Università degli Studi di Ferrara

IUSS - Ferrara 1391

Department of Mathematics and Computer Science

PhD School of Mathematics

Lectures on

Lagrangian numerical schemes for continuum mechanics

The behavior of a continuum is mathematically described by systems of nonlinear hyperbolic partial differential equations (PDE). Both fluids and solids are modelled by balance laws which are based on first physical principles like conservation of mass, momentum and total energy. A wide range of applications are involved in continuum mechanics, such as environmental and meteorological flows, hydrodynamic and thermodynamic problems, plasma flows as well as the dynamics of many industrial and mechanical processes, namely high energetic interactions of metals involving fluidization, melting and solidification in metallurgy, complex flows like granular flows and flows of viscoplastic fluids (yield stress fluids), which exhibit properties of both elastic solids and viscous fluids. The numerical solution of the discrete governing equations constitutes nowadays a challenging task, thus being a very active research field in the context of applied mathematics. Lagrangian algorithms, in which the computational mesh moves with the material velocity, have become very popular in the last decades due to the excellent properties achieved by these numerical methods in the resolution of moving material interfaces and contact waves. Since the computational mesh is moving with the local fluid velocity, Lagrangian methods are typically affected by much less numerical dissipation compared to classical Eulerian approaches on fixed grids, hence obtaining a more accurate approximation of the solution.
This series of lectures aims at introducing the governing equations for continuum mechanics and at providing an overview of the state-of-the-art numerical methods for the numerical solution of the PDE in the Lagrangian framework.

Date

1st – 3rd December 2020.

Venue

Online seminar on Google Meet platform.

Registration and contacts

Please register by email to walter.boscheri@unife.it before 15th November 2020.

Note

PhD students will be granted 1 CFU for attending the entire series of lectures.

Program

1st December, 9:00 – 11:00 am

Governing equations and models for continuum mechanics **Ilya Peshkov**

2nd December, 9:00 – 11:00 am

Lagrangian and ALE numerical methods. **Raphaël Loubère**

3rd December, 9:00 – 11:00 am

ALE and structure-preserving numerical schemes for fluids and solids. **Walter Boscheri**

Lecturers

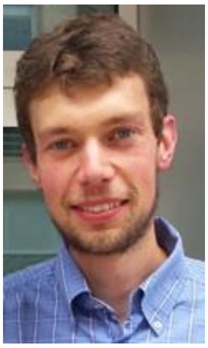
Ilya Peshkov

Ilya Peshkov is a representative of the Russian school on hyperbolic partial differential equations lead by Prof. Godunov. He was graduated from the Novosibirsk State University (Russia). His PhD study was dedicated to computational methods in solid mechanics. After that, he went through several postdoctoral research positions at Ecole Polytechnique de Montreal (Canada), Aix-Marseille University (France), Paul Sabatier University (France), and now he got a tenure track Associate Professor position at the University of Trento. His research is dedicated to the development of continuum mechanics models and computational methods for complex phenomena in fluids and solids.

Raphaël Loubère

Raphaël Loubère is a senior researcher from CNRS (Centre National de Recherche Scientifique) in the Mathematical Institute in Bordeaux, France. He has spent ten year as a researcher in Toulouse University, France and three years at the Los Alamos National Laboratory, New-Mexico, U.S.A. His expertise covers mainly the high performing numerical methods and techniques dedicated to the numerical simulation of fluid flows in Lagrangian reference.

Walter Boscheri



Walter Boscheri is tenure track Associate Professor at the University of Ferrara. His PhD proposed a novel class of Arbitrary-Lagrangian-Eulerian space-time high order numerical methods on moving unstructured meshes in multiple space dimensions. His research activity was partially carried out in Toulouse (France) and South Bend (IN – USA). He is currently active in the development of new numerical schemes for the solution of low Mach flows, solid mechanics in Lagrangian form and the design of compatible schemes for the preservation of involution constraints.