Math 60790: Spring 2008

Numerical Analysis II (Numerical PDEs)

Instructor: Yongtao Zhang

Email: yzhang10@nd.edu

Textbook

1. Computational Differential Equations, by K. Eriksson, D. Estep, P. Hansbo and C. Johnson, Cambridge University Press, ISBN: 0-521-56738-6, 1996.

Course Description

This is an introduction course for graduate students to learn fundamental concepts, theory and techniques in numerical solution of partial differential equations. Both finite difference and finite element methods are covered in this course.

Topics

1. **Finite Difference Methods (FDM)**
   - Grid-functions and Difference operators
   - Well-Posed Problems
   - Stability and Convergence for FDM
   - Finite Difference schemes for hyperbolic PDEs
   - Finite Difference schemes for parabolic PDEs
   - Finite Difference schemes for problems with discontinuous solutions
   - High order FDM
2. **Finite Element Methods (FEM)**
   - Galerkin's Method, Finite Element Spaces
   - FEM for two-point boundary value problems
   - FEM for elliptic PDEs
   - Review of direct and iterative methods for solving linear systems
   - FEM for parabolic PDEs
   - FEM for hyperbolic PDEs
   - The Discontinuous Galerkin FEM

Prerequisites: a programming language (Fortran or C or C++ or matlab, etc.)

References

[1] B. Gustafsson, H.-O. Kreiss and J. Oliger, Time dependent problems and difference methods, John Wiley & Sons, Inc, 1995.

[2] J. C. Strikwerda, Finite Difference Schemes and Partial Differential Equations, SIAM, 2004.