Towards the Learning from Low Quality Data in a Fuzzy Random Forest ensemble [#299]

Jose M. Cadenas
M. Carmen Garrido
Raquel Martinez
Piero P. Bonissone

University of Murcia, Spain
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University of Murcia, Spain
GE Global Research, United States

Imperfect information inevitably appears in real situations for a variety of reasons. Although efforts have been made to incorporate imperfect data into classification techniques, there are still many limitations as to the type of data, uncertainty and imprecision that can be handled. In this paper, we will present a Fuzzy Random Forest ensemble for classification and show its ability to handle imperfect data into the learning and the classification phases. Then, we will describe the types of imperfect data it supports. We will devise an augmented ensemble that can operate with others type of imperfect data: crisp, missing, probabilistic uncertainty and imprecise (fuzzy and crisp) values. Additionally, we will perform experiments with datasets used in other papers to show the advantage of being able to express the true nature of imperfect information.

5:20PM Non-monotone averaging aggregation [#480]

Gleb Beliakov
Shui Yu
Daniel Paternain

Deakin University, Australia
Deakin University, Australia
Public University of Navarra, Spain

We advance the theory of aggregation operators and introduce non-monotone aggregation methods based on minimization of a penalty for inputs disagreements. The application in mind is processing data sets which may contain noisy values. Our aim is to filter out noise while at the same time preserve signs of unusual values. We review various methods of robust estimators of location, and then introduce a new estimator based on penalty minimisation.

5:40PM Linguistic Local Change Comparison Of Time Series [#147]

Rita Castillo-Ortega
Nicolas Marin
Daniel Sanchez

University of Granada, Spain
University of Granada, Spain
European Centre for Soft Computing, Spain

In this paper a methodology is proposed for providing a linguistic summary of the comparison of time series. This series are obtained as a result of queries which the user defines over a data cube with time dimension. Our objective is that the final summary describe the similarity between series by using local changes. Definitions of

the degree and sign of local changes are proposed. The understandability of the linguistic summary is achieved by means of linguistically quantified sentences. So are the coverage and brevity by using a hierarchical partition of time dimension inherited from the data warehouse. Our linguistic summaries are well suited to be included in an interface layer of a data warehouse system, improving the quality of human-machine interaction and the understandability of the results.

(FCW & PT) Fuzzy Computing with Words and Possibility Theory

Thursday, June 30, 5:00PM-6:00PM, Room: Peacock, Chair: Chin-Wang Tao

5:00PM *Indirect Adaptive Model Predictive Control Supervised by Fuzzy Logic* [#434]

Jerry Mamboundou
Nicolas Langlois

IRSEEM, France
IRSEEM, France

In order to get correct results using the model predictive control, one must find the suitable values of its tuning parameters. In many case this task is achieved by empirical methods. It's sufficient to control a physical system which internal parameters remain the same. The chosen controller parameters continue to provide satisfactory performances against small system variations. They become quickly inappropriate when strong variations occur in the process. One of the classical approaches consists to identify online the system model to update its controller based on this model. This solution doesn't ensure always best results. In this paper, we show how one can perform a suitable control to a system with variable parameters applying a fuzzy-logic-supervised predictive control. The fuzzy logic supervisor fulfills the online tuning of the predictive control parameters. Thus, we carry out a comparison between these two strategies.

5:20PM *Maximum likelihood principle for possibility distributions viewed as families of probabilities* [#319]

Mathieu Serrurier
Henri Prade

University of Toulouse III, France
University of Toulouse III, France

An acknowledged interpretation of possibility distributions in quantitative possibility theory is in terms of families of probabilities that are upper and lower bounded by the associated possibility and necessity measures. This paper proposes a likelihood function for possibility distributions that agrees with the above-mentioned view of possibility theory in the continuous and in the discrete cases. Especially, we show that, given a set of data following a probability distribution, the optimal possibility distribution with respect to our likelihood function is the distribution obtained as the result of the probability-possibility transformation that obeys the maximal specificity principle. It is also shown that when the optimal distribution is not available, a direct application of this possibilistic likelihood provides more faithful results than approximating the probability distribution and then applying the probability possibility transformation. We detail the particular case of triangular and trapezoidal possibility distributions and we show that any unimodal unknown probability distribution can be faithfully upper approximated by a triangular distribution obtained by optimizing the possibilistic likelihood.

