Special issue on multiscale computations for solids and fluids

Adnan Ibrahimbegovic[*1,2,3]

*¹Universite de Technologie Compiegne – Sorbonne Universities, Laboratoire Roberval de Mecanique,
Centre de Recherche Royallieu, Compiegne, France*
²Institut Universitaire de France (IUF)
³Academy of Sciences and Arts BiH

Abstract. This special issue contains selected papers first presented in a short format at the 4th International Conference ECCOMAS MSF 2019 – Multiscale Computations for Solids and Fluids, organized in Bosnian capital Sarajevo, September 18-20, 2019.

Keywords: multiscale computations; solid mechanics; fluid mechanics

1. Introduction

This special issue seeks to provide a more lasting result of ECCOMAS MSF 2019, the fourth in the series of International Conferences focusing upon Computational Methods in Solids and Fluids, held every two years in different countries in Europe. Previous meeting have all been organized under umbrella of ECCOMAS, 'The European Community on Computational Methods in Applied Sciences', as the sponsor of ECCOMAS conference series. For this particular Conference, we had an additional sponsor from the host country: ANUBiH, 'Academy of Sciences and Arts of Bosnia and Herzegovina'. The institutions organizing ECCOMAS MSF 2019 were Faculties of Civil Engineering and of Mechanical Engineering of University of Sarajevo in collaboration with University of Technology Compiegne, a member Alliance of Sorbonne University. The ECCOMAS MSF 2019 was held from 18 to 20 September 2019 in Sarajevo, after the short course offered to young participants held from 15 to 17 September 2019. The Conference provided a platform for learning from some of the worlds' leading specialists in numerical methods, coming from different engineering disciplines and applied mathematics.

The ECCOMAS MSF 2019 venue was the Bosnian capital Sarajevo (see Fig. 1). First of the reasons for this choice of venue is cultural: the charm of Sarajevo is confirmed by the travel guide series, Lonely Planet, which has ranked Sarajevo as one of the top ten cities to visit in 2010. The city urban area provides home to the population of roughly half a million. Sarajevo, or 'Palace place', has always been the major crossroad in the center on migration paths and conquests by Eastern Roman Empire, Slavs, Jews from Spain, Ottoman and Austro-Hungarian Empires, each leaving the imprint and contributing to the rich cultural heritage and numerous monumental

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∗Corresponding author, Professor, E-mail: adnan.ibrahimbegovic@utc.fr

buildings that remain in the city. In the former Yugoslavia, city of Sarajevo was known for most vibrant music scene, 1984 Winter Olympic Games, and the long siege in 1990's during the break-up of the country. Presently, Sarajevo has fully regained its status as the crossroad between East and West and a new tourist 'must-see' destination with well-known 'Sarajevo-Film-Festival'. Hence, the conference participants could benefit from high level of both scientific and social events.
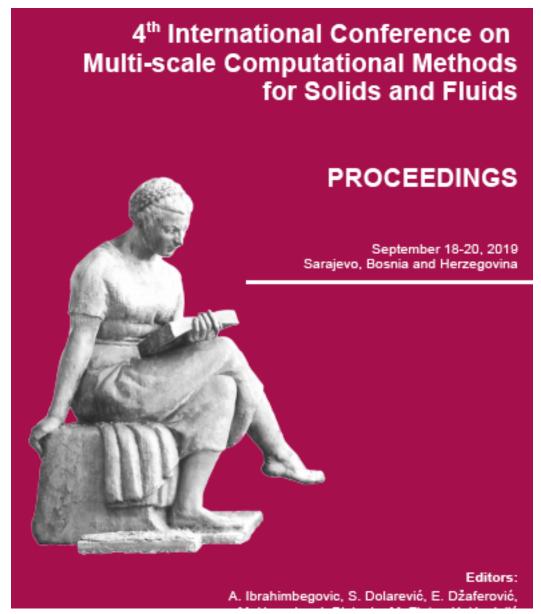

Fig. 1 Thematic Conference From Series ECCOMAS-European Community on Computational Methods in Applied Sciences; http://gf.unsa.ba/eccomas-msf-2019/

