Application of Discontinuous Galerkin Adaptive Mesh and Order Refinement Method to Energy Transport and Conservation Equation in Radiationhydrodynamics

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ABSTRACT

In the field of laser generated high energy density physics, hydrodynamics is a very popular approach to describe the created plasma. In the present work, we treat the energy conservation equation of the radiationhydrodynamic model [1]. Particularly, we aim to simulate spatial-time evolution of a coupled system of plasma temperature and radiation field which is provoked by absorption of intense laser energy. According to [2], we are challenging a specific behaviour which exhibits the radiation transport, i.e. Free-stream propagation in transparent plasma regions, diffusion in high density plasma regions and non-local transport everywhere else. We have extended the efficient adaptive mesh refinement (AMR) algorithm [3] based on BoxLib library by adding the discontinuous Galerkin (DG) order refinement capability. The resulting 2D adaptive mesh and order refinement (AMOR) method satisfies all of the latter specific plasma conditions. This extension is based on high order spatial discretization MFEM library and assures a precise calculation of radiation transport even in the diffusive plasma region inspite of the advection transport model used. Summing up, we merged the high order DG finite element method with the computationaly efficient AMR parallel scheme to obtain an implicit, local, stable, and conservative method to solve the radiation-hydrodynamic energy conservation equation. The laser generated plasma physics can be found in Inertial Confinement Fusion systems, that is where our method aims to participate in complex plasma behavior simulations [4].

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