XII International Conference on Coupled Problems in Science and Engineering, COUPLED 2027
June 27-30, 2027, Palma de Mallorca, Spain

MIXED-DIMENSIONAL MODELING: DISCRETIZATIONS, SOLVERS AND MULTI-PHYSICS APPLICATIONS

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ABSTRACT

Multi-physics systems often involve the solution of coupled partial differential equations (PDEs) defined across domains with different topological dimensions. This scenario is common in various fields, among them geology, biomedicine, cell biology, fracture mechanics, material modeling, or fluid-structure interaction to only name a few. Mixed-dimensional modeling addresses these challenges by simultaneously solving PDEs of varying dimensionality. With its many applications and recent progress in modeling and the analysis of the underlying PDEs, mixed-dimensional modeling has recently become a lively field of research with its own identity.

The differences in dimensionality across the coupled PDEs introduce unique challenges throughout the simulation process: During the modeling phase, suitable coupling conditions must be established to bridge the dimensionality gap. In the discretization phase, careful consideration is required to ensure accuracy and stability, particularly in the imposition of coupling conditions. Furthermore, the resulting systems of equations need to be solved both accurately and efficiently.

This minisymposium is dedicated to all aspects of mixed-dimensional modeling of multi-physics systems. Topics of interest range from modeling aspects, mathematical analysis, innovative discretization approaches, computer implementation, as well as efficient solvers and preconditioners. It will offer a forum to showcase challenging applications of mixed-dimensional models in science, engineering and biomedicine. The minisymposium is aiming to attract scientists form a broad range of scientific communities who are currently using mixed-dimensional PDE models for their research to foster discussions and share insights and ideas.