AMSC 612 — Fall 2008

NUMERICAL METHODS FOR PDE

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Tu Th 2-3:15, MTH 1313 (Office Hours: Mo 2-3 and We 5-6)

Objectives

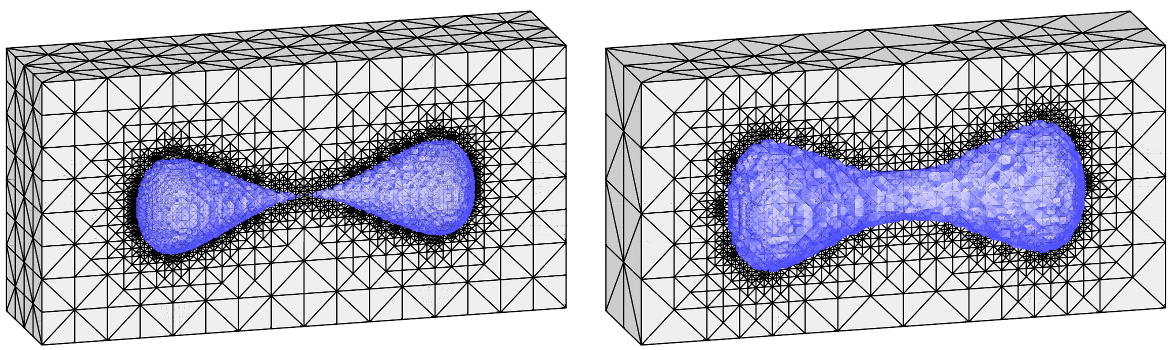
This course covers the basic theory of finite difference methods and variational (finite element) methods for elliptic, parabolic, and hyperbolic partial differential equations (PDE). Each topic will start with a review of the corresponding PDE class. If time permits, the course will also discuss theory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



3D elliptic obstacle problem computed with an adaptive finite element method with piecewise linear elements and forcing functions $f = -2, -10$. The pictures display both the interfaces and adaptive grids through a topological change that occurs while changing f.

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%. The Final Exam on Thursday, Dec 18, will consist of an individual chat of about 15 minutes about the homework.