2. Selected papers

The main idea of this ECCOMAS MSF 2019 Conference was to examine recent advances in numerical methods in currently most active research domains, with applications to interface and/or interaction of Civil and Mechanical engineering and other pertinent disciplines. The multi-physics models and methods of this kind are often bridging the phenomena taking place at multiple scales in space and time, which ought to be placed in interaction or accounted for simultaneously in order to provide the most reliable results explanations. This class of problems calls for the development and combination of different modeling tools and computational methods in order to advance the field towards currently relevant industrial applications. A number of different schools have developed in various domains, both in engineering sciences and mathematics, with sometimes very little or no interaction between them. It is an explicit goal of this ECCOMAS MSF 2019 Conference to bring all the different communities together, in the truly open scientific spirit, and thus provide a sound basis for a fruitful exchange and cross-fertilization of ideas among them.

The main conference topics were quite diverse: *Heterogeneous materials*, *Masonry structures*, *Complex structures*, *Material and structure failures*, *Adaptive modeling*, *Mechanics of porous media*, *Fluid-structure interaction*, *Multi-phase flows*, *Turbulence*, *Wave propagation*, *Stochastic Processes*, *Uncertainty Propagation*. The conference proceedings (Ibrahimbegovic *et al*. 2019) containing 113 extended abstracts can be consulted for the full-size presentation of the results that ECCOMAS MSF 2019 managed to achieve. In that special issue, we have selected among these abstracts, and invited full-size paper contributions, which jointly more than touch upon all different ECCOMAS MSF 2019 Conference topics. With such a topic-wise diversity, perhaps the best order is the random one, with respect to the alphabetic order and date of arrival of each particular contribution for this double special issue.

In particular, in his work (Demirdžić 2020) provided a thorough comparison between the most frequently used discretization methods in Computational Mechanics, which are Finite Element Method (FEM) and Finite Volume Method (FVM), with a number of novel and less known results that can be of great interest to researchers and practicing engineers. The contribution from (Hajdo *et al*. 2020) provides very efficient approach to dealing with buckling or linear instability problems, whereas the work of Mejia-Nava *et al*. 2020) takes these consideration further to nonlinear instability problems with large pre-buckling displacement providing both statics and dynamics frameworks for solving such problems.

Several papers deal with improved solution procedures for special class of problems. In particular, (Paulin *et al*. 2020), provide a very efficient procedure for mesh adaptivity for transport problems typical of fluid mechanics with use of a co-mesh, while (Reut *et al*. 2020) provide a very efficient solution method based upon special semi-strip approximations for non-stationary mixed problem in elasticity.

The latter arrivals are papers placed in the second part of this double special issue of CSM journal. The work of (Ademović and Ibrahimbegovic 2020) provides a review of novel approach to complex system design, currently known as resilience-based design that can provide a unified framework for disasters combining different extreme loads and comprehensively evaluate different response phases including system integrity, its durability and finally its reparation with full-functionality restoration. The work of (Džubur and Serdarević 2020) considers how to make the dynamic modeling predictions of daily influent variation for of wastewater treatment plants, whereas the contribution by Hadžalić *et al*. (2020) considers what an advanced mathematical modeling of coupled problems in fluid-structure interaction by using the full thermo-hydro-

mechanical coupled formulation for poro-plastic media based upon an efficient discrete lattice model.

The work of (Miljanović and Zlatar 2020) deals with computing the stiffness of hybrid structural systems for concrete with and without pre-stressing, while contribution in (Suljevic *et al.* 2020) considers the fire resistance studies of concrete and reinforced concrete structural systems. Finally, the paper of (Taleshian *et al.* 2020) considers the effect of rigid connection on the random seismic response in an asymmetric building.

For more details, I invite the readers to carry on with their own explorations, and I wish they be very fruitfull. Last but not least, I wish to thank to all the authors of this special issue for contributing to the worthy goal of providing a more lasting impact of ECCOMAS MSF 2019 with their full-size papers.

Acknowledgments

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