Preface

The IX Workshop on Optimization and Inverse Problems in Electromagnetism, OIPE_Sorrento

Sorrento, Italy 13–15 September 2006

It is a real honour and a great pleasure to introduce the special section of this IJAEM issue, devoted to publish a selection of contributions presented during the IX Workshop on Optimization and Inverse Problems in Electromagnetism (OIPE_Sorrento), held in Sorrento, Italy, in Sept. 13th–15th 2006.

OIPE Workshops provide one of the wider and most relevant forum for the lively community of scientists active in the challenging field of optimization and inverse problems in electromagnetism. As a matter of fact, the main aim of OIPE is to discuss recent developments in optimization and inverse methodologies and their applications to the design and operation of electromagnetic devices. Therefore the workshop represents a stimulating occasion offered to scientists working in various fields (e.g. mathematics, physics, engineering, etc.) to exchange information of potential relevance for the innovation in electromagnetic methods and applications.

The OIPE series was promoted since 1989 (Pavia, Italy) on the basis of the perspective intuition in the strategic importance of optimization and inverse problems in the electromagnetic research. The starting experience continued with a deep scientific path through a set of biennial editions held in Warsaw, Poland (1992), Geneva, Switzerland (1994), Brno, Czech Republic (1996), Jyvaskyla, Finland (1998), Torino, Italy (2000), Lodz, Poland (2002), Grenoble, France (2004) until the last 9th one held in Sorrento (2006).

Among the guidelines of the OIPE philosophy, a prominent role is given to the interdisciplinary. The idea is quite simple while effective.

Researchers investigating in optimization and inverse problems in electromagnetism need quite complex and innovative mathematical tools; in addition, they know that the most innovative ideas for high performance function analysis come from nature (including sociology, ethology, genetics, thermodynamics, and so on). Therefore, the people who first started OIPE workshops aimed to a deep and stable cooperation with other scientific communities, that seemed very promising in terms of effectiveness, innovation capability and, in general, carrier of new cultural prospects.

In addition they also realized that the electromagnetism is a very challenging and attractive scientific field also for other research communities. As a matter of fact it continues to propose new challenging question from both conceptual and applicative point of view in several directions including communications, human and animal health, technical compatibility, energy conversion and transportation, and so on.
As a consequence, a scientific alliance was promoted among different cultural sectors aimed to exchange experience and enthusiasm in the perspective of new goals in the innovative sector of optimization and inverse problems methods, algorithms and applications.

Today, after a course of about 20 years, the figures showing the consistence and of the operative capabilities of such community seems very encouraging: the scientific program of OIPE-Sorrento (organized by R. Martone and A. Formisano, chairman and responsible of the Secretariat, respectively) included more than 100 contributions, selected by means of a peer reviewing procedure among more than 120 submitted records; the wide international character of OIPE 2006 is witnessed by more than 250 authors, coming from 24 different countries of Europe, Asia, Africa, North and South America.

The call for paper for OIPE-Sorrento were based on the following main topics:

1. Theoretical Aspects and Formulations, including fundamental mathematical theory, issues on existence and uniqueness, regularisation techniques, etc.
2. Algorithms and Numerical Techniques, including classical and new techniques (swarm, ant colony, immune algorithms, etc.), multi-objective optimization, design sensitivity, uncertainties treatment, etc.
3. Devices and Applications, including electrical and electronic engineering (magnets, electrical machines, power and distribution systems, etc.), non destructive diagnostics, testing and evaluation (eddy current, magnetography, tomographic techniques, etc.), nano and micro systems, bio-medical systems, etc.
4. Software Methodologies and tools, including optimization environment, soft computing (neural networks, fuzzy systems, artificial intelligence, etc.), parallel and distributed algorithms, etc.

As anticipated, in OIPE-Sorrento a double step peer reviewing procedure has been carried out. The first step was aimed to select the papers to be presented at the Workshop among the digest submitted; the second step addressed to rank the full papers in order to select the best ones to be published in the international journal IJAEM (and those published in the journal COMPEL, the International Journal for Computation and Mathematics in Electrical and Electronic Engineering).

24 high level and well known scientists, from 9 different countries of Europe, Asia, and Americas, were included in the OIPE-Sorrento Editorial Board, with conviction that their service was the essential tool to consolidate the high standard of the conference.

The answer of the scientific community was a wide-ranging set of significant and interesting papers, covering the largest part of the topics. Moreover, if carefully examining the content of the papers submitted to OIPE, the main guide lines of the future tendencies of the research in the specific sector can be foreseen.

The first guide line is that the collective algorithms specialized for global searching (including genetic, evolutionary, immune and fuzzy systems, neural network) kept the full interest of the community. However such an interest seems particularly oriented to face with vectorial search (multiobjective optimization problems, often studied by means of Pareto approaches) or to suitably reduce the impact of ill-posedness or of uncertainties (both for optimization and inverse problems). Particular attention seems to be reserved to the optimized design of the overall system for inverse problems, from the optimal choice of the representation basis to the optimal allocation of the probe set.

The second general indication regards the range of applications, where, among the classical ones, a special attraction seems to be reserved to a couple of emerging appealing fields: the biomedicine and the energy management in the contest of a renewed care for the nature environment. As a matter of fact, several papers deal with applications in the field of electromechanics (e.g. optimal design and
fault diagnostics), in non destructive testing (in the classical industrial applications as well as in the new applications in civil engineering), in power and signal electronics (e.g. circuit design, passive and active shielding, filter optimization), and many of these papers appear to be very interesting and full of innovative ideas. However an increasing number of papers are focused in biomedical applications including magneto-pneumology, electroencephalography, nerves system and brain studies, electro-thermal ablation, resonance imaging, and so on. In addition, a significant number of contributions deal with energy management, including optimization of power plants, wind turbines and solar plants studies, cogeneration system optimization, and so on.

Such research directions, that are now establishing, seem to confirm the importance of the cooperation among different expertises and new knowledge, that was one of the basis of the OIPE community since the beginning. It is consequently easy to foresee for the near future a new, deepened, cooperation in various fields, including several high specialization in medicine, thermodynamics, mechanics, air pollution, as well as, in the general expertise in protection of the environment.

The positive results achieved by the IX Edition of OIPE Workshop series is mainly due to the support received from several institutions (in particular, Seconda Università di Napoli, Italy and Consorzio CREATE, Italy), from the enthusiastic work given by senior and junior colleagues (including the members of the International Steering Committee, of the Editorial Board, of the Local Steering Committee and a number of PhD students of Seconda Università di Napoli) and from the encouragement and the fruitful cooperation given by the scientific journals COMPEL and IJAEM.

As a concluding remark, we wish to share with the readers the firm belief that the lively scientific community gathering around OIPE workshops, deep-rooted inside the wider international community of people researching in electromagnetism, thanks to its high enthusiasm and its open-mindedness towards different expertises, will provide a useful and active contribution to the development of scientific competencies in this area.

Alessandro Formisano and Raffaele Martone
Guest editors
Napoli, December 2006