Computational methods for PDEs

Prerequisites

- Courses: basic courses in numerical analysis, ordinary differential equations, partial differential equations. Most of the needed topics are covered in the appendix of the textbook.

- Matlab: Matlab will be used extensively in the class, both for the examples discussed during the lectures, and for the final project. The class webpage will contain links to online Matlab tutorials; it is strongly recommended that students with no previous Matlab experience follow those tutorials before the start of the class.

Course description

The focus will be on finite difference methods for time-dependent problems. The course will cover numerical methods for ordinary differential equations (consistency, convergence, stability, ...) and numerical methods for time-dependent partial differential equations (hyperbolic and parabolic equations, explicit and implicit methods, stability, convergence, introduction to level-set methods for Hamilton-Jacobi equations). I will follow mostly part II (chap. 5-11) of the book, with additional notes for the level-set methods. There will be a very strong emphasis on linking the numerical analysis theory with the practical implementation of the methods and the analysis of the results, through examples, exercises and projects.

Required text

Finite Difference Methods for Ordinary and Partial Differential Equations: Steady-State and Time-Dependent Problems, by Randall J. LeVeque

Remark: copies of the texts for all courses will be available through the library. However, students may well want to purchase their own copies for convenience.

Evaluation

3 quizzes (10% each). Final project (50% written report, 20% oral presentation).