

Math 597

Multilevel and Adaptive Methods for Partial Differential Equations

(topical course, Fall 2010)

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This is a graduate topic course on modern numerical techniques for partial differential equations. An integrated study will be given for a large class of linear and nonlinear partial differential equations, involving: discretization, grid adaptation, algebraic solver and parallel implementation. In particular, a class of mathematically optimal and practically user-friendly numerical methods will be presented for several applications.

Topics include:

- Geometric and algebraic multigrid methods
- Fast auxiliary space preconditioning methods
- Differential forms, Lie derivatives and their discretizations
- Eulerian-Lagrangian methods
- Adaptive finite element methods
- Navier-Stokes equations
- Complex fluids models
- Maxwell equations and MHD
- Porous media flows

Knowledge of basic numerical analysis (Math 451) and partial differential equations (Math 412) are required in order to take this course. Some knowledge of functional analysis, differential geometry and finite element methods will be helpful but is not required.