(SS07 & SS33) Special Session: Metaheuristics and Its Applications & Fuzzy and Paraconsistent Intelligent Systems

Thursday, June 30, 5:00PM-6:00PM, Room: Phoenix, Chair: Chun-Wei Tsai and Shih-Yu Li

5:00PM *Ant Colony Optimization with Dual Pheromone Tables for Clustering* [#378]

Chun-Wei Tsai
Kai-Cheng Hu
Ming-Chao Chiang
Chu-Sing Yang

Chia Nan University of Pharmacy and Science, Taiwan
National Sun Yat-sen University, Taiwan
National Sun Yat-sen University, Taiwan
National Cheng Kung University, Taiwan

This paper presents a novel pheromone update strategy for improving the clustering results of ant colony optimization (ACO). The proposed algorithm is motivated by the observation that most of the ACOs only keep track of the promising foraging information, which has the potential to lead to better solutions than all the other search directions in the pheromone table. This eventually makes the search converge to particular search directions in later iterations because the pheromone values on good routing paths will be reinforced. As such, the breadth of search (diversity) will be reduced, thus limiting the clustering results of ACO. The proposed algorithm adds a second pheromone table to ACO for recording the unpromising foraging information that is worse than all the other search directions and using a novel construction method to explore the new search directions. In other words, by leveraging the strengths of diversification and intensification, the proposed algorithm can find better solutions than traditional ACO. To evaluate the performance of the proposed algorithm, we use it to solve the data clustering problem. Our experimental results indicate that the proposed algorithm can significantly improve the quality of ant colony optimization.

5:20PM *Job Shop Scheduling Based on ACO with a Hybrid Solution Construction Strategy* [#376]

Shih-Pang Tseng
Chun-Wei Tsai
Jui-Le Chen

National Sun Yat-sen University, Taiwan
Chia Nan University of Pharmacy and Science, Taiwan
National Cheng Kung University, Taiwan

Ming-Chao Chiang
Chu-Sing Yang

National Sun Yat-sen University, Taiwan
National Cheng Kung University, Taiwan

This paper presents a novel ant colony optimization (ACO) based on an efficient solution construction strategy (transition operator) for improving the quality of the end results of job shop scheduling problem (JSSP). Inspired by the observation that the quality of the end results of ACO is largely affected by their operators--especially the transition operator, a novel solution construction strategy is presented in this paper. The proposed algorithm uses two different strategies to compute the probability of solution construction to improve the end results. Our experimental results show that the proposed algorithm outperforms all state-of-the-art job shop scheduling algorithms evaluated in this paper and can significantly improve the quality of ant colony optimization for JSSP.

5:40PM *The Sensing System for the Autonomous Mobile Robot Emmy III* [#321]

Claudio Torres
Jair Abe
Germano Lambert-Torres
Joao da Silva Filho

Universidade Metodista de Sao Paulo, Brazil
Paulista University - UNIP, Brazil
Federal University of Itajuba, Brazil
Universidade Santa Cecilia - UNISANTA, Brazil

This paper shows the results of the sensing system which was designed for the autonomous mobile robot Emmy III. The proposed Sensing System has as main part the Paraconsistent Neural Network. This type of artificial neural network is based on the Paraconsistent Evidential Logic. The objective of the Sensing System is to inform the other robot components the obstacle position. The reached results have been satisfactory.

