Syllabus: Numerical methods for partial differential equations II

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In this lecture we will continue to investigate a number of partial differential equations (PDEs) that are important in applications. Special emphasize is also devoted to the iterative solution of linear systems and aspects of scientific computing. A more detailed outline of the lecture and the methods covered can be found below.

02.03 Iterative methods for linear systems (Jacobi and Gauss-Seidel methods, block Jacobi method, Successive over-relaxation, analysis of convergence for Poisson's equation, preconditioning)

03.03 Iterative methods for linear systems (Krylov subspace methods, conjugate gradient, GMRES, convergence analysis)

09.03 Tutorial

10.03 Tutorial

16.03 no lecture

17.03 no lecture

23.03 Scientific computing (UNIX and the shell, C++)

24.03 Tutorial (C++, in a computer room)

13.04 KdV equation (dispersive equations, third order CFL condition, tailored numerical schemes)

14.04 Assignment of projects

20.04 Scientific computing (advanced topics in C++, performance considerations, parallel programming on distributed memory systems)

21.04 Scientific computing (MPI)

27.04 Tutorial (MPI, in a computer room)

28.04 Tutorial (who can write the fastest iterative Poisson solver)

04.05 Linear elasticity (motivation, the constitutive laws, analytic solutions, Euler and Lagrange formulation)

05.05 Linear elasticity (finite element approximation, quasi-static approximation)

11.05 Euler equations (conservation laws, Riemann solvers, limiters, second order methods)

12.05 Tutorial

18.05 Iterative methods for linear systems (multigrid methods for Poisson's equation on a square)

19.05 Tutorial

25.05 Public holiday

26.05 Iterative methods for linear systems (domain decomposition)

01.06 Molecular dynamics (Lennard-Jones potential, stiffness of ordinary differential equations, velocity-verlet, long time energy conservation)

02.06 Molecular dynamics (exponential integrators)

08.06 Schrödinger equation (ground state vs boundary conditions, Variational principle, Hartree–Fock methods)

09.06 Schrödinger equation (density functional theory)

15.06 Stokes equation (motivation, discontinuous Galerkin method)

16.06 Tutorial

22.06 no lecture

29.06 Project presentations (14:00)