MATH-351

Advanced numerical analysis II

Picasso Marco

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Computational science and engineering minor	H	Opt.
Financial engineering	MA1, MA3	Opt.
Mathematics	BA5	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The student will learn state-of-the-art algorithms for solving differential equations. The analysis and implementation of these algorithms will be discussed in some detail.

Content

Numerical Solution of Ordinary Differential Equations
Explicit Runge-Kutta methods. Order 4 conditions. Step size control. Convergence. Implementation.
Finite differences methods for partial differential equations
Elliptic problems in 1,2 and 3d, parabolic and hyperbolic problems in 1d. Convergence. Implementation.

Keywords

Explicit Runge-Kutta methods, elliptic, parabolic and hyperbolic pdes with finite difference methods.
Stability, converegence, implementation with matlab.

Learning Prerequisites

Recommended courses

Some background in numerical analysis and proficiency in programming - Matlab/Octave 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

Quizzes, graded homeworks 20%
Written examination 80%
Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

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.

Ressources en bibliothèque

- Solving ordinary differential equations / Hairer

Moodle Link

- https://go.epfl.ch/MATH-351