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A Bibliographic Analysis of Transformer Literature 1990-2000

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Abstract This paper presents an analysis of the bibliography on transformers covering the period from 1990 to 2000. It contains all the transformer subjects: a) Transformer design, b) Transformer protection, c) Transformer connections, d) Transformer diagnostics, e) Transformer failures, f) Transient analysis of transformers (overvoltages, overcurrents), g) Modeling and analysis of transformer using FEM (thermal modeling, losses modeling, insulation modeling, windings modeling). Several international journals were investigated including the following: Advances in Electrical and Computer Engineering, Canadian Journal of Electrical and Computer Engineering, COMPEL (The International Journal for Computation and Mathematics in Electrical and Electronic Engineering), Electrical Engineering, Electric Power Components and Systems, Electric Power Systems Research, European Transactions on Electrical Power, IEEE Transactions on Magnetics, IEEE Transactions on Power Delivery, International Journal of Electrical Power and Energy Systems, and IET Generation Transmission & Distribution. Due to the high number of publication in journals, we are not considering publications of conferences and symposia. A total of 700 publications are analyzed in this paper. The research presented in this paper is important because it contains and analyzes the best research papers on transformers coming from many countries all over the world and published in top rated scientific electrical engineering journals.

Keywords Connection, Design, Diagnostics, Failure, Protection, Transformer, Transient Analysis

1. Introduction

This paper analyzes publications of all the different subje cts of transformer, e.g.: a) Transformer design, b) Transformer protection, c) Transformer connections, d) Transformer diagnostics, e) Transformer failures, f) Transient analysis of transformers (overvoltages, overcurrents), g) Modeling and analysis of transformer using FEM (thermal modeling, losses modeling, insulation modeling, windings modeling). All electrical engineering journals in English are included. All journals investigated are shown in Table 1. The analysis of publications can help assess the productivity and impact of authors, institutions, and countries in worldwide transformer research.

2. Methodology for Analyzing Transformer Bibliography

All publications on transformers were downloaded from the respective Internet sites of the journals and the following elements were stored in a database: journal name, year of publication, paper title, number of citations, name of first author, affiliation of first author, and country of first author. In this contribution only research papers were considered, including original research papers, reviews, and letters. To assess the impact of these papers, we downloaded citation information, during December 2010, from Google Scholar (including self-citations). We preprocessed the collected data for bibliographic analysis by crediting each paper to its first author. This means that if a paper has more than one author, then the paper is credited to its first author, i.e., the paper is credited to the name of the first author, to the affiliation of the first author, and to the country of the first author. If the first author has more than one affiliation, we consider only the first affiliation of this author.

Table 2 shows the most cited papers from 1990 to 2000. Obviously in these outstanding papers in terms of citations received, the names of all authors are presented in the third column of that table. It can be seen in Table 2 that the three most cited papers accumulate a total of 420 citations. Moreover, these three most cited papers are related to the diagnosis of transformers. The three most cited papers have an average of 7 to 11 citations per year starting from the date of their publication.

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Table 1. Electrical engineering journals investigated (journals are listed in alphabetical order)

Advances in Electrical and Computer Engineering
Canadian Journal of Electrical and Computer Engineering
COMPEL (The International Journal for Computation and Mathematics in Electrical and Electronic Engineering)
Electrical Engineering
Electric Power Components and Systems
Electric Power Systems Research
European Transactions on Electrical Power
IEEE Computer Applications in Power Magazine
IEEE Transactions on Applied Superconductivity
IEEE Transactions on Dielectrics and Electrical Insulation
IEEE Transactions on Education
IEEE Transactions on Energy Conversion
IEEE Transactions on Industry Applications
IEEE Transactions on Magnetics
IEEE Transactions on Power Delivery
IEEE Transactions on Power Systems
IET Electric Power Applications
IET Generation Transmission & Distribution
IET Science Measurement & Technology
International Journal of Electrical Power & Energy Systems
International Review of Electrical Engineering-IREE
Journal of Magnetism and Magnetic Materials

3. Outstanding Papers, Authors, Institutions and Journals from 1990 to 2000

Tables 3 to 5 show the most productive countries, institutions, and authors, respectively, from 1990 to 2000. It may be concluded that research on transformers was dominated by USA and Japan researchers (see Table 3). Tokyo Electric Power (Japan), General Electric (USA), and Department of Electrical Engineering of Toronto University (Canada) are the three most productive institutions (see Table 4). According to the analysis, Pierce, de Leon, and Arturi are the three most productive authors with 19 publications in total (see Table 5). It can be seen from Table 6 that 475 papers on transformers have been published in IEEE Journals, i.e., 68% of the total 700 publications on transformers collected from the period from 1990 to 2000.

Table 2. Most cited papers from 1990 to 2000

Rank	Title	Authors	Year	Country	Cites
1	"An artificial neural network approach to transformer fault diagnosis"	Zhang, Y.	1996	USA	175
2	"An expert system for transformer fault diagnosis using dissolved gas analysis"	Lin, C.E.; Ling, J.-M.; Huang, C.-L.;	1993	China	130
3	"Developing a new transformer fault diagnosis system through evolutionary fuzzy logic"	Yann-Chang Huang	1997	Taiwan	115
4	"A high frequency transformer model for the EMTP"	Morched, A.; Marti, L.; Ottevangers, J.;	1993	Canada	98
5	"A transformer model for winding fault studies"	Bastard, P.; Bertrand, P.; Meunier, M.;	1994	France	98
6	"A combined ANN and expert system tool for transformer fault diagnosis"	Zhenyuan Wang Yilu Liu Griffin	1998	USA	96
7	"Improved simulation models for current and voltage transformers in relay studies"	Lucas, J.R.; McLaren, P.G.; Keerthipala, W.W.L.; Jayasinghe, R.P.;	1992	Sri Lanka	93
8	"Power differential method for discrimination between fault and magnetizing inrush current in transformers"	Yabe, K.	1997	Japan	88
9	"Status and trends in transformer monitoring"	Bengtsson, C.	1996	Sweden	86
10	"Complete transformer model for electromagnetic transients"	de Leon, F.; Semlyen, A.;	1994	Canada	83

