

Selected papers from HES-2019 conference

HES conference is a meeting point for different cultures and expertise. The HES-19 edition was particularly important because it celebrated the twentieth anniversary of the conference. In fact, starting from the early beginning in the year 1998, the conference has become more and more of an attractive event for academics and professionals working in the broad area of electro-technologies. Devices and systems exploiting electromagnetic heating in all its forms, such as conduction, induction and microwaves, are the main focus of our community. HES-19 was organized at Padua University in the period 22-24 May 2019.

The main developments in the area of electroheat are strictly related to the deep understanding of physical processes, which in turn are fostered by the multi-physics approach to modelling and simulation. In most applications, in fact, the solution of stand-alone electromagnetic or thermal problems is no longer sufficient, and coupling among different physical domains is mandatory. In this respect, electromagnetics, heat transfer and thermodynamics, magneto-fluid dynamics, phase transitions, residual stresses are considered as coupled domains in the contributed papers. Many computational methods have been presented, but not all of them appear convenient enough for use in practical engineering. In fact, technical and industrial challenges set some principal requirements and criteria for efficient computational methods. In this respect, the main task of a researcher consists of reducing the still intractable problems of field analysis and synthesis to the search for cost-effective approximate solutions based on friendly tools. This is one of the most important messages which came out of the conference.

A growing field of research presented at the conference is the electromagnetic processing of materials, where the electromagnetic field with different characteristics (high or low intensity, single or multi-phase, DC, AC, high or low frequency) is used to obtain materials with improved properties. The research in more traditional fields, such as induction heating, is also moving towards new applications and asks for a deeper understanding of different phenomena during heat treatment processes. Several papers deal with home appliances of induction heating, with a special attention to increasing the efficiency and reducing the cost of induction systems; in this respect, induction cooktop is nowadays one of the most promising fields of application.

As far as induction hardening is concerned, most of papers deal with multi-physics simulation of the process with the evaluation of temperature distribution, phase change during the process, hardening profiles, deformations and residual stresses. In turn, inverse problems in induction heating are another class of emerging topics: a typical issue is to synthesize the distribution of currents in the winding, which gives rise to a prescribed thermal profile along the workpiece. The exploitation of multi-objective optimization techniques and evolutionary computing algorithms help the solution of the inverse problem.

Another important event was the panel session organized according to a triplicate flow:

- (1) First, a short focus on a few hot topics in our community, such as multi-physics modelling and optimal synthesis methods, is more oriented to scientific aspects.
- (2) Next, a possible scenario of “Inductor 4.0”, i.e. a paradigm of multi-sensorized and IoT-connected inductive systems for big data exploitation, is more oriented to technological aspects.



- (3) Eventually, the presentation of applicable EU fundings for projects in electrotechnology area, is more oriented to financial aspects and business opportunities.

All in one, it appeared that digital transformation in electro-technologies is an urgent challenge to tackle for updating industrial processes and increasing company competitiveness.

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Finally, a special parallel session on atmospheric plasma for industry was organized, at which various papers focussing on innovative technologies for the surface treatment of materials were presented; accordingly, numerical models for the simulation of the streamer formation in the discharge process were proposed.

Specifically, 87 papers have been presented at HES 19 by the authors coming from 22 countries. The 28 papers selected for this special issue of *COMPEL – International Journal for Computation and Mathematics in Electrical and Electronic Engineering* – after a peer-review procedure, cover all the main topics presented at the conference. The editors would like to thank all the authors for their valuable contributions and, in particular, the editor-in-chief of the journal for the opportunity of addressing a broader international audience.

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