Toward less synchronous composable multilevel methods for implicit multiphysics simulation

Jed Brown, Argonne National Laboratory

Software for multiphysics simulation requires balancing often conflicting objectives of software modularity, algorithmic flexibility, and high performance. For strongly coupled physical processes, an robust algorithmic methodology is obtained by composing multilevel methods with physics-based block preconditioners (e.g. multigrid inside splits or splitting as multigrid smoothers). We discuss how a diverse class of such methods can be constructed without compromising software modularity, using tools developed in PETSc. We highlight excessively synchronous components of the current approach and investigate the impact on algorithmic flexibility and software modularity imposed by remedies for these synchronization points.