Serious Numerics for Serious Physics: Nonlocal Transport Hydrodynamic Model on Curvilinear Meshes

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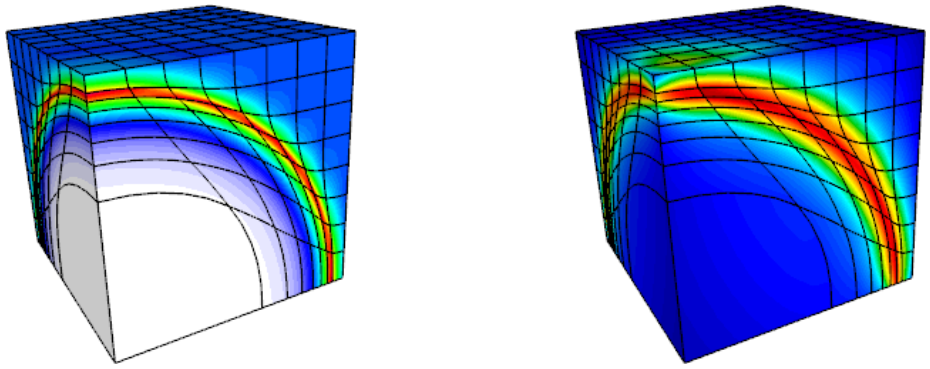
ABSTRACT

A novel high-order method for solving the Bhatnagar-Gross-Krook form of the Boltzmann transport equation is presented [1]. Consequently, the classical diffusive transport closure to the Euler equations in a moving Lagrangian frame can be generalized to the nonlocal regime. Our approach presents a phase-space (including photon and electron momentum) extension of the general high-order curvilinear finite element approach for solving Lagrangian hydrodynamics [2]. We discretize the transported quantity in space and momentum using a discontinuous Galerkin high-order basis of arbitrary polynomial degree defined on a curvilinear mesh via a corresponding high-order parametric mapping from a standard reference element. Even though extra dimensions of momentum need to be discretized, the computational cost remains comparable with usual diffusion transport methods. By the means of hydrodynamic simulations, the effect of nonlocal transport is investigated for high-power laser interactions with matter [3].



LAGHOS NTH

Figure 1: Left: LAGHOS - curvilinear mesh of Sedov problem. Right: Nonlocal Transport Hydrodynamics (NTH) - high-order radiation energy density computed on the curvilinear mesh.

References

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