International Journal of Applied Electromagnetics and Mechanics 76 (2024) 1–2
DOI 10.3233/JAE-249004
IOS Press

Preface

Special Issue on Electromagnetic Fields in Mechatronics, Electrical and Electronic Engineering

The worldwide community active in the broad area of computational electromagnetics – which grew up substantially in the last decades – gathers academic and industrial researchers who utilize field based numerical models with the manyfold scope of designing new devices, predicting the behavior of prototypes, or interpreting measurements.

Accordingly, in this special issue (SI) of the IJAEM, a collection of 22 papers, selected after a peer-review procedure, covers the main subjects of interest for the community.

A confirmed tendency is multi-physics – or coupled field – approach, more and more considered when modelling and simulating electromagnetic devices; in fact, thermal and mechanical effects in the magnetic field are often taken into account when dealing with industrial applications. The multi-domain analysis is based on 2D or even 3D Finite Element Models, giving rise to complex problems and, therefore, a challenge for numerical solvers takes place.

An emerging tendency is the use of machine learning techniques for solving analysis and synthesis of field problems; an original application is the analysis of a magnetic levitation actuator.

A group of papers is focused on the investigation of the properties and performance of electrical machines in terms of increasing the efficiency and reducing the power losses; specifically, the most widespread applications, considered in the SI, are power devices like electric motors and transformers. Special attention is paid to the use of low-loss materials utilized for the transformer core.

Another timely subject is the design of innovative systems for wireless power transfer with application in electric vehicles and electrical machines.

More likely than not, field analysis is the common ground upon which models of specific devices are developed: in fact, field-based models are especially suited to predict the behavior of devices exhibiting complex shapes and non-linear material properties, or to synthesize new devices characterized by better performance or lower cost with respect to existing prototypes. The main development in the area is intimately related to the deep understanding of physical processes, which in turn is fostered by advanced numerical methods.

In general, one of the most important messages that comes out of the SI is that university and industry should cooperate in a closer way to dominate the challenges of product innovation. In fact, technical challenges set requirements and criteria for the development of numerical methods: one of the main aims is reducing complex problems of field analysis and synthesis to the search for cost-effective approximate solutions based on user-friendly tools.

All in one, the collection of papers here presented provides an updated scenario of contemporary computational electromagnetics in the area of electromagnetism, mainly for low-frequency applications.

Eventually, the editors are grateful to all the authors for their valuable contributions as well as to the editor-in-chief of the Journal for the opportunity of addressing a wide international audience.

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