Multimethod approaches in time integration

Adrian Sandu
(Virginia Tech)

Computer simulations of evolutionary multiscale multiphysics partial differential equations are important in many areas of science and engineering. Algorithms for time integration of these systems face important challenges. Multiscale problems have components evolving at different rates. No single time step can solve all components efficiently (e.g., when an explicit discretization is used, and the spatial discretization uses both fine and coarse mesh patches). Multiphysics problems are driven by multiple simultaneous processes with different dynamic characteristics. No single time discretization method is best suited to solve all processes (e.g., when some are stiff and others non-stiff).

In order to address these challenges, multimethods have been proposed. Multimethods are time integration approaches that use different solution strategies for different subsystems have been developed. For example, different processes are discretized with different numerical schemes, and different components of the system are solved with different time steps. We discuss several general aspects of mutimethods for the integration for multiphysics systems, as well as new developments in the field.