TIME TABLE

TIME	Monday	Tuesday	Wednesday	Thursday	Friday
	October 15	October 16	October 17	October 18	October 19
9.00 - 9.45	Registration	Allix	Jasak	Huerta	Wriggers
9.45 - 10.30	Wriggers	Allix	Jasak	Huerta	Wriggers
11.00 - 11.45	Wriggers	Wriggers	Allix	De Lorenzis	Düster
11.45 - 12.30	Jasak	Wriggers	Allix	De Lorenzis	Düster
14.00 - 14.45	Jasak	Allix	De Lorenzis	Düster	
14.45 - 15.30	De Lorenzis	Allix	De Lorenzis	Düster	
16.00 - 16.45	De Lorenzis	Jasak	Huerta	Huerta	
16.45 - 17.30	Düster	Jasak	Huerta	Huerta	
18.00	Welcome Aperitif				

ADMISSION AND ACCOMMODATION

The registration fee is 600.00 Euro + VAT*, where applicable (bank charges are not included). The registration fee includes a complimentary bag, four fixed menu buffet lunches (on Friday upon request), hot beverages, downloadable lecture notes and wi-fi internet access.

Applicants must apply at least one month before the beginning of the course. Application forms should be sent on-line through the following web site: http://www.cism.it. A message of confirmation will be sent to accepted participants. Applicants requiring assistance with the registration should contact the secretariat at the following email address cism@cism.it.

Applicants may cancel their course registration and receive a full refund by notifying CISM Secretariat in writing (by email to cism@cism.it) no later than two weeks prior to the start of the course.

Cancellation requests received during the two weeks prior to the start of the course will be charged a 50.00 Euro handling fee. Incorrect payments are also subject to a 50.00 Euro handling fee.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered lodging and/or board, if available, in a reasonably priced hotel or student guest house.

Requests should be sent to CISM Secretariat by **July 29, 2018** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

Information about travel and accommodation is available on the web site www.cism.it, or can be mailed upon request.

* Italian VAT is 22%.

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ACADEMIC YEAR 2018
The Boley Session

Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

MODELING IN ENGINEERING USING INNOVATIVE NUMERICAL METHODS FOR SOLIDS AND FLUIDS

Advanced School
coordinated by

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H2020-MSCA-RISE-2016
Project Nr.734370
Project Acronym: BESTOFRAC
Workshop II

Udine ***October 15 - 19*** **2018**

MODELING IN ENGINEERING USING INNOVATIVE NUMERICAL METHODS FOR SOLIDS AND FLUIDS

The development of reliable and efficient discretization methods for solids and fluids supports the modeling process in engineering and enables the understanding of complex physical phenomena. In this way the design and optimization of products and processes can be accelerated in almost all fields of engineering. Based on numerical simulations, the number of time-consuming and expensive experiments can be significantly reduced. So engineering decisions can be supported by computed data, which might be very difficult if not impossible to obtain experimentally.
The fast growing performance of available computers itself, however, is not sufficient to satisfy the increasing requirements for the simulation of complex problems arising in fluid and solid mechanics. To this end, innovative numerical methods need to be further developed in order to enable modeling of complex engineering problems. In response to the requirement for improved numerical methods, in Germany a Priority Program has been established entitled “Reliable Simulation Techniques in Solid Mechanics. Development of Non-standard Discretization Methods, Mechanical and Mathematical Analysis”.
Inspired by the above mentioned challenges and stemming from the context of this Priority Program, the present CISM course focuses on innovative numerical methods for solid and fluid mechanics in order to support the modeling process in engineering. The objective is to present new and emerging simulation methods to young scientists and engineers from academia and industry.

The topics to be focused on are
- Particle methods addressing particle-based materials and numerical methods that are based on discrete element formulations and include fluid particle interaction as well as coupling with finite element methods. These methods are of importance in natural and engineering sciences.
- Phase field models, which have become very popular to model and simulate problems with surfaces and interfaces that are described implicitly.
- Fictitious domain methods, which allow for efficient discretization of very complex problems for which meshing with finite elements is very difficult.
- High-order continuous and discontinuous Galerkin methods, which offer high convergence rates and overcome many problems related to standard finite element approaches.
- Computational Fluid Dynamics based on modern finite volume schemes to efficiently discretize the Navier-Stokes equations.
- Nonintrusive coupling methods for structural models that allow to perform model adaptive simulations based on existing well developed solvers.

