MATH-660

Numerical methods for data assimilation

Nobile Fabio

Cursus	Sem.	Type
Mathematics		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Oral presentation
Workload	60h
Hours	**36**
Lecture	20
Practical work	16
Number of positions	

Frequency

Only this year

Summary

This course will review modern techniques for parameter and state estimation in a Bayesian framework for models involving differential equations, with particular attention to the high dimensional setting.

Content

This course focuses on numerical methods for data assimilation in mathematical models governed by differential equations with particular attention to high-dimensional problems.
The first part will consider parameter estimation in a Bayesian framework, possibly set in function spaces. We will review modern methods of Monte Carlo and Markov Chain Monte Carlo type (such as preconditioned Crank-Nicolson) for posterior exploration and computation of posterior expectations, combined with numerical discretization's of the underlying differential model.
The second part will consider the filtering problem of state estimation in a dynamical system from partial and noisy observations and will review the main techniques such as Ensemble Kalman and particle filters, again with attention to the high dimensional setting. This is a participative course in which each participant will be assigned one or more topics and asked to deliver an oral presentation accompanied by lecture notes.
Reference material include
D. Sanz-Alonso, A. Stuart, A. Taeb, "Inverse problems and data assimilation", Cambridge, 2023
K. Law, A. Stuart, K. Zygalakis, Data assimilation, a mathematical introduction", Springer, 2015
M. Dashti, A. Stuart, "The Bayesian approach to inverse problems", Handbook of Uncertainty Quantification, 2017
R. Scheichl, J. Zech, "Numerical methods for Bayesian inverse problems", lecture notes 2021
together with recent more specific recent research articles.

Resources

Moodle Link

- https://go.epfl.ch/MATH-660