1077-35-2309 **Lois Curfman McInnes*** (curfman@mcs.anl.gov), Mathematics and Computer Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439. *Nonlinear Solvers in Large-Scale Computational Science: Challenges and Opportunities.*

Parallel implicit solution strategies have proven robust and efficient in resolving challenging nonlinearities in many large-scale PDE-based simulations. We discuss the use of preconditioned Newton-Krylov methods in the PETSc library for parallel applications in coupled core-edge plasma and multiphase reactive flow, and we introduce new work on capabilities for the solution of differential variational inequalities as motivated by heterogeneous materials modeling. We also discuss challenges and opportunities in developing robust, scalable, and extensible algorithms and software to support multimodel and multiphysics simulations on emerging high-performance architectures. (Received September 22, 2011)