Title: New Asymptotic Preserving Methods Based on Active Flux Central-Upwind Schemes

Abstract:

This talk is a continuation of Alina Chertock's presentation, where she introduces novel semi-discrete finite-volume active flux central-upwind (AF-CU) schemes for hyperbolic systems of conservation laws. Here, I will focus on the extension of these methods to stiff hyperbolic systems that model flows in nearly incompressible regimes characterized by small Mach or Froude numbers. Specifically, I will demonstrate how a simple and effective flux splitting can be constructed for the nonconservative system formulated in terms of primitive variables. This splitting is then used to develop asymptotic preserving (AP) implicit-explicit (IMEX) schemes for the nonconservative system. The resulting schemes exhibit high accuracy in the low Mach/Froude regime, where conservation is less critical due to the negligible strength of shock waves. In addition, we introduce a special post-processing procedure used to construct an all-Mach/Froude AF-CU scheme. This procedure reduces the contribution of the non-AP conservative solution when the Mach or Froude number is small and, conversely, diminishes the influence of the nonconservative solution in regimes where shock waves must be accurately resolved.

I will illustrate the performance of the proposed AP method examples involving the full Euler equations of gas dynamics and the thermally coupled rotating shallow water equations.

This is a joint work with Alina Chertock (NC State University, USA), Smadar Karni (University of Michigan, USA), Lorenzo Micalizzi (NC State University, USA), and Nan Zhang (SUSTech, China).