The course is addressed to scientists and engineers from both academia and industry working in the broad field of civil and mechanical engineering or applied physics and mathematics. The intention is to give a sound introduction into innovative numerical methods for solids and fluids which can be used to model complex problems in engineering.

PRELIMINARY SUGGESTED READINGS

M. Ambati, T. Gerasimov, L. De Lorenzis, A review on phase-field models of brittle fracture and a new fast hybrid formulation. Computational Mechanics, 55(2): 383-405, 2015.

B. Cockburn, Discontinuous Galerkin methods for Computational Fluid Dynamics, in Encyclopedia of Computational Mechanics, Volume 3, Chapter 4, Edited by E. Stein, R. de Borst and T.J.R. Hughes, John Wiley & Sons, 2004.

A. Düster, E. Rank, B. Szabó, The p-Version of the Finite Element and Finite Cell Methods, in Encyclopedia of Computational Mechanics, 2nd Edition, Volume 2, Chapter 4, Edited by E. Stein, R. de Borst, T.J.R. Hughes, John Wiley & Sons, 2017.

L. Gendre, O. Allix, P. Gosselet, F. Comte, Non-intrusive and exact global/local techniques for structural problems with local plasticity, Computational Mechanics, 44(2):233-245, 2009.

F. Moukalled, L. Mangani, M. Darwish, The Finite Volume Method in Computational Fluid Dynamics, An Advanced Introduction with OpenFOAM® and Matlab, Springer, 2015.

R. Sevilla and A. Huerta, Tutorial on Hybridizable Discontinuous Galerkin (HDG) for second-order elliptic problems, in Advanced Finite Element Technologies, CISM International Centre for Mechanical Sciences, Vol. 566, Edited by J. Schröder and P. Wriggers, Springer International Publishing, 105-129, 2016.

P. Wriggers, Computational Contact Mechanics, 2nd ed. Springer, 2006.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from the CISM web site. Instructions will be sent to accepted participants.

INVITED LECTURERS

Laura De Lorenzis - TU Braunschweig, Germany
6 lectures on: phase-field modeling in applied sciences and engineering, phase-field modeling of brittle fracture, monolithic and staggered solution schemes, combination with structural models for plates and shells, phase-field modeling of ductile fracture and of fracture in porous media, open issues.

Alexander Düster - Hamburg University of Technology, Germany
5 lectures on: fictitious domain methods for problems of solid mechanics, high-order methods, numerical integration techniques for broken cells, local enrichment, applications in solid mechanics: numerical homogenization, wave propagation, nonlinear problems.

Olivier Allix - École normale supérieure Paris-Saclay, France
6 lectures on: non-intrusive computational techniques and application to multi-scale analysis of complex visco-plastic structures and composites, numerical acceleration techniques, mixed approaches and homogenization like approaches, plates and junction and wave propagation.

Antonio Huerta - Universitat Politècnica de Catalunya, Spain
6 lectures on: Discontinuous Galerkin (DG) methods. After an introduction on DG for first-order PDEs and a historical overview on DG methods for diffusion problems, the lectures will cover the Hybridizable Discontinuous Galerkin method (concept, accuracy and superconvergence) and its application in convection-diffusion, compressible and incompressible Navier-Stokes.

Hrvoje Jasak - University of Zagreb, Croatia
6 lectures on: Practical Computational Fluid Dynamics with the Finite Volume Method. Lectures shall include the basics of the second-order accurate Finite Volume discretisation with polyhedral cell support. Attention shall be given to numerical handling of the computational mesh, linear solver technology and solution of coupled equation sets. The course shall be accompanied with examples from industrial CFD.

Peter Wriggers - Leibniz Universität Hannover, Germany
6 lectures on: discrete element methods including contact laws for normal and tangential contact, coupling with finite element methods using standard solid and shell elements where surface and solid coupling is applied, treatment of particle fluid interactions, use of high performance computing for discrete elements, applications to different engineering and biomechanical problems.