Special issue on multiscale computations for solids and fluids

Adnan Ibrahimbegovic[*1,2,3]

[1]*Université de Technologie Compiègne – Sorbonne Université, Laboratoire Roberval de Mécanique,*
Centre de Recherche Royallieu, Compiègne, France
[2]*Institut Universitaire de France (IUF)*
[3]*Academy of Sciences and Arts BiH*

Abstract. This special issue contains selected papers first presented in a short format at the 5th International Conference ECCOMAS MSF 2019-Multiscale Computations for Solids and Fluids, organized in Dalmatian capital Split, Croatia, June 30-July 2, 2021.

1. Introduction

This special issue seeks to provide a more lasting result of ECCOMAS MSF 2021, the fifth in the series of International Conferences focusing upon Computational Methods in Solids and Fluids, which is held every two years in different countries in Europe. Previous meeting and this one have all been organized under umbrella of ECCOMAS, 'The European Community on Computational Methods in Applied Sciences', as the sponsor of ECCOMAS conference series. The institutions organizing ECCOMAS MSF 2021 were Faculties of Civil Engineering, Architecture and Geodesy of University of Split and Civil Engineering of University of Sarajevo, in collaboration with University of Technology Compiegne, a member Alliance of Sorbonne University. The ECCOMAS MSF 2021 was held from June 30 to July 2, 2021 in Split after the short course offered to young participants held from June 27 to 29, 2021. 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 2021 venue was the Dalmatian capital Split (see Fig. 1). First of the reasons for this choice of venue is cultural, with the charm of Split confirmed by several travel guide series that have ranked Split as one of the top destinations to visit at Croatian coast in 2021. The rich cultural heritage starts from early day history of Split that revolves around a Greek settlement founded in the area between the 3rd and 4th centuries. The most famous historic development came in 295 AD, when Roman emperor Diocletian ordered an imperial palace to be built there, for his retirement. History says that Diocletian was local son from present-day Solin (known as Salona in Roman times), about 5 km from Split, who first became Roman army general

---

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

and then emperor, and finally the first emperor to take retirement. Diocletian palace, which took ten years to build, is at present one of the most magnificent monuments in Split. It was used after Diocletian's death by many other Roman rulers, until 7th century when the Roman settlement of Salona (Solin) was abandoned, which allowed many of its inhabitants to seek sanctuary behind the palace's high walls and some of their descendants still live within the palace walls. The rest of city history is quite turbulent, alternating the periods of autonomy (until 14th century) and of domination by Venetian until late 18th century and Habsburg's empire until early 20th century, all contributing to rich cultural and monumental heritage of Split.

In the former Yugoslavia, city of Split was known for most vibrant sport scene, with a number of soccer, basketball, athletics and water-sports champions. Presently, Split has become the most important city on the Croatian coast, as the crossroad of ferries to beautiful islands (Hvar, Brač, Korčula …) and a new tourist 'must-see' destination. Split is also a very pleasant place to spend some leisure time, with city's location offering quick trip to many Adriatic Sea resorts.

2. Selected papers

The main idea of this ECCOMAS MSF 2021 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 2021 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, and Nikolić 2021), containing 93 extended abstracts, can be consulted (Fig. 1) for the full-size presentation of the results that ECCOMAS MSF 2021 managed to achieve. In this double special issue, we have selected among these abstracts, and invited full-size paper contributions, which jointly more than touch upon all different ECCOMAS MSF 2021 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.
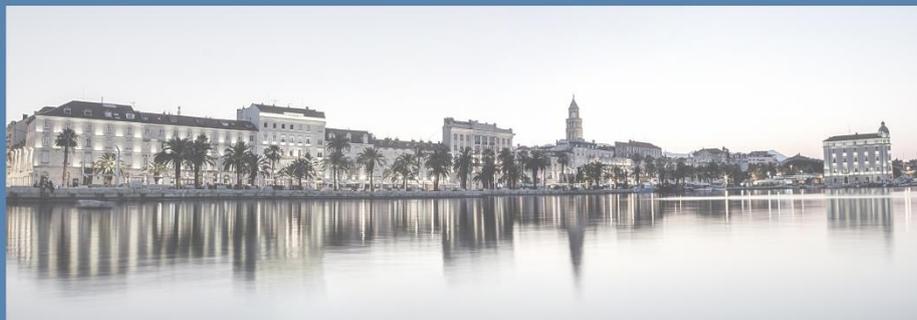
In particular, in his work (Grozdanović, Galić, Marović 2021) study some Aspects of the analysis of glass structures exposed to impact load and propose novel method for dealing with this class of problems, which is nowadays frequently encountered in Civil Engineering practice. Hence, a number of novel and less known results that can be of great interest to researchers and practicing engineers. The contribution from (Kalajdžisalihović, Milašinović, Harapin 2021) provides very efficient approach to dealing with new developments of a Weir Type by using the SPH or Smoothed Particle Hydrodynamic Model. The latter can bring an enhanced computational

Fig. 1 Thematic Conference From Series ECCOMAS-European Community on Computational Methods in Applied Sciences; http://gf.unsa.ba/eccomas-msf-2021/

performance for this class of problems of great interest in Hydraulic Engineering.