(IA) Informatics & Analytics

Thursday, June 30, 5:00PM-6:00PM, Room: Crane, Chair: Janusz Kacprzyk and Lawrence Mazlack

5:00PM *On a benchmark related assessment of the performance of mutual (investment) funds* [#297]

Anna Wilbik
Janusz Kacprzyk

Systems Research Institute PAS, Poland
Systems Research Institute PAS, Poland

We deal with the problem of how to evaluate the performance of an investment (mutual) fund, over a past period. We assume a widely assumed attitude that an investment fund is said to have performed well if its unit price have been rising faster than its benchmark during a period of growth, and has been falling slower than its benchmark during the period of decline. We develop a novel, flexible and human consistent comparison method that operates on the comparison of trends (segments) extracted from the times series representing the behavior of the fund and its benchmark. The result of comparison becomes a new data set that is linguistically summarized using the method proposed in our previous works.

5:20PM *Discerning Suicide Notes Causality Using Fuzzy Cognitive Maps* [#545]

Ethan White
Lawrence Mazlack

University of Cincinnati, United States
University of Cincinnati, United States

An important question is how to determine if a person is exhibiting suicidal tendencies in behavior, speech, or writing. This paper demonstrates a method of analyzing written material to determine whether or not a person is suicidal. The method involves an analysis of word frequencies that are used in a fuzzy cognitive map. The fuzzy cognitive map determines if there are suicidal tendencies. The method could have substantial potential in suicide prevention as well as in other forms of sociological behavior studies that also might exhibit their own identifying patterns.

(SS13-2) Special Session: Fuzzy Multiple Criteria Decision Making

Thursday, June 30, 5:00PM-6:00PM, Room: Egret, Chair: Gwo-Hshiung Tzeng

5:00PM *Constant Penalty Functions to Simplify Optimization of the Choquet Integral under Constraints* [#235]

Tanja Magoc

University of Maryland, United States

The Choquet integral have been used in many decision making problems as the optimization function that needs to be maximized or minimized. The complexity of these optimization problems is often increased by numerous constraints that are imposed to the solution. Several methods have been developed for optimization under constraints, one of them being penalty functions method. This method transforms a constrained optimization problem in an equivalent unconstrained optimization problem by adding penalties to the solutions that do not satisfy one of more constraints. Penalty functions method is an iterative process, which adjusts penalty functions in each iteration, often yielding a large number of iterations until a satisfying solution is found. To speed the process of the Choquet integral optimization under constraints, we propose to use constant penalty functions. This approach requires only one iteration, and is therefore much faster than the generic penalty function method. In this paper, we derive the constant penalty function that guarantees that the optimal solution found in the first iteration satisfies all constraints.

5:20PM Design of a reliable hub-and-spoke network using an interactive fuzzy goal programming [#489]

Mohammad Hossein Fazel Zarandi
Soheil Davari
Ali Haddad Sisakht

Amirkabir University of Technology, Iran
Amirkabir University of Technology, Iran
Sharif University of Technology, Iran

A Hub Location Problem (HLP) deals with finding the locations of hub facilities and assignment of demand nodes to established facilities. Hubs play a central role in many networks such as telecommunication networks and their unavailability may lead to network breakdown or poor service levels. An objective in design of a hub- and-spoke network is maximization of reliability to transfer flows. This paper puts forward design of a reliable single-allocation hub-and-spoke network using an interactive fuzzy goal programming. To model and solve the problem, a fuzzy goal programming approach was developed for design of network in an interactive manner between decision maker and the model. To validate the model and the proposed solution approach, a test problem is presented and comparison of results is made using this problem.

(FDM & DSS-2) Fuzzy Decision Making and Decision Support Systems

Thursday, June 30, 5:00PM-6:00PM, Room: Swallow, Chair: Kuang-Yow Lian

5:00PM Connection Manager: A FAHP-based System for Classifier and Decision-Making [#198]

Chih-Wei Hsu
Sheng-Tzong Cheng

Institute for Information Industry, Taiwan
National Cheng Kung University, Taiwan

This Connection Manager Intelligence Agent's an attractive feature is use the network traffic and behavior with multi-attributes to find the best network devices and connection devices meet user habits that it possible to access various multimedia contents everywhere at any time. In this agent, information process is thoroughly integrated into embedded system for connection manager of Meego or Android. We have implemented an interactive interface through this function (User interface for Qt vision and CMIA) acquisition user behavior and to scholars of the machine. We have a successful user interaction of the agent can be decision making the choice of match the user intent.

