

Multirate schemes for time integration of multiscale systems: an overview

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, multirate methods have been proposed. Multirate schemes apply different time steps to different components of the system. We discuss several general aspects of multirate methods for the integration of multiscale systems.