Several papers deal with providing solution to inverse problems, either as a part of parameter identification procedure, enhanced measurements or accounting for probability aspects. In particular, (Kožar, Bede, Bogdanić, Mrakovćić 2021), provide a very efficient procedure for data driven inverse stochastic models applied to identification problems posed by fiber reinforced concrete structures, one of the currently hot applications in Structural Engineering. The solution of inverse problem is also studied in (Szardenings, Hoefer, Fassbender 2021), who provide the development of a reduced order model for battery systems capable of dealing providing approximation of the cooling plate. The applications of this kind are of great interest in Electrical Engineering. Final paper in Part I of this double special issue is contribution of (Vrgoč, Tomičević, Smaniotto, Hild 2021), who also deal with fiber reinforced structures, but polymer rather than concrete, which is of current interest for Aerospace Engineering. They study in particular how to characterize damage on the basis of modern tomographic measurements of structure deformation known as Digital Volume Correlation.

The latter arrivals are papers placed in the second part of this double special issue of CSM journal. Papers in Part II of this double special issue are also ordered in alphabetic order, thus mixing the various contributions that cover broad area of multiscale solids and fluids computations. A very representative application is given in (Balić, Hadžalić, Dolarević 2021) dealing with identification problem for for the strain-dependent coefficient of permeability. The latter is achieved by combining both experimental and numerical results. The contribution proposes nonstandard approach of odometer tests that allow free lateral movement, which can be of interest to specialists of Geotechnical Engineering.

The work of (Bartulović, Tomčević, Bubalo, Hild 2021), provides an assessment of DVC or Digital Volume Correlation measurement uncertainty on glass fiber reinforced polymers with various fiber architectures. The latter plays important role in optimizing such material performance for Aerospace Engineering applications. Another paper that also studies different aspects of measurements is contributed by (Kožar, Lozzi Kožar, Toric Malić 2021), where the authors propose a simple factor analysis of measured data in order to improve the measurement results. Yet another identification problem in this part is studied in (Suljević, Ibrahimbegovic, Karavelić, Dolarević 2021), seeking to develop the most reliable estimates for concrete fracture parameters for the model that can represent full set of 3D failure modes. Needless to say, such models will be of great interest to specialists of Structural Engineering.

In their contribution (Šuvalija, Milišić, Hadžić 2021) provide some recommendation to good modeling practice of water treatment processes, which will be of interest in Hydraulic Engineering. The final contribution for this special issue by (Zaplatić, Tomičević, Čakmak, Hild 2021) proposes the most suitable approach to identify Ludwik's law parameters, depending upon the sample geometry via inverse identification procedure.

For more details, I invite the readers to carry on with their own explorations, and I wish they be very fruitful. 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 2021 with their full-size papers.

Acknowledgments

References

Balić, A., Hadžalić, E. and Dolarević, S. (2021), "Identification for the strain-dependent coefficient of permeability by combining the results of experimental and numerical oedometer tests with free lateral movement", *Couple. Syst. Mech.*, **10**(5/6), 1-15.

Bartulović, A., Tomčević, Z., Bubalo, A. and Hild, F. (2021), "Assessment of DVC measurement uncertainty on glass fiber reinforced polymers with various fiber architectures", *Couple. Syst. Mech.*, **10**(5/6), 1-19.

Grozdanović, G., Galić, M. and Marović, P. (2021), "Some aspects of the analysis of glass structures exposed to impact load", *Couple. Syst. Mech.*, **10**(5/6), 1-16.

Ibrahimbegovic, A. and Nikolić, M. (2021), "Proceedings ECCOMAS MSF 2021-Multiscale computations for solids and fluids", University of Sarajevo Press.

Kalajdžisalihović, H., Milašinović, Z. and Harapin Z. (2021), "Developing of a new weir type using the smoothed particle hydrodynamic model", *Couple. Syst. Mech.*, **10**(5/6), 1-18.

Kožar, I., Bede, N., Bogdanić, A. and Mrakovćić, S. (2021), "Data driven inverse stochastic models for fiber reinforced concrete", *Couple. Syst. Mech.*, **10**(5/6), 1-13.

Kožar, I., Lozzi Kožar, D. and Toric Malić, N. (2021), "Simple factor analysis of measured data", *Couple. Syst. Mech.*, **10**(5/6), 1-8.

Suljević, S., Ibrahimbegovic, A., Karavelić, E. and Dolarević, S. (2021), "Meso-model based deterministic approach to parameter estimation of 3D macro-scale model representing full set of failure modes", *Couple. Syst. Mech.*, **10**(5/6), 1-24.

Šuvalija, S., Milišić, H. and Hadžić, E. (2021), "Good modeling practice of water treatment processes", *Couple. Syst. Mech.*, **10**(5/6), 1-14.

Szardenings, A., Hoefer, N. and Fassbender, H. (2021), "Towards a reduced order model of battery systems: approximation of the cooling plate", *Couple. Syst. Mech.*, **10**(5/6), 1-18.

Vrgoč, A., Tomičević, Z., Smaniotto, B. and Hild, F. (2021), "Damage charcterization in fiber reinforced polymer via Digital Volume Correlation", *Couple. Syst. Mech.*, **10**(5/6), 1-19.

Zaplatić, A., Tomičević, Z., Čakmak, D. and Hild, F. (2021), "Identifiability of Ludwik's law parameters depending on the sample geometry via inverse identification procedure", *Couple. Syst. Mech.*, **10**(5/6), 1-18.