MATHEMATICS DEPARTMENT SEMINAR

Numerical Analysis of Spherical Harmonic Discontinuous Galerkin Methods for Scaled Radiative Transfer Equations with Isotropic Scattering

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2:10 PM TO 3:00 PM

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Science III, Room 240

Abstract

Spherical-harmonics (P_N) discontinuous Galerkin (DG) discretizations for the scaled radiative transfer equation (RTE) are attractive because they are asymptotic-preserving (AP): they capture the diffusion limit at the discrete level without excessive mesh or polynomial refinement. In this talk, we present an error analysis of the P_N–DG method for the scaled RTE and show that, under mild additional assumptions, the discrete solutions converge uniformly in the scaling parameter ε to the solution of the scaled RTE. The analysis further reveals that uniform convergence is retained when the DG spatial discretization employs non-constant basis functions only for the zeroth spherical-harmonic moment (the scalar flux), while using piecewise-constant elements for all higher moments. Guided by this insight, we introduce heterogeneous/hybrid P_N–DG schemes that preserve both the AP property and the convergence rate, while substantially reducing the number of degrees of freedom.

STUDENTS ARE WELCOME!