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Special issue editorial

Mathematical models, numerical methods and scientific computing technologies for new arising problems (MATHSCICOMP2023)

This Special Issue of Mathematics and Computers in Simulation collects a selection of peer-reviewed original articles on research topics developed in connection with IMACS2023, the IMACS World Congress, held in Rome (Italy) at the Faculty of Engineering, *Sapienza* University of Rome on September 11–15, 2023, that we organized, in the role of Local Scientific Committee, together with Rosa Maria Spitaleri, Congress Chair.

IMACS, the International Association for Mathematics and Computers in Simulation, traces its origins back to 1955, when the first International Conference on Analog Computation was held at the Universite Libre de Bruxelles (ULB). The success of that pioneering event, which united scientists and engineers from across Europe, the United States, Russia, and Japan, highlighted the need of a permanent platform for collaboration in the emerging field of computation and simulation. This led, in 1956, to the foundation of the Association Internationale pour le Calcul Analogique (AICA) under the Belgian law.

With the leadership of Professor Jean Hoffmann, AICA fostered international cooperation in analog and, later, digital computation. His successor, Professor Robert Vichnevetsky, guided the organization through a period of transformation, culminating into the IMACS birth in 1976, a change that reflected the shift from analog to digital paradigms and also the expanding role of mathematics in computational sciences.

Today, IMACS continues to promote the development and application of mathematical and computational methods across engineering, physics, and applied sciences for achieving powerful scientific computing tools to handle more and more complex simulation processing. The Association sponsors selected high-level international Congresses, in particular its Technical Committees promote yearly or biennial meetings focussed on specific fields of scientific computing. Moreover IMACS disseminates high-quality research through its journals, notably Mathematics and Computers in Simulation and Applied Numerical Mathematics, both published by Elsevier.

IMACS2023 was the twenty-first event in the distinguished series of triennial world Congresses, which began in 1955 and, since then, have taken place across all the continents. The complete list of previous congresses includes:

1955 Brussels (Belgium); 1958 Strasbourg (France); 1961 Opatija (Yugoslavia); 1964 Brighton (Great Britain); 1967 Lausanne (Switzerland); 1970 Munich (Germany); 1973 Prague (Czechoslovakia); 1976 Delft (The Netherlands); 1979 Sorrento (Italy); 1982 Montreal (Canada); 1985 Oslo (Norway); 1988 Paris (France); 1991 Dublin (Ireland); 1994 Atlanta (USA); 1997 Berlin (Germany); 2000 Lausanne (Switzerland); 2005 Paris (France); 2009 Cairns (Australia); 2013 Madrid (Spain); 2016 Xiamen (China); and finally, 2023 Rome (Italy).

The 2023 Congress edition was attended by more than 300 researchers from 28 countries all around the world.

The scientific program featured 7 scientific Plenary Lectures, each of them of excellent quality. In alphabetical order the invited speakers were Remí Abgrall (University of Zurich), Zhiming Chen (Chinese Academy of Sciences, Beijing), Roberto Natalini (National Research Council, Rome), Michele Piana (University of Genoa), Antonello Provenzale (National Research Council, Pisa), Andrea Tosin (Politecnico di Torino) and Jessica Zhang (Carnagie Mellon University, Pittsburgh USA).

Alongside there were 12 Mini-Symposia and 14 Special Sessions consisting averagely of 10 and 5 presentations, respectively. In addition, 35 Talks in General Sessions and 3 Poster presentations were delivered, reflecting the diversity and vitality of current research in applied mathematics, computation, and simulation. The commitment of the organizers and of the contributors led to a very interesting and up-to-date scientific event, altogether in a very warm and friendly atmosphere. Interested readers can refer to

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IMACS2023 Book of Abstracts [1] for all the presentations. The Foreword by the IMACS honorary President, Robert Vichnevetsky, is also included there.

