

Numerical PDE I

Prerequisite: MTH 852 recommended

Basic concepts of partial differential equations; differential equations for physics, fluid dynamics, solid mechanical, electromagnetics, image processing and data mining. Introduction to numerical methods; stability, convergence, conservation, consistence. Review of linear equation system; solution of matrix, direct methods, iterative methods, ADI methods, Runge Kutta, preconditions, Bi-conjugate gradient, multigrid. Spatial discretizations; methods of weighted residual, Galerkin, collocation, finite difference methods, finite volume methods, finite element methods, wavelet methods; grid generations. Methods for temporal discretizations.

Numerical PDE II

Prerequisite: Numerical PDE I

Discontinuous Galerkin. Collocation methods. Tau methods. Wavelet methods; orthogonal and bi-orthogonal wavelets, frames. Spectral methods; Fourier spectral methods, Chebyshev methods. Ritz methods; variation formulations. Sobolev spaces. Elementary distributions. Application to computational fluid dynamics; Navier-Stokes equations, incompressible flow, compressible flow, turbulent flow, shock-capturing. Application to computational electromagnetics; waveguide, electromagnetic potential, wave propagation in homogeneous and inhomogeneous media. Application to structural analysis; vibration, bending and buckling of beam, plate, and shell.