5:20PM Approximate Confidence Interval for Generalized Taguchi Process Capability Index [#460]

Abbas Parchami
Mashaallah Mashinchi
M. Hadi Mashinchi

Shahid Bahonar University of Kerman, Iran
Shahid Bahonar University of Kerman, Iran
Macquarie University, Australia

The impreciseness happens in the quality control same as other statistical problems. In quality control where specification limits are better expressed by fuzzy sets, the generalized process capability indices C_p , C_{pk} and C_{pm} can be helpful and necessary for measuring the capability. We propose a generalized form of Taguchi index C_{pm} to assess the ability of the fuzzy process to be clustered around the target value. An approximate confidence interval for the generalized process capability index C_{pm} by using fuzzy specification limits is also presented.

5:40PM Generalized Intuitionistic Fuzzy Soft Set and its Application in Practical Medical Diagnosis Problem [#131]

Manish Agarwal
Madasu Hanmandlu
Kanad K. Biswas

Indian Institute of Technology, India
Indian Institute of Technology, India
Indian Institute of Technology, India

In this paper, generalized Intuitionistic Fuzzy Soft Set (GIFSS) is introduced and its various properties are presented. Intuitionistic generalized soft fuzzy relations on GIFSS have been defined and their properties are discussed. We have also devised a new scoring function to compare Intuitionistic numbers. An application of GIFSS, intuitionistic generalized soft relations on GIFSS and the novel score function is demonstrated through a practical example of a multi-criteria medical diagnosis problem.

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2011 IEEE International Conference on Fuzzy Systems

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Timetable

2011 IEEE International Conference on Fuzzy Systems

Monday, June 27, 2011

Time	Peacock	Phoenix	Crane
8:00 AM 5:00 PM	Registration		
9:00 AM 10:30 AM	T01-1 Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems Rafael Alcalá	T02-1 Interpolative Fuzzy Rule Bases László Koczy	T03-1 Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 1 Jerry Mendel
10:30 AM 11:00 AM	Coffee Break		
11:00 AM 12:30 PM	T01-2 Evolutionary Multi-Objective Design of Fuzzy Rule-Based Systems Rafael Alcalá	T02-2 Interpolative Fuzzy Rule Bases László Koczy	T03-2 Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 1 Jerry Mendel
12:30 PM 1:30 PM	Lunch Break		
1:30 PM 3:00 PM	T04-1 Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 2 Hani Hagrás	T05-1 Towards a Unified Framework for Intelligent Robotics Honghai Liu Naoyuki Kubota	W03-1 Computational Intelligence Techniques for Smart Grids
3:00 PM 3:30 PM	Coffee Break		
3:30 PM 5:00 PM	T04-2 Theoretical and Practical Aspects of Type-2 Fuzzy Systems: Part 2 Hani Hagrás	T05-2 Towards a Unified Framework for Intelligent Robotics Honghai Liu Naoyuki Kubota	W03-2 Computational Intelligence Techniques for Smart Grids
6:00 PM	Welcome Reception		

(FUZZ-IEEE 2011) Timetable

Monday, June 27, 2011

Egret	Swallow	Magpie
Registration		
W01-1 Fuzzy Approaches to Ambient Intelligence SS06 Intelligent Agents	W02 Standards in Computational Intelligence	HCGC-1 Human vs. Computer Go Competition
Coffee Break		
W01-2 Fuzzy Approaches to Ambient Intelligence SS06 Intelligent Agents	FC Fuzzy Competition	
Lunch Break		
W04-1 Computer Game and Fuzzy-based Game Applications	W05-1 Hybrid Computational Intelligence Applications	
Coffee Break		
W04-2 Computer Game and Fuzzy-based Game Applications	W05-2 Hybrid Computational Intelligence Applications	
Welcome Reception		

