MATH-532

Kinetic and non-equilibrium conservation laws

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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	Oral
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Study of kinetic models and non-equilibrium conservation laws, linking particle interactions to macroscopic behavior. Covers analysis, simulation, and modeling across scales and media using kinetic theory, reduced-order models, and particle methods.

Content

- Interacting Particle Systems: Markov processes, Langevin Dynamics
- Fundamental Kinetic Equations: Boltzmann, Vlasov, and Fokker-Planck Equations
- Moment Hierarchy & Hydrodynamic Limit
- Fluctuation-Dissipation Theorem & Mori-Zwanzig Formalism
- Numerical Methods for Kinetic Equations and Particle Simulations

Keywords

Kinetic Theory, Langevin Dynamics, Particle Methods

Learning Prerequisites

Required courses

Background in PDEs, stochastic processes, and basic numerical methods is required.

Teaching methods

Lectures: Delivered using both blackboard and slides. Lecture notes will be provided.
Exercise Sessions: Weekly sessions combining problem-solving exercises with seminar-style discussions.

Assessment methods

Oral

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

Moodle Link

- https://go.epfl.ch/MATH-532