EFFICIENT AND SCALABLE METHODS FOR MULTISCALE AND MULTIPHYSICS PROBLEMS

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ABSTRACT

Many physical systems involve interactions across different scales in space and time, often due to complex microstructures that influence larger-scale behaviors. For instance, biological tissues are made up of millions of cells but are often studied as a whole, requiring careful attention to differences in both space and time scales.

This Invited Session focuses on recent developments on efficient numerical methods, solvers, and software to tackle these complex systems. The goal is to gather researchers working on creating tools that can run effectively on modern high-performance computing (HPC) systems. These tools must be able to handle the challenges posed by multiscale and multiphysics problems, making use of the latest HPC architectures.

A key and common point should include not just efficiency in terms of speed, but also in energy consumption. As computing becomes more central to solving these large-scale problems, it is important that the methods developed are also energy-efficient. By optimizing the usage of the computational resources, we can reduce the energy required, which is crucial for promoting sustainable practices in scientific computing.

The Session will explore practical strategies for achieving this, such as using parallel computing, adaptive algorithms, efficient scalable preconditioners etc. These approaches will help ensure that we can accurately and efficiently simulate systems that vary widely in scale, while also minimizing the environmental impact of the computations.

In this Session we hope to foster the dialogue among communities using different tools for the mathematical modeling of multiphysics and multiscale phenomena, such as cardiovascular biomechanics, fracture mechanics and poroelasticity.