Elsevier contributed to the Congress to allow an open updating on the relevant positions achieved by the IMACS journals and to draw attention on the advanced publishing ethical issues. These aspects were introduced during the Editorial Boards Meeting by Anna Hajduk, the Applied Mathematics and Statistics publishing manager, and Darren Sugrue, expert in Publishing Ethics, respectively.

The Scientific Program Assistant, Stefania Giuffrida, and the IT Assistant, Paolo Rughetti, with the Administrative Staff of the Faculty of Civil Engineering of *Sapienza* University of Rome, have actively and competently contributed to make all this happen.

The present Special Issue, MATHSCICOMP2023, standing for *Mathematical Models, Numerical Methods and Scientific Computing Technologies for New Arising Problems*, collects peer-reviewed contributions developed exclusively from the General Talks of the 21st IMACS World Congress and is part of a coordinated set of publications derived from this event. Actually, it is to be combined with three special issues of Applied Numerical Mathematics

- NUMDIFINT2023, *Recent Trends in the Numerical Solution of Differential and Integral Problems*
- AMNMAS2023, *Advanced Mathematical and Numerical Models in Applied Sciences*
- PHASEFIELD2023 *New Trends in Phase Field: Theory and Applications*

and with three additional special issues of Mathematics and Computers in Simulation

- MODOCSG2023, *Modeling, Design Optimization and Control in Smart Grids*
- MEFISOS2023, *Recent Problems and Methods in Economics, Finance and Social Sciences*
- MMSEP2023, *Innovative Mathematical Approaches to Recent Environmental Problems*.

In particular the special issue, MODOCSG2023, is accomplished by the IMACS Technical Committee, Electrimacs. Further, the special issue, MMSEP2023, results from the active collaboration of the following IMACS Technical Committees: Modelling, Methods and Simulations in Environmental Problems and Mathematical and Numerical Modeling of Porous Media in Subsurface Environments.

The successful realization of the entire collection has been granted by our coordination effort, as members of the Local Scientific Committee of the Congress, in close collaboration with the Guest Editors of each special issue, according to the results dissemination plan designed by the IMACS President, Spitaleri. The topics addressed across are fully aligned with the aims and scope of IMACS, which have represented the conceptual support of the whole Congress.

MATHSCICOMP2023 includes studies on a wide range of mathematical and computational modeling problems, such as:

- construction of a mathematical model for the optimization of COVID-19 vaccination programs [2],
- development of training of a robust neural network [3],
- development of an unsupervised noisy image segmentation procedure [4],
- an analysis of mesh-based segmentation for automated margin line generation [5],
- investigation of a tetrahedral family in iterative Longest Edge Bisection [6],
- Convolutional Neural Network-based approach integrated with digital twin approach for building evaluation [7],
- wavelet thresholding on independent subspace factorizations of spatially indexed functional data [8],
- perception-guided training of a Convolutional Neural Network for high precision image detection [9],
- algorithmic modeling of complex redundant multi-state systems [10],
- multi-objective optimization using the Normal Boundary Intersection Method [11],
- a kinetic description and macroscopic limit of swarming dynamics [12],
- non-standard finite difference scheme for optimal control problems [13],
- 3D vorticity dynamics with the Diffused Vortex Hydrodynamics method [14].

Authors have also considered a vast set of real world applications which have added to the presented studies a perspective on their immediate impact on modern societies. Examples include: structural health monitoring in civil engineering, improvement of vaccination programs with pre-set conditions, epidemic control, accurate image detection (for medical imaging, autonomous driving, face recognition, and other complex setups), identification of artifacts in Electro-Encefalo-Graphic (EEG) signals, supporting Precision Viticulture via advanced Computer Graphics, supporting multi-state systems reliability, optimal naval design, study of the evolution of swarms, animal groups and human crowds.

We are indebted to the twenty-six reviewers involved who generously devoted their time, care and expertise in deep reading of the manuscripts, providing their critics and rich and fruitful comments.

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