ADMISSION

The webinar will be hosted on the Microsoft Teams platform.

The registration fee is 100.00 Euro + VAT*, where applicable (bank charges are not included).

CISM will financially support students participating in the Advanced Webinar by providing free registration to a number of PhD student and early stage researchers.

Online registration is available at https://www.cism.it/en/activities/courses/E2015

A message of confirmation will be sent to accepted participants.

The application deadline is December 3, 2020.

For further information, please visit CISM website.

* Italian VAT is 22%.

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ACADEMIC YEAR 2020

Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

ADVANCED TOPICS IN COMPUTATIONAL MECHANICS

Advanced Webinar
Coordinated by

Wolfgang A.Wall
Institute for Computational Mechanics
Technical University of Munich, Germany

December 7-9-10, 2020

ADVANCED TOPICS IN COMPUTATIONAL MECHANICS

In this webinar some advanced and highly up-to-date topics in the area of Computational Mechanics will be presented by international leading scientists in the respective fields. The spectrum of topics will cover solid mechanics, fluid mechanics, coupled problems, model reduction, inverse analysis / uncertainty quantification and the combination of machine learning and physics-based modeling. All lecturer will try to start from a basic introductory level for a generally interested audience but will also cover aspects of current scientific interest.

LECTURERS

Marek Behr
Chair for Computational Analysis of Technical Systems, RWTH Aachen University, Germany

Phaedon-Stelios Koutsourelakis
Professorship of Continuum Mechanics, Technical University of Munich, Germany

Martin Kronbichler
Institute for Computational Mechanics, Technical University of Munich, Germany

Paris Perdikaris
Department of Mechanical Engineering and Applied Mechanics, Penn Institute of Computational Science, University of Pennsylvania, Philadelphia, USA

Alexander Popp
Institute for Mathematics and Computer-Based Simulation, University of the Bundeswehr Munich, Germany

Gianluigi Rozza
SISSA, Scuola Internazionale Superiore di Studi Avanzati, Trieste, Italy

Wolfgang A. Wall
Institute for Computational Mechanics, Technical University of Munich, Germany

PROGRAMME

Session I: Martin Kronbichler

Lectures on "High-performance fluid dynamics simulations on the exascale threshold"

Topics covered: Incompressible and compressible Navier-Stokes equations and brief overview of turbulence; high-order discontinuous Galerkin methods; iterative solvers and multigrid methods; achieving high node-level performance via efficient matrix-free implementations; utilizing large-scale computers by domain decomposition; SIMD vectorization.

Session II: Gianluigi Rozza

Lectures on "Reduced order methods for CFD"

Topics covered: Reduced basis method, reduced order modelling, parametric PDEs, proper orthogonal decomposition, stability, CFD.

Session III: Alexander Popp

Lectures on "Computational contact and interface mechanics"

Topics covered: Challenges of contact problems; nonlinear contact kinematics; constraint enforcement techniques; finite element discretization schemes; introduction to mortar methods; contact and high-performance computing (HPC); interface mechanics beyond classical contact and friction.

Session IV: Marek Behr & Wolfgang A. Wall

Lectures on "Deforming domain flow simulations and fluid-structure interaction"

Topics covered: Brief overview on approaches for handling flows on deforming domains; space-time method (M. Behr);

CutFEM based fixed-grid approach; introduction to fluid-structure interaction (FSI); coupling schemes and solver for FSI; fluid-structure contact interaction (W.A. Wall).

Session V: Paris Perdikaris

Lectures on "Making neural networks physics-informed"

Topics covered: Brief overview of physics-informed neural networks; current capabilities, advantages and limitations; implementation aspects and common caveats; applications in design optimization, heat transfer, wave propagation, cardiovascular fluid mechanics, and modeling of COVID-19 spread dynamics.

Session VI: Phaedon-Stelios Koutsourelakis

Lectures on "Bayesian inverse problems and Multi-fidelity Uncertainty Quantification"

Topics covered: Brief overview of inverse problems and Bayesian formulations; Sampling- and non-sampling-based solution techniques; Black-box and grey-box approaches; Brief overview of uncertainty propagation and associated challenges; Single vs multi-fidelity techniques.

SCHEDULE

Monday, December 7

08.40 - 09.00 Welcome

09.00 - 10.30 Session I - Martin Kronbichler

11.00 - 12.30 Session I - Martin Kronbichler

14.00 - 15.30 Session II - Gianluigi Rozza

16.00 - 17.30 Session III - Alexander Popp

Wednesday, December 9

09.00 - 10.30 Session III - Alexander Popp

11.00 - 12.30 Session IV - Marek Behr & Wolfgang A. Wall

14.00 - 15.30 Session V - Paris Perdikaris

16.00 - 17.30 Session V - Paris Perdikaris

Thursday, December 10

09.00 - 10.30 Session IV - Wolfgang A. Wall

11.00 - 12.30 Session VI - Phaedon-Stelios Koutsourelakis

14.00 - 15.30 Session VI - Phaedon-Stelios Koutsourelakis

16.00 - 17.30 Session II - Gianluigi Rozza