A Hybrid Deterministic-Monte Carlo Thermal Radiative Transfer Solver with High-Order, Low-Order Method.

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Accurate modeling of neutral particle transport behavior is of great importance in many science and engineering applications. Many numerical transport algorithms suffer from slow convergence in optically thick regions, where a particle undergoes a large number of scattering and/or absorption-emission events. Recently, we have developed a moment-based, scale-bridging algorithm (or High-Order, Low-Order, HOLO) for solving thermal radiative transfer equations. This algorithm accelerates convergence of stiff physics (e.g., absorption-emission) by utilizing the phase-space integrated low-order (LO), continuum system without introducing (traditional) linearization of stiff nonlinear term. Traditional linearization not only introduces an additional error, but also imposes a time-step restriction.
A novel feature of our algorithm is a "discretely consistency" between original transport equation and the corresponding LO system. Furthermore, the resulting LO system can be solved efficiently via preconditioned Jacobian-free Newton-Krylov method.

In this talk, we will discuss our recent progress in the HOLO algorithm, Our talk will focus on hybrid deterministic-Monte Carlo methods and extension to more complex multi physics problems, (e.g., radiation-hydrodynamics, 3-Temperature TRT).