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MATHEMATICAL AND COMPUTATIONAL ASPECTS OF MIXED-DIMENSIONAL COUPLING PROBLEMS

4000 - Computational Applied Mathematics

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ABSTRACT

Mixed-dimensional partial differential equations (PDEs) couple unknown fields defined over domains of differing topological dimension. Such systems typically arise when the domains are characterized by large aspect ratios. Examples include fractures in subsurface, flow through root systems and flow through the vascularized tissue of biological systems. Mixed-dimensional models can also be used to impose non-standard coupling conditions through the use of Lagrange multipliers defined over lower-dimensional domains.

The use of mixed-dimensional PDEs requires careful mathematical analysis in order to formulate suitable numerical methods. The resulting discretization usually involves nested meshes of heterogeneous topological dimension. The assembly of such systems is non-standard and non-trivial especially with regard to the terms involved in the interactions between the different domains.

Our minisymposium aims to address state-of-the-art discretization methods and numerical schemes for mixed-dimensional PDEs, together with dedicated computational frameworks and solvers. Contributions on applications such as (but not limited to) geology, bio-medicine and fracture mechanics are also appreciated. In this regard, we particularly welcome applied cases showing the importance of these methods with respect to the problem definition, the feasibility of the assembly, or the computational requirements.