
Editorial: Recent advances in Heating by Electromagnetic Sources (HES-23)

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Selected papers from HES-2023 conference

The 9th edition of the HES conference, Heating by Electromagnetic Sources, originally scheduled for spring 2022, had to be postponed and was eventually held from 10 to 12 May 2023 at the historic Botanical Garden of the University of Padua. The conference was rather poorly attended compared to previous editions, with 60 participants and 52 papers presented.

The opening session of the conference was dedicated to the sustainability of electrothermal processes, a particularly important topic for both environmental and socio-economic issues. In fact, the tense international situation has led to a sharp decrease in availability and an impressive increase in prices, especially of natural gas, a fossil source widely used in many heating processes, not only industrial. The need to reduce the environmental impact of processes that make use of fossil fuels and at the same time the need to use energy sources that guarantee greater stability in price and supply has led many companies to explore the possibility of replacing polluting processes based on combustion with processes that make use of electricity.

The design and implementation of electrothermal process plants require the modelling of complex multi-physical problems, as the physics of electromagnetic fields, thermal fields, deformation and mechanical stress and sometimes fluid dynamics are closely coupled. Electroheat has made an extensive use of numerical modelling, especially based on the FE method but not only, and optimisation methods for the study of processes and plant design since many years. This has given great impetus to the realisation of increasingly high-performance plants, with tailored design process, but unfortunately the creation and solution of “traditional” numerical models involves very significant construction and calculation times, which sometimes limit their applicability in certain industrial sectors where simpler and faster tools are sought. For this reason, a special panel session, with speakers Professor F. Bay (Ecole des Mines de Paris – France), Professor P. Di Barba (University of Pavia – Italy), Professor F. Dughiero (University of Padova – Italy) and Professor O. Lucia (University of Zaragoza – Spain), was dedicated to artificial intelligence in electrothermal technologies. Artificial intelligence can be implemented in various tools, such as the realisation of digital twins or the development of calculation models based on neural networks, which in the future will enable increasingly fast, reliable and accurate design and diagnostic tools. On the subject of artificial intelligence, and in particular on the training of deep neural networks capable of replacing traditional numerical models, a number of works were presented, mainly on research and the exploration of potential, which demonstrate a certain amount of activity in this very topical area of research.



This paper forms part of a special section “Recent advances in heating by electromagnetic sources (HES-23)”, guest edited by Paolo Di Barba, Fabrizio Dughiero, Michele Forzan and Maria Evelina Mognaschi.

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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An important area 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. Research in more traditional areas, such as induction heating, is also moving towards new applications and requires a deeper understanding of different phenomena during heat treatment processes.

The 2023 edition of the HES conference also saw an important contribution of work in the field of power electronics. The development of new technologies for manufacturing power electronics components, in particular the introduction of silicon carbide as a replacement for silicon as a substrate for transistors, has made it possible to create increasingly high-performance power converters with more flexible control capabilities. Many of the articles selected for this special edition of Compel concern power converters for electro-thermal applications.

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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