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Tuesday, June 28, 2011

Time	Swan	Peacock	Phoenix	Crane
8:00 AM 5:00 PM	Registration			
8:00 AM 10:20 AM	SS02-1 Evolutionary Fuzzy Systems	SS12-1 Recent Advances in Fuzzy-Model-Bas ed Control Systems	SS14 Advances in Fuzzy Theory and their Applications	SS28-1 Current Development in Pattern Classification-Ker nelization, Pairwise Constraints, and Classifiers
10:20 AM 10:50 AM	Coffee Break			
10:50 AM 12:00 PM	Opening Ceremony & Keynote Speech I Inferring Disease Related Gene-Gene Interactions: A Fuzzy Logic Based Approach Nikhil Pal Place: Grand Ballroom I Chair: Jyh-Yeong Chang			
12:00 PM 1:30 PM	Lunch Break IEEE TFS AE Lunch Meeting (TFS AE only) IEEE WCI Lunch Meeting			
1:30 PM 2:30 PM	Plenary Speech I Type-2 Fuzzy Sets and Systems: Challenges and Misconceptions Jerry M. Mendel Place: Grand Ballroom I Chair: Chang-Shing Lee			
2:30 PM 2:50 PM	Break			
2:50 PM 4:30 PM	SS05 Fuzzy Robotics	SS18 Recent Advances in Fuzzy Logic in Image Processing	SS27 Communication Robotics and Computational Intelligence Co-creation	SS28-2 Current Development in Pattern Classification-Ker nelization, Pairwise Constraints, and Classifiers
4:30 PM 5:00 PM	Coffee Break			
5:00 PM 6:30 PM	SS10-1 Medical and Wellness Engineering	SS09 Applications of Fuzzy Logic to Awareness Promotion	SS08 Innovative Fuzzy Approaches to Management Engineering	SS37 Fuzzy Logic Based Computer Vision and Its Applications to Guidance and Control
6:30 PM 7:00 PM				

Egret	Swallow	Grand Ballroom I	Grand Ballroom II	Magpie
Registration				
SS16 Fuzzy Interpolation SS11 Large-Scale Clustering	T2FL & FPR Type-2 Fuzzy Logic and Fuzzy Pattern Recognition	Panel Session I Interpolation and Approximation in Fuzzy Rule Bases	FA-1 Fuzzy Applications	HCGC-2 Human vs. Computer Go Competition
Opening Ceremony & Keynote Speech I Inferring Disease Related Gene-Gene Interactions: A Fuzzy Logic Based Approach Nikhil Pal Place: Grand Ballroom I Chair: Jyh-Yeong Chang				
Lunch Break IEEE TFS AE Lunch Meeting (TFS AE only) IEEE WCI Lunch Meeting				
Plenary Speech I Type-2 Fuzzy Sets and Systems: Challenges and Misconceptions Jerry M. Mendel Place: Grand Ballroom I Chair: Chang-Shing Lee				
Break			PS01 Poster Session I	
SS42-1 Fuzzy Cognitive Maps-Theory and Applications	SS21-1 Fuzzy Control in Industrial and Application	Invited Panel Session Birth and Evolution of Fuzzy Logic		
Coffee Break			PS02 Poster Session II	
SS17-1 Practical and Applications Aspects of Type-2 Fuzzy Logic Systems	SS19 Fuzzy Inference Systems-Theory and Applications	Panel Session II Computing With Words		

