

ADVANCES IN HIGH-ORDER METHODS FOR HYPERBOLIC PDES

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ABSTRACT

Hyperbolic PDEs govern a wide range of models in geophysics and continuum mechanics, from shallow water flows to compressible gas dynamics, multiphase flows, and elasticity. Their numerical solution requires high-order schemes that remain robust in the presence of shocks, moving interfaces, and stiff source terms, while preserving, at the discrete level, the structural properties of the continuous models, such as entropy inequalities, positivity of some variables, etc. This minisymposium brings together recent developments on discontinuous Galerkin, finite volume, and finite element methods addressing these issues, including entropy-stable and invariant-domain-preserving discretizations, well-balanced schemes, all-Mach formulations, subcell finite volume techniques, shock capturing on fixed and moving meshes, and efficient implicit and semi-implicit time integration. The applications considered range from shallow-water, landslide, and thin-film models, to multiphase systems and hyperbolic reformulations of continuum mechanics. The contributions span the entire spectrum, from the construction and analysis of the schemes to their implementation and validation through demanding benchmarks.

SPEAKERS

1. Saray Busto (Universidade de Santiago de Compostela, Spain): High order semi-implicit hybrid methods for continuum mechanics.
2. Enrique Fernández Nieto (Universidad de Sevilla, Spain): Explicit and semi-implicit high-order well-balanced finite volume solvers for the Saint-Venant–Exner model: limitations of well-balanced methods for shallow water equations.

3. Peter Frolkovich (Slovak University of Technology, Slovakia): Efficient solvers for high order implicit schemes to solve some hyperbolic systems.
4. Maria Kazolea (Center Inria of the University of Bordeaux, France): Subcell finite volume techniques for wet/dry fronts in DG schemes.
5. Alessia Lucca (Università di Trento, Italy): A high-order scheme for a first-order hyperbolic reformulation of Cahn-Hilliard Navier-Stokes equations.
6. Philipp Öffner (Technische Universität Clausthal, Germany): Balancing structure and efficiency: high-order entropy-conservative (dissipative) DG methods for thin-film flows.
7. Hendrik Ranocha (Johannes Gutenberg University Mainz, Germany): Structure-preserving methods for hyperbolic dispersive shallow-water flows.
8. Laura Río-Martín (Center Inria of the University of Bordeaux, France): High-order ADER Discontinuous Galerkin schemes for a symmetric hyperbolic model for compressible multi-phase flows in poroelastic media.
9. Laura Saavedra (Universidade de Santiago de Compostela, Spain): High-order invariant domain preserving ALE finite element methods for hyperbolic equations.
10. Ana Schwarz (University of Stuttgart, Germany): Entropy stable shock capturing for high-order DG on moving meshes.
11. Matteo Semplice (Università degli Studi dell'Insubria, Italy): A high order finite-volume low-Mach based on QUINPI.
12. Davide Torlo (Università di Roma La Sapienza, Italy): Global Flux finite element methods for multidimensional equilibria preservation: a bridge between Raviart-Thomas and Q^k elements.
13. Andrew Winters (Linköping University, Sweden): Entropy stable discontinuous Galerkin methods applied to landslide models.
14. David Zorio (Universitat de València, Spain): Implementation of numerical boundary conditions in finite-difference schemes for hyperbolic conservation laws.