

Dynamical systems

Introducing

Description

- Definition of an autonomous ODE, definition of a Cauchy Problem, Theorem of Cauchy-Lipschitz
- Definition of a maximal solution and the maximum domain, analysis of the stability
- Qualitative properties: conservative systems, Lyapunov functions, introduction to bifurcations (+ limit cycles)
- Construction of the phase portrait of an ODE in dimension 1 and 2
- Numerical integration of an autonomous ODE (Euler, RK, Crank-Nicholson)
- Analysis of a numerical scheme: stability, consistency and convergence

The above-mentioned concepts will be introduced and applied to 4 dynamical systems used all along this class

Objectives

At the end of this module, the student will have understood and be able to

- Define a Cauchy problem and prove the well-posedness of an autonomous ordinary differential equation
- Obtain qualitative properties of the solution of an autonomous ordinary differential equation (maximal solution, maximum domain, stability)
- Draw the phase portrait of an autonomous ordinary differential equation in dimension 1 and 2
- Solve using numerical integration an autonomous

ordinary differential equation

- Apply these notions to analyze a dynamical system used in physics, biology or population dynamics

Necessary prerequisites

Differential and integral calculus, linear algebra

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

 Toulouse