

Hybrid Schwarz-Based Coupling: A Plug-and-Play Framework for Integrating Model Reduction with High-Fidelity Simulation

I. Tezaur (Sandia National Laboratories)

The Schwarz alternating method (SAM) provides a flexible and minimally intrusive framework for coupling models defined on different subdomains. After briefly reviewing our initial work on coupling high-fidelity models full order models (FOMs) in solid mechanics within the production-scale SIERRA/SM solid mechanics code, I will focus on our recent efforts to extend this framework to incorporate reduced-order and data-driven models. I will survey hybrid couplings involving intrusive projection-based ROMs, non-intrusive polynomial Operator Inference (OpInf) ROMs, structure-preserving neural-network OpInf (NN-OpInf) ROMs, kernel ROMs, and Numerics-Informed Neural Networks (NINNs), coupled with each other and/or with conventional high-fidelity models. Numerical examples will illustrate the flexibility, robustness, and computational benefits of this approach. I will conclude by discussing some of our more recent work on accelerating Schwarz convergence, and enabling adaptive, on-the-fly switching between reduced and high-fidelity models during a numerical simulation.