2011 IEEE International Conference on Fuzzy Systems

Wednesday, June 29, 2011

Time	Swan	Peacock	Phoenix	Crane
8:00 AM 5:00 PM	Registration			
8:00 AM 9:00 AM	SS02-2 Evolutionary Fuzzy Systems	SS12-2 Recent Advances in Fuzzy-Model-Based Control Systems	SS31 Human Symbiotic Systems	FC&IS Fuzzy Control and Intelligent Systems
9:00 AM 10:20 AM				
10:20 AM 10:50 AM	Coffee Break			
10:50 AM 12:00 PM	Keynote Speech II Fuzzy Approaches to Information Fusion Bernadette Bouchon-Meunier Place: Grand Ballroom I Chair: Chia-Feng Juang			
12:00 PM 1:30 PM	Lunch Break IEEE FSTC Lunch Meeting			
1:30 PM 2:30 PM	Plenary Speech II Soft Computing in Prognostics and Health Management (PHM) Applications: A Case Study in Anomaly Detection Piero Bonissone Place: Grand Ballroom I Chair: Faa-Jeng Lin			
2:30 PM 2:50 PM	Break			
2:50 PM 4:30 PM	SS20 Universal Contents Creation/Distribution and Intelligent System	SS03 Uncertainty and the Semantic Web	SS04 Soft Computing for Operations Research and Optimization	SS01 Fuzzy Ontologies and FML Applications
4:30 PM 5:00 PM	Coffee Break			
5:00 PM 6:00 PM	Invited Talk II Acceleration and Scalability for c-Means Clustering James Bezdek Chair: Li-Wei Ko	SS40 Fuzzy Approach for Information Security Management	SS38 Fuzzy Knowledge Discovery and Its Applications	SS39 Fuzzy Based Computation on Biomedical Systems
6:00 PM 7:00 PM	Invited Talk III Activity Summarization from 3D Video Systems in an Eldercare Environment Jim Keller Chair: Li-Wei Ko			
7:30 PM	Conference Banquet Place: Grand Ballroom I			

(FUZZ-IEEE 2011) Timetable

Wednesday, June 29, 2011

Egret	Swallow	Grand Ballroom I	Grand Ballroom II	Magpie	
Registration					
SS10-2 Medical and Wellness Engineering	SS13-1 Fuzzy Multiple Criteria Decision Making	Invited Talk I Casual Communication between Robots and Humans based on Robot Technology Middleware and Multimedia Recognition Kaoru Hirota Chair: Yau-Hwang Kuo	FA-2 Fuzzy Applications	HCGC-3 Human vs. Computer Go Competition	
Coffee Break					
Keynote Speech II Fuzzy Approaches to Information Fusion Bernadette Bouchon-Meunier Place: Grand Ballroom I Chair: Chia-Feng Juang					
Lunch Break IEEE FSTC Lunch Meeting					
Plenary Speech II Soft Computing in Prognostics and Health Management (PHM) Applications: A Case Study in Anomaly Detection Piero Bonissone Place: Grand Ballroom I Chair: Faa-Jeng Lin					
Break			PS03 Poster Session III		
SS42-2 Fuzzy Cognitive Maps-Theory and Applications	SS21-2 Fuzzy Control in Industrial and Application				
Coffee Break					
SS17-2 Practical and Applications Aspects of Type-2 Fuzzy Logic Systems SS15 Type-2 Fuzzy Logic Theory	SS30 Computing With Words SS43 Fuzzy Systems of Unknown Nonlinear Complex Systems		PS04 Poster Session IV		
Conference Banquet Place: Grand Ballroom I					

