

MATH-452

**Numerical integration of dynamical systems**

Rosilho De Souza Giacomo

Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**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****Required courses**

Advanced 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

**Teaching methods**

Ex cathedra lecture, exercises in classroom and with computer

**Expected student activities**

Attendance of lectures.

Completing exercises.

Solving problems on the computer.

## Assessment methods

Written

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
Assistants	Yes

## Resources

### Bibliography

E. Hairer and 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

- [Geometric Numerical Integration / Hairer](#)
- [Solving Ordinary Differential Equations II / Hairer](#)