MATH-351

Advanced numerical analysis

Picasso Marco

Cursus	Sem.	Type
Computational science and Engineering	MA2	Opt.
Mathematics	BA6	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The student will learn state-of-the-art algorithms for solving ordinary differential equations, nonlinear systems, and optimization problems. Moreover, the analysis of these algorithms and their efficient implementation will be discussed in some detail.

Content

Numerical Solution of Ordinary Differential Equations
Runge-Kutta methods. Stability concepts. Multistep methods. Step size control.
Nonlinear systems of equations
Solution of large-scale linear and nonlinear systems.
Numerical Optimization
Newton, BFGS and conjugate gradient methods. Constrained optimization problems. Quadratic programming.

Keywords

Ordinary differential equations, adaptive methods, nonlinear solvers, optimization, large-scale problems.

Learning Prerequisites

Recommended courses

Some background in numerical analysis and proficiency in programming - Matlab recommended

Important concepts to start the course

Numerical methods for approximation, differentiation and integration of functions. Basic knowledge of ordinary differential equations and their solutions. Basic knowledge of numerical techniques for solving systems of linear equations.

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze methods
- Choose an appropriate method
- Prove basis properties of methods
- Derive new methods
- Conduct computational experiments
- Implement computational methods

Teaching methods

Lecture style with computational experiments in class to illustrate analysis.

Expected student activities

Students are expected to attend lectures and participate actively in class and exercises. Exercises will include both theoretical work and implementation and test of a variety of methods.

Assessment methods

Written examination

Resources

Bibliography

Lecture notes will be provided by the instructor. Complimentary reading:
Hairer, E.; Norsett, S. P.; Wanner, G. Solving ordinary differential equations. I. Springer, 1987.
Nocedal, J.; Wright, S. J. Numerical optimization. Second edition. Springer, 2006

Ressources en bibliothèque

- Numerical optimization / Nocedal
- Solving ordinary differential equations / Hairer