Advanced and physically oriented numerical methods for continuum mechanics simulations

Organizers:

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Numerical simulation is widely recognised as the third cornerstone of scientific investigation, being nowadays on the same ground of theory and experiments for the investigation of a wide class of physical phenomena. However, the need to study complex multiphysics and multiscale problems, especially in non academic configurations, continues to challenge the numerical community and to push research toward the development of numerical approaches suited for the problem at hand. Numerical methods used in the simulation of modern complex phenomena in continuum mechanics, and more in general in applied physics, are often developed by physicists or engineers. It is so because in many complex problems the physical traits of the phenomenon dictates the numerical approach to be used. In this situation, the emphasis on the quality of a numerical procedure has gradually moved from purely mathematical notions of formal asymptotic accuracy to robustness and consistency with the physical character of the solutions. These considerations recently led to the development of the so called physics-compatible numerical methods, which are methods designed to preserve key physical properties of the continuum formulation in the discrete algebraic representation. Among these methods are the so called mimetic finite difference methods and all the numerical approaches which preserve, on the discrete level, symmetries, invariants, monotonicity or maximum principle of the physical model. Also related to this class of methods are all the approaches which are constructed to model the interaction between different physical entities in complex multiphysics problems. This minisymposium aims to gather together all the researchers working on the development of physically oriented numerical methods for the simulation of complex physical phenomena, in both fluid and structure continuum mechanics, and is open also to the applications of these methods to engineering problems. The physics-compatible character of the numerical approaches is extended to all the modelling efforts devoted to the simulation of complex coupled problems, routinely occurring in modern engineering applications.
Topics of the minisymposium include, but are not limited to:

- feature preserving numerical algorithms (i.e. methods preserving energy or other invariants, symmetries or extrema principles of the continuum model)
- physics-compatible techniques in finite-element and discontinuous Galerkin methods
- structure preserving and geometric integrators
- modeling of coupling effects in multiphysics simulations in fluid and solid mechanics
- conservative methods for moving grids and fluid-structure interaction problems
- assessment and validation of physics compatible discretizations in engineering problems