AMSC 612 — Spring 2007

NUMERICAL METHODS FOR PDE

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Tu Th 11-12:15

Objectives

This course covers the basic theory of finite difference methods and variational methods (finite element and spectral methods) for elliptic, parabolic, and hyperbolic partial differential equations (PDE). Each topic will start with a review of the corresponding PDE class. The course will also discuss theory and numerical methods for nonlinear conservation laws.

Prerequisites

Some basic knowledge of PDE and elementary numerical analysis is recommended. The required PDE theory will be reviewed. No previous exposure to Matlab is necessary.

Textbook

[1] Stig Larsson and Vidar Thomée, *Partial Differential Equations with Numerical Methods*, Springer (2003), ISBN 3-540-01772-0

Other Textbooks

[2] R.J. LeVeque, *Numerical Methods for Conservation Laws*, Birkhäuser (1992), ISBN 0-8176-2723-5.

[3] Dietmar Kröner, *Numerical Schemes for Conservation Laws*, Wiley (1997), ISBN Wiley 0-471-96793-9.

[4] Alfio Quarteroni and Alberto Valli, *Numerical Approximation of Partial Differential Equations*, Springer (1994), ISBN 3-540-57111-6.

[5] J.C. Strikwerda, *Finite Difference Schemes and Partial Differential Equations*, Wadsworth (1989), ISBN 0-534-09984-X.

[6] Lloyd N. Trefethen, *Spectral Methods in* Matlab, SIAM (2000), ISBN 0-89871-465-6.

Syllabus

1. Elliptic PDE: The Laplace equation.
2. Initial value problems for ordinary differential equations (ODE).
3. Parabolic PDE: the heat equation.
4. Hyperbolic PDE: the wave equation.
5. Nonlinear conservation laws.

Evaluation

Homeworks, both theoretical and computational (using MATLAB), with a ratio of about 75/25%.