Bobby Philip

3D Structured Adaptive Mesh Refinement and Multilevel Preconditioning for Non-Equilibrium Radiation Diffusion

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This talk will describe a highly efficient solution method for the coupled nonlinear time dependent non-equilibrium radiation diffusion equations combining fully implicit time integration schemes with 3D adaptive mesh refinement (AMR). This coupled system of nonlinear equations exhibits multiple temporal and spatial scales rendering it a stiff coupled system to solve. In the literature, previous work has described solution methods for the non-equilibrium radiation diffusion equations that combine implicit time integration with preconditioned Jacobian free Newton-Krylov (JFNK) methods for the nonlinear solves at each timestep on uniform as well as unstructured grids. Typically a multigrid preconditioner was used for the Krylov methods. In this paper, we advance the state of the art by combining the efficiency obtained with respect to time integration in the previous methods with efficiency in space by introducing 3D block structured adaptive mesh refinement and preconditioning using the multilevel Fast Adaptive Composite Grid (FAC) method. In addition, progress permitting we will compare the performance of FAC with asynchronous variants such as AFAC and AFACx in the context of preconditioning Krylov methods.