MATH-452

Numerical integration of dynamical systems

Blumenthal Adrian

Cursus	Sem.	Type
Computational science and Engineering	MA2, MA4	Opt.
Computational science and engineering minor	E	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	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

In this course we will introduce and study numerical integrators for multi-scale (or stiff) differential equations and dynamical systems with special geometric structures (symplecticity, reversibility, first integrals, etc.). These numerical methods are important for many applications.

Content

- Numerical integration of multi-scale or stiff differential equations.
- Numerical methods preserving geometric structures of dynamical systems (Hamiltonian systems, reversible systems, systems with first integrals, etc.).

Keywords

stiff differential equations, multiscale problems, Hamiltonian systems, geometric numerical integration

Learning Prerequisites

Recommended courses

Analysis, Linear Algebra, Numerical Analysis

Learning Outcomes

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

- Identify stiff and Hamiltonian differential equations
- Analyze geometric and stability properties of differential equations
- Choose an appropriate method for the solution of stiff or Hamiltonian differential equations
- Analyze geometric and stability properties of numerical methods
- Implement numerical methods for solving stiff or Hamiltonian differential equations

Transversal skills

- Use a work methodology appropriate to the task.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Demonstrate the capacity for critical thinking

Teaching methods

Ex cathedra lecture, exercises in classroom and with computer.

Expected student activities

Attendance of the lectures.
Completing the exercises.

Assessment methods

Written examination.
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.

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	Yes

Resources

Bibliography

E. Hairer ans G. Wanner, "Solving Ordinary Differential Equations II", second revised edition, Springer, Berlin, 1996.
E. Hairer, C Lubich and G. Wanner, "Geometric Numerical Integration", second edition, Springer, Berlin, 2006.

Ressources en bibliothèque

- Find the references at the Library

Moodle Link

- https://go.epfl.ch/MATH-452