Course information

September 6, 2021

Course period. 29 September 2021 to 20 October 2021.

Lectures. Days and times: Mondays (13:15-15:00) and Wednesdays (8:15-10:00), precise schedule on the webpage for the course.

The course will be given over zoom (clickable link), password: 31415.

Possibility to give the presentation on campus if desired. Room: MVL:14.

Webpage for the course. http://www.math.chalmers.se/~cohend/ (and click on "Teaching (Chalmers)" in the menu).

Information.

In order to get 7.5 credit points, each participant must

1. present at least one paper from the list below (or another one in agreement with the teacher),
2. prepare a short written report/summary (1 – 2 pages) for the other participants, where the authors, the results and the main ideas of the paper are presented. This should be sent out ca. ±3 days around the date of the presentations,
3. be active in participating in all presentations and have briefly read the presented paper before the presentation.

The presentations are ca. 30 minutes long and will be followed by discussions. Each student will be guided by at least one teacher and feedbacks (from teachers and students, see the given questionnaire) will be provided.

Some useful links:

- MacTutor History of Mathematics
- Mathscinet (to download the papers for instance, use vpn)
- Need to know
- How to give presentations I, How to give presentations II, How to give presentations III
- LaTeX beamer I, LaTeX beamer II
- Presenting papers by AMS
- How to give a good 20 minutes math talk by William T. Ross
- How to communicate mathematics in 6 easy steps by Chris Tisdell
- 10 tips for academic talks by Matt Might
- How to talk mathematics by P.R. Halmos
- How to write a paper by Arieh Iserles

Possible papers. Possible examples of papers are (no prefered order)

- J. W. Cooley, J. W. Tukey, *An algorithm for the machine calculation of complex Fourier series*. This paper presents the idea of the fast Fourier transform (FFT). From wikipedia: ”Fast Fourier transforms have been described as the most important numerical algorithm[s] of our lifetime” It is a short and relatively easy to read paper.
- J. Crank, P. Nicolson, *A practical method for the numerical evaluation of solutions of partial differential equations of the heat-conduction type*. This paper introduces and analyses one of the first finite difference method for parabolic PDEs.
- N. Metropolis, S. Ulam, *The Monte Carlo method*. This is the first time that one uses a probabilistic approach to solve deterministic problems. Applications are in all sciences (computational biology, engineering, finance, physical sciences, etc.).
- E. Hairer, C. Lubich, G. Wanner, *Geometric numerical integration illustrated by the Störmer/Verlet method*. This paper gives a nice summary of the state of the art numerical methods for ODEs.
- C. De Boor, *On calculating with B-splines*. This is the first paper on splines and its uses in car design.
- Y. Saad, M. H. Schultz, *GMRES: A generalized minimal residual algorithm for solving nonsymmetric linear systems*. This paper presents an iterative method for the numerical solution of nonsymmetric systems of linear equations.
- E. N. Lorenz, *Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas?*. Early reference on chaos theory.
- A. S. Householder: *Unitary triangularization of a nonsymmetric matrix*. This paper introduces the Householder transformation in linear algebra.
- C. F. Curtiss and J. O. Hirschfelder: *Integration of stiff equations*. One of the earlier reference to the term stiff differential equations, where one has a stability requirement of the stepsize for instance.
- R. Courant: *Variational methods for the solution of problems of equilibrium and vibrations*. One of the first paper on finite element methods.
- M. R. Hestenes and E. Stiefel: *Methods of conjugate gradients for solving linear systems*. This paper presents one of the first iterative algorithm to solve linear systems of equations.
- R. Fletcher, M. J. D. Powell: *A rapidly convergent descent method for minimization*. This reference discusses an optimization algorithm.
- G. H. Golub, J. H. Welsch: *Calculation of Gauss quadrature rules*. This paper presents several algorithms for computing Gauss quadrature rules.

- G.G. Dahlquist: *A special stability problem for linear multistep methods.* This paper shows that A-stable linear multistep methods cannot have an order higher than two.
- G. Wanner, E. Hairer and S. P. Norsett: *Order stars and stability theorems.* This paper discusses A-stability of numerical methods for ordinary differential equations.
- A. Brandt: *Multi-level adaptive solutions to boundary value problems.* Seminal paper on multigrid method.
- P. Brenner, V. Thomée: *On rational approximations of semigroups.* This paper studies rational approximation of strongly continuous semigroups in Banach space by means of the Fourier transform.
- B. Engquist, A. Majda: *Absorbing boundary conditions for the numerical simulation of waves.*
- N.J. Gordon, D.J. Salmond, and A.FM. Smith: *Novel approach to nonlinear/non-Gaussian Bayesian state estimation.*

Further details on the original idea of the course can be found here.