2011 IEEE International Conference on Fuzzy Systems

Thursday, June 30, 2011

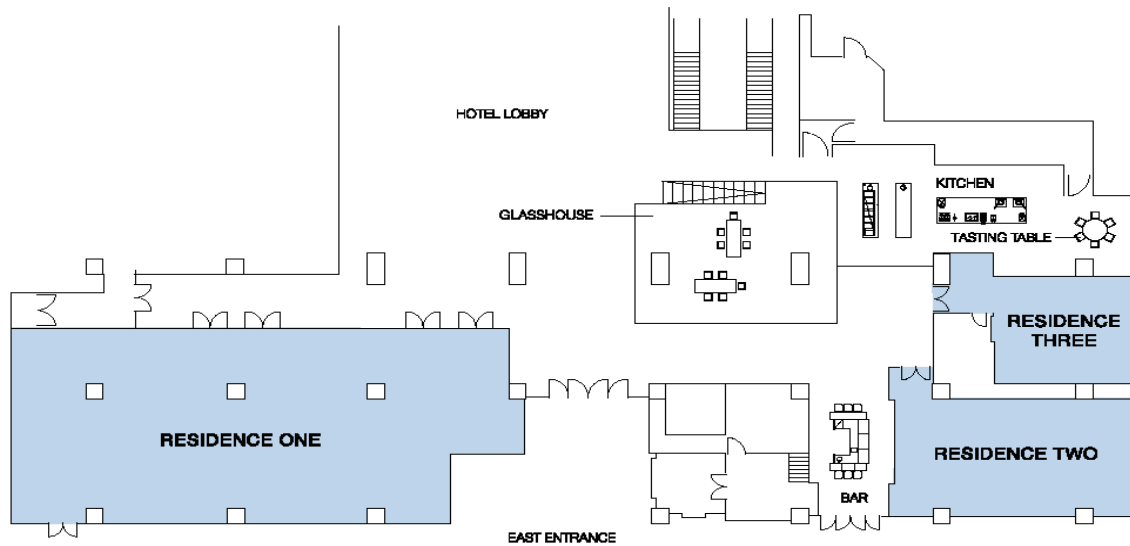
Time	Swan	Peacock	Phoenix
8:00 AM 5:00 PM	Registration		
8:00 AM 10:20 AM	SS23 Industrial Applications of Evolving Fuzzy Systems	MFI & RWA Medical, Financial, Industrial and Other Real World Applications	FSM & IS Fuzzy Systems Modeling and Intelligent Systems
10:20 AM 10:50 AM	Coffee Break		
10:50 AM 12:00 PM	Keynote Speech III Soft Computing for Hard Pattern Recognition Problems Paul Gader Place: Grand Ballroom I Chair: Jung-Hsien Chiang		
12:00 PM 1:30 PM	Lunch Break		
1:30 PM 2:30 PM	FOD Fuzzy Optimization and Design	FO & FEC Fuzzy Optimization and Fuzzy Emotional Computing	RS & RDA Rough Sets and Rough Data Analysis
2:30 PM 2:50 PM	Break		
2:50 PM 4:30 PM	SS29 Software Engineering with Computational Intelligence	SS34 Brain and Learning	SS35 Fuzzy Regression Analysis and Its Applications
4:30 PM 5:00 PM	Coffee Break		
5:00 PM 6:00 PM	SS22 Fuzzy Methods in Machine Learning and Data Mining	FCW & PT Fuzzy Computing with Words and Possibility Theory	SS07 Metaheuristics and Its Applications SS33 Fuzzy and Paraconsistent Intelligent Systems

