

Modelling of magnetic and electric circuits

It is a great pleasure to introduce this special issue of *COMPEL* (*The International Journal for Computation and Mathematics in Electrical and Electronic Engineering*) with selected extended papers presented originally at the 24th Symposium on Electromagnetic Phenomena in Nonlinear Circuits (EPNC 2016) held from 28 June to 1 July 2016 in Helsinki, Finland. The 24th EPNC Symposium was organized by Aalto University, School of Electrical Engineering (Finland), Polish Academy of Sciences and Polish Society for Theoretical and Applied Electrical Engineering – Poznań Section. Professor Anouar Belachen from the Aalto University was the Chairman of the Organizing Committee.

The first EPNC Symposium took place in Poznań, Poland, in November of 1972. The first 11 conferences were local meetings, although speakers from other countries also participated. The last 13 conferences were international events with proceedings published in English. Initially selected papers from EPNC conferences were submitted to regular issues of *COMPEL*. After EPNC 2004 in Poznań, for the first time, selected and extended papers from EPNC were published as a special issue of *COMPEL*. The current issue of *COMPEL* is the seventh such special issue.

The aim of the EPNC 2016 was to present the recent advances in the analysis and synthesis of nonlinear electric and magnetic circuits and in nonlinear optics and nonlinear electromagnetic problems in medicine, as well as to provide a forum for discussion and dissemination of recent results on applications of nonlinear phenomena in electrical engineering. The EPNC conferences are intended to be an opportunity to exchange ideas and experiences between specialists and young PhD students in electromagnetic field modelling, electric drives, electronics, electrical machines and electric and magnetic materials. The topics of the symposiums included: ferromagnetics and magnetic circuits, semiconductors and nonlinear electric circuits, nonlinear optics and wave propagation and nonlinear electromagnetic problems in medicine.

At EPNC in Helsinki, 75 papers were presented by participants from 14 countries. Two-page versions of all papers were published in the conference proceedings. A limited number of 20 extended papers, selected in a peer review process, were chosen by EPNC 2016 Editorial Board and *COMPEL* Guest Editors for publication in this special issue of *COMPEL*. The papers presented at the Conference confirmed the general trends in the field of electromagnetism and electrical machines. Amongst those, the attempts to accurately model the multi-physical behaviour of magnetic materials, such as coupled mechanics and magnetism or thermal and magnetic problems, is worth mentioning. This is motivated by the increasing efficiency requirements for electrical motors because of the European and international regulations regarding these devices. The other motivation is driven by the need to construct electrical machines that able to work at higher temperature than conventional ones. Both trends require complex and costly material characterisation with non-standard measurement set-ups and devices and the related methodologies. From the devices point of view, the design and simulation of permanent magnet machines are the most prominent topics. The conference presentations showed that more accurate numerical methodologies or models of materials, e.g. hysteresis models, are still being developed and deployed for optimised designs of these machines. This is inspired by the increasing need for efficient and robust traction motors for the fast-developing field of hybrid and electric vehicles.



As at the last few EPNC conferences, a special Emerald/COMPEL award for the best paper delivered by a young researcher was offered by Professor Jan Sykulski, Editor-in-Chief of *COMPEL*, to Ugur Aydin (Aalto University) for the presentation of the paper entitled "A novel rotational single sheet tester design". Two *COMPEL* commendations were also awarded, and special diplomas were presented to Jan Karthaus (RWTH Aachen University, Institute of Electrical Machines) and Virginie Majchrzak (Artois University). The papers by these award-winning researchers may be found in this special issue of *COMPEL*.

We hope that this issue of *COMPEL* will provide stimulating new information to the readers.

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