Table 3. Most productive countries from 1990 to 2000

Rank	Country	Counts
1	USA	183
2	Japan	106
3	Canada	55
4	China	47
5	United Kingdom	36
6	France	33
7	Poland	30
8	Germany	22
9	Italy	19
10	India	18

Table 4. Most productive institutions from 1990 to 2000 (taking into account only the affiliation of the first author)

Rank	Institution	Counts
1	Tokyo Electric Power Co., Ltd.	10
2	General Electric Co., Rome, Georgia	8
3	Dept. of Electr. Eng., Toronto Univ., Ont.	7
4	Dept. of Electr. Power Eng., Rensselaer Polytech. Inst., Troy, NY	7
5	Chubu Electric Power Co., Inc. Nagoya, Japan	6
6	Coll. of Eng., Idaho State Univ., Pocatello, ID	6
7	Dipartimento di Elettrotecnica, Politecnico di Milano	6
8	Dept. of Electr. & Electron. Eng., Tokyo Inst. of Technol., Japan	5
9	Amorphous Magnetic Device Lab., Sendai	4
10	Cooper Power Syst., Pewaukee, WI	4
11	Dept. of Electr. Eng., Arizona State Univ., Tempe, AZ	4
12	Dept. of Electr. Eng., British Columbia Univ., Vancouver, BC	4
13	Dept. of Electr. Eng., Ohio State Univ., Columbus, OH	4
14	Dept. of Electr. Eng., Southeast Univ., Nanjing	4
15	Inst. de Recherche, IREQ, Varennes, Que.	4

Table 5. Most productive authors from 1990 to 2000 (taking into account only the affiliation of the first author)

Rank	Name	Affiliation	Counts	Country
1	Pierce, L.W.;	General Electric Co., Rome, GA	8	USA
2	de Leon, F.; Semlyen, A.;	Inst. Politecnico Nacional, Mexico City	6	Mexico
3	Arturi, C.M.;	Dipartimento di Elettrotecnica, Politecnico di Milano	5	Italy
4	Lin, C.E.; Yeh, J.C.; Huang, C.L.; Cheng, C.L.;	Dept. of Electr. Eng., Cheng Kung Univ., Taiwan	5	China
5	Tsujimoto, H.; Wada, T.; Shirae, K.;	Fac. of Eng. Sci., Osaka Univ.	5	Japan
6	Yamaguchi, H.; Sato, Y.; Kataoka, T.;	Dept. of Electr. & Electron. Eng., Tokyo Inst. of Technol., Japan	5	Japan
7	Kasztenny, B.	Texas A&M Univ., College Station, TX	4	USA
8	Koppikar, D.A.	Transformer Div., Crompton Greaves Ltd., Kanjur	4	India
9	Tang Renyuan; Yang Junyou; Lin Feng; Lu Yongping;	Res. Inst. of Special Electr. Machines, Shenyang Polytech. Univ.	4	China
10	Blue, R.	Strathclyde Univ., Glasgow	3	United Kingdom
11	Brubaker, M.A.x	Los Alamos Nat. Lab., NM	3	USA
12	Cui Xiang; Lui Jianxin; Xie Yucheng; He Ronggui; Zhang Guoqiang; Yang Chunping	Dept. of Electr. Eng., North China Inst. of Electr. Power	3	China
13	E. Leśniewska and Z. Kowalski	University Warsawa, Poland	3	Poland
14	Ebert, J.A.;	MagneTek Electr., Waukesha, WI	3	USA
15	Elleuch, M.	Lab. des Syst. Electr., Ecole Nat. d'Ingenieurs, Tunis	3	Tunisia

Table 6. Most productive journals from 1990 to 2000

Rank	Journals	Counts
1	IEEE Transactions on Power Delivery	243
2	IEEE Transactions on Magnetics	158
3	IEEE Transactions on Industry Applications	35
4	COMPEL	31
5	Electric Power Systems Research	22
6	IET Science Measurement & Technology	22
7	IET Generation, Transmission and Distribution	21
8	IEEE Transactions on Dielectrics and Electrical Insulation	20
9	IEEE Transactions on Applied Superconductivity	19
10	Electric Power Components and Systems	16

4. Conclusions

This paper assesses the state of transformer research based on the publications in the main electrical engineering journals during the decade of 1990-2000. It was found that USA and Japan researchers dominate transformer research. Following USA and Japan, Canadian researchers have also published a significant number of papers. The three most cited papers have an average of 7 to 11 citations per year and these papers are from USA, China, and Taiwan, respectively. Pierce, de Leon, and Arturi are the three most productive authors. Tokyo Electric Power (Japan), General Electric (USA), and Department of Electrical Engineering of Toronto University (Canada) are the three most productive institutions. Our results of ranking should not be viewed as definitive. This publication is the starting point of many different ways to interpret the transformer research in many electrical engineering journals. We hope that in the near future this kind of information will keep moving. Bear in mind that this bibliographic research work may contain omissions. Basically, Table 5 should be more exhaustive by including co-authors. Some of the authors have certainly co-authored papers not as first authors. An alternative way should be investigated by assigning to each author a coefficient depending on the total number of authors.

The authors are still engaged in future work aiming at establishing a web search engine to investigate information presented in this contribution. This information would be presented and updated automatically using this web search engine.

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