(FUZZ-IEEE 2011) Timetable

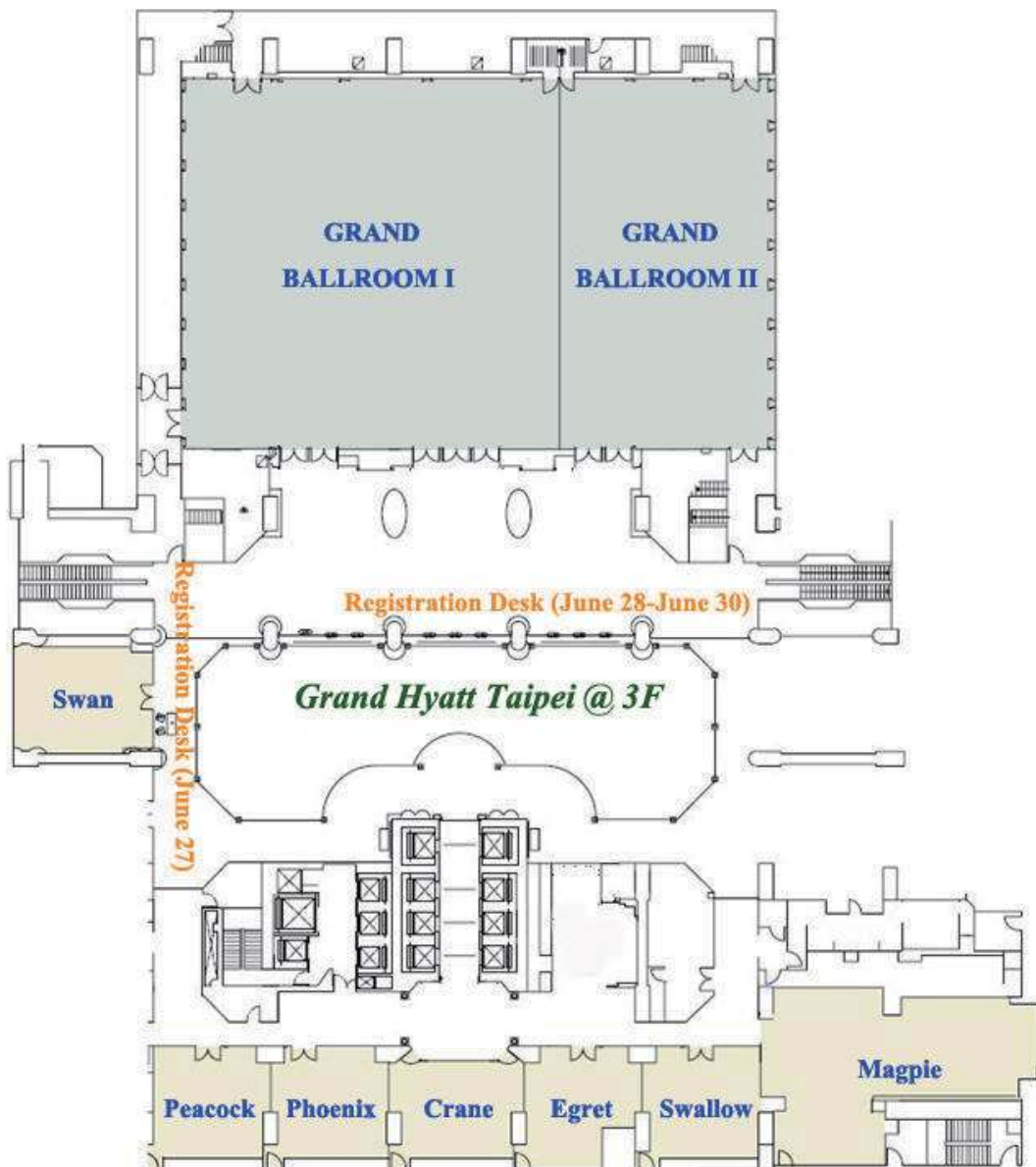
Thursday, June 30, 2011

Crane	Egret	Swallow	Magpie
Registration			
FST & GC Fuzzy Set Theory and Granular Computing	SS36-1 Fuzzy Systems on Renewable Energy	FS & FDM Fuzzy Clustering and Fuzzy Data Mining	HA Hybrids and Other Applications
Coffee Break			
Keynote Speech III Soft Computing for Hard Pattern Recognition Problems Paul Gader Place: Grand Ballroom I Chair: Jung-Hsien Chiang			
Lunch Break			
T2FL Type-2 Fuzzy Logic	SS36-2 Fuzzy Systems on Renewable Energy	FDM&DSS-1 Fuzzy Decision Making and Decision Support Systems	HFS Hybrid Fuzzy Systems
Break			
SS41 Neuro Fuzzy Systems and Their Real World Application	SS25 Evolving and Adaptive Fuzzy Systems	SS24 Hybrid Learning for Fuzzy Systems	SS32 Adaptive Fuzzy Logic Control
Coffee Break			
IA Informatics and Analytics	SS13-2 Fuzzy Multiple Criteria Decision Making	FDM&DSS-2 Fuzzy Decision Making and Decision Support Systems	

Venue Floor Plan



THE GRAND RESIDENCE – LOBBY LEVEL



All Session Rooms Are at 3rd Floor, Grand Hyatt Taipei