

Title: Space-Time Spectral Methods for PDEs on Irregular Domains

Abstract: One major drawback of classical spectral methods is their inability to handle irregularly shaped domains. There have been many attempts to adapt classical spectral methods for elliptic PDEs on domains with an irregular geometry, but far fewer studies have focused on time-dependent PDEs. Here, we propose a space-time spectral collocation scheme to solve time-dependent PDEs on irregular domains. The main idea is to embed the irregular domain in a regular one, and extend the data from the physical domain to the larger regular domain. We employ a one-dimensional non-periodic extension of the data by modifying Huybrechs' method, which was originally developed for periodic extensions. For 2D domains, a new method "Alternating Non-periodic Extension" is proposed. Numerical results for the 2D Poisson, heat, wave, Allen Cahn, nonlinear Schroedinger, unsteady Stokes and Navier-Stokes equations demonstrate full space-time spectral convergence. This is joint work with Chandramali P. Willegoda Liyanage.