Generalized Voronoi Diagram: A Geometry-Based Approach to Computational Intelligence

Studies in Computational Intelligence, Volume 158

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Generalized Voronoi Diagram: A Geometry-Based Approach to
Computational Intelligence, 2008
ISBN 978-3-540-85125-7

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Generalized Voronoi Diagram: A Geometry-Based Approach to Computational Intelligence

Springer

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ISBN 978-3-540-85125-7 e-ISBN 978-3-540-85126-4

DOI 10.1007/978-3-540-85126-4

Studies in Computational Intelligence ISSN 1860949X

Library of Congress Control Number: 2008932957

Typeset & *Cover Design:* Scientific Publishing Services Pvt. Ltd., Chennai, India.

Printed in acid-free paper

9 8 7 6 5 4 3 2 1

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To my family: my parents, my husband and my boys,
an inspiration and light of my life.

Preface

The year 2008 is a memorial year for Georgiy Voronoï (1868-1908), with a number of events in the scientific community commemorating his tremendous contribution to the area of mathematics, especially number theory, through conferences and scientific gatherings in his honor. A notable event taking place in September 2008 a joint conference: the 5th Annual International Symposium on Voronoi Diagrams (ISVD) and the 4th International Conference on Analytic Number Theory and Spatial Tessellations held in Kyiv, Georgiy Voronoï's native land. The main ideas expressed by G. Voronoï's through his fundamental works have influenced and shaped the key developments in computation geometry, image recognition, artificial intelligence, robotics, computational science, navigation and obstacle avoidance, geographical information systems, molecular modeling, astrology, physics, quantum computing, chemical engineering, material sciences, terrain modeling, biometrics and other domains.

This book is intended to provide the reader with in-depth overview and analysis of the fundamental methods and techniques developed following G. Voronoi ideas, in the context of the vast and increasingly growing area of computational intelligence. It represents the collection of state-of-the art research methods merging the bridges between two areas: geometric computing through Voronoi diagrams and intelligent computation techniques, pushing the limits of current knowledge in the area, improving on previous solutions, merging sciences together, and inventing new ways of approaching difficult applied problems. Some chapters of the book were invited following the successful 3rd Annual International Symposium on Voronoi Diagrams (ISVD'06), that took place in Banff, Canada, in June 2006. Some others are direct submissions by leading international experts in the prospective areas.

It is our hope that the reader holding this edited collection in his hands will both benefit from the intricate and up-close view on where the hundred years of intense research shaping Voronoi ideas has lead. It is also out hope that the book will inspire the reader to work with more passion, knowledge and intelligence to push the limits of the new and emerging areas of scientific endeavor.

The book meticulously explores current developments in the area of computational geometry, indicating, where possible, its intricate relationship to the area of computational intelligence, following the 100 years of Voronoi diagram research. It is structured in the following way: Introductory chapter provides a reader with an overview of the recent developments in the area of computational geometry and its increasingly

engaged and intricate relationship to the science of computational intelligence, as well as the overall computational science paradigm.

The second section: Generalized Voronoi Diagrams: State-of-the-Art in Intelligent Treatment of Applied Problems, presents an in-depth overview of the key definitions, notions and concepts introducing Voronoi diagrams, Generalized Voronoi diagrams and Delaunay tessellations, their unique properties and a gamut of novel applications including shape modeling, quantum computing, path planning, biomedical and cartographic applications.

The third sections: Advanced Treatment of Topics of Special Interest, is devoted to specific in-depth treatment of mathematical and computational issues related to Voronoi diagrams, including implementation and construction of Centroidal Voronoi Tessellations on surface meshes, using line and texture to visualize higher-order Voronoi diagrams, developing genetic algorithms for optimal triangulations, and performing robust point location in Generalized Voronoi diagrams.

Finally, the book is concluded with a brief look at the exciting future developments in the compssutational geometry area bringing new horizons closer to the present.

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Contents

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Russel A. Apu was born in Bangladesh, in 1979. He completed his undergraduate degree in Computer Science in 2001 from the North South University of Dhaka, Bangladesh. Mr. Apu obtained his Master degree in computer science from the University of Calgary, Canada in 2004. Currently, he is enrolled as a PhD student at the department of computer science, University of Calgary. Mr. Apu's research interest includes computational geometry, computer graphics and computational intelligence.

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Maciej Dakowisz was born in Poland, spent 4 years attending Hong Kong Polytechnic University, and recently working with Prof. Christopher Gold group in Cardiff, UK, researching Voronoi Diagrams.

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Professor **Christopher Gold** has worked on the development of GIS methods since the 1970s, and is particularly concerned about the integration of geographical analysis and algorithms, and cooperation with the Computer Science community. As well as his current emphasis on spatial data structures and algorithms, he has had extensive experience in applications such as forestry, geology, landscape modelling and marine navigation. His best-known research has been concerned with Voronoi diagrams as a fundamental spatial model for many GIS application areas. From 1990 to 1999 he was Senior Researcher of an Industrial Research Chair at Laval University funded by the Quebec Forest Industry and the Canadian National Science and Engineering Research Council (NSERC). He was then Professor in the Land Surveying and Geo-Informatics Department, Hong Kong Polytechnic University. From 2004-2007 Professor Chris Gold, held the post of TMarie Curie ChairУ with the GIS Research Group at the University of Glamorgan, Wales.

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