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Preface to: Novel computational approaches to old and new problems in mechanics

Sonia Marfia · Anna Pandolfi · Alessandro Reali

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This Special Issue (SI) of Meccanica has been inspired by the success of the XXI Meeting of the Italian Group of Computational Mechanics (GIMC), which took place in Lucca on June 26-29, 2016, joined to the VIII Meeting of the Materials Group (GMA) of the Italian Association of Theoretical and Applied Mechanics.

Oral presentations delivered at the meeting were characterized by a very high quality in terms of advanced applications, innovative methods, variety of themes. At the end of the meeting, the GIMC committee has decided to organize the publication of original contributions in the form of scientific articles.

The issue of a special volume of Meccanica oriented to Computational Mechanics is motivated by the observation that numerical simulations are becoming an indispensable tool for a wide range of modern engineering activities. Accordingly, Computational Mechanics is becoming a primal research field for most engineering branches, in particular for Civil, Mechanical, Aerospace, Naval, Environmental, and Biomedical Engineering. An active and constantly increasing research effort toward innovative and highly efficient computational techniques has led to the development of new advanced numerical methods able to subside the limitations of conventional finite elements, so far the gold standard discretization tool of Computational Mechanics. Examples of innovative methods are Isogeometric Analysis, Mimetic Finite Differences and Virtual Elements, X-FEM, Immersed Methods, SPH and Particle Methods, and others.

The invitation to contribute to the SI with an article, concerning the conception, development, mathematical analysis, and validation of traditional and more advanced numerical methods and modern computational techniques, was sent initially only to the speakers of the meeting. Subsequently, the invitation was extended to renowned European scientists to increase the internationality of the SI.

The response has been more than satisfactory, and the SI collects seventeen excellent papers covering numerous fields of mechanics. Contributions address the numerical modeling of material behaviors, i.e., reinforced concrete [14, 15, 17], composites [1], and shape memory alloys [9], or the numerical simulation of structures, e.g., thin shells [5] and beams [7, 10, 14, 17]. Some of the papers discuss the treatment of multiscale behaviors [4], homogenization techniques [1, 6, 8], or shape optimization [17]. Advanced discretization approaches include the virtual element method [1] and isogeometric analysis

S. Marfia
Università di Cassino e del Lazio Meridionale, Cassino, Italy

A. Pandolfi (✉)
Politecnico di Milano, Milano, Italy
e-mail: anna.pandolfi@polimi.it

A. Reali
Università di Pavia, Pavia, Italy

[10, 12]. Mechanics of contact [11], damage [5, 7], fracture [2, 5, 13], phase field [2, 16] are other important topics of the SI. Hydro-elastic coupling is considered in [3, 12], transport processes are discussed in [4], dynamical applications and seismic problems are tackled in [3, 5, 17]. The variety of themes makes this volume of particular interest for applied mechanics scholars.

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