AN UPWIND HYBRIDIZED DISCONTINUOUS GALERKIN FRAMEWORK: THEORY, ALGORITHMS, AND APPLICATIONS

Tan Bui-Thanh
Department of Aerospace Engineering and Engineering Mechanics
Institute for Computational Engineering and Sciences
The University of Texas at Austin

We will present several new developments on the emerging *Hybridized Discontinuous Galerkin* (HDG) method. First, starting either from the Godunov upwind idea or from the Rankine-Hugoniot condition we derive a unified HDG framework for linear *PDEs* that allows one to uncover new HDG methods and recover most of the existing ones for a large class of PDE including the Friedrichs' systems. Analysis and numerical results for the unified framework will be presented. Second, we will present an *IMEX* scheme for the HDG method that: 1) facilitates high-order solutions both in time and space; 2) avoids overly small time-step sizes; 3) requires only one linear system solve per time stage. Third, we will present our recent developments on multilevel and multigrid as scalable solvers and preconditioners for HDG trace systems. Various numerical results in atmospheric flows and magnetohydrodynamics will be presented to validate the developments.