

# ETICS 2019

## École Thématique sur les Incertitudes en Calcul Scientifique

### Research School on Uncertainty in Scientific Computing

September, 22-27, Fréjus, France - <https://www.caes.cnrs.fr/sejours/la-villa-clythia>



### Objectives

The goal of this school is to develop the skills of researchers and engineers in the domain of uncertainty management of computer codes. Some of the lectures will be followed by practical computer works. Collaborative works, round tables and poster sessions will promote exchanges between participants. The prerequisites to possess are the mathematical bases of the uncertainty quantification science.

### Lecturers

Dr. [Aurélien Bellet](#) (INRIA Lille - Nord Europe, France) - Similarity and distance metric learning

Prof. [Bernard Bercu](#) (Université de Bordeaux, France) - Asymptotic behavior of stochastic algorithms with statistical applications

Prof. [Jean-Michel Marin](#) (Université de Montpellier, France)

Prof. [Youssef Marzouk](#) (Massachusetts Institute of Technology, Cambridge, MA, USA)

### Organization

CEA DAM



EDF R&D



CMLA  
ENS Paris  
Saclay



Under the scientific labeling of the [GdR MASCOT-NUM](#)



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Registration: <https://www.azur-colloque.fr/DR04/inscription/inscription/132/fr>

Registration fees 900€ including accommodation and meals

## Schedule

**Sunday, September, 22th:** Travel (at the charge of each participant) to Fréjus

### Monday, September, 23th:

9:00 - 9:30	Opening and Welcome speech	Bertrand Iooss Guillaume Perrin
9:30 – 12:30	MCMC	Jean-Michel Marin
14:00 – 17:30	Lecture or Practical session	Jean-Michel Marin

### Tuesday, September, 24th:

9:00 – 12:30	Asymptotic behavior of stochastic algorithms with statistical applications	Bernard Bercu
14:00 – 17 :00	Practical session	Bernard Bercu
17 :30-19 :00	Poster session	Participants

### Wednesday, September, 25th:

9:00 – 12:30	Transport methods in Bayesian computation	Youssef Marzouk
14:00 – 20 :00	Free afternoon	

### Thursday, September, 26th:

9:00 – 12:30	Similarity and distance metric learning	Aurélien Bellet
14:00 – 17:30	Practical session	Youssef Marzouk

### Friday, September, 27th:

9:00 – 12:30	Practical session	Aurélien Bellet
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## ABSTRACTS

### Jean-Michel Marin - TBA

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### Youssef Marzouk - Transport methods in Bayesian computation

Bayesian inference provides a natural framework for quantifying uncertainty in parameter estimates and model predictions, and for combining heterogeneous sources of information. Characterizing the results of Bayesian inference---by simulating from the posterior distribution---often proceeds via Markov chain Monte Carlo or sequential Monte Carlo sampling, but remains computationally challenging for complex posteriors and large-scale models.

This lecture will describe a broad framework for using transport in Bayesian computation. This framework seeks deterministic couplings of the posterior measure with a tractable "reference" measure (e.g., a standard Gaussian). Such couplings are induced by transport maps, and enable direct simulation from the desired measure simply by evaluating the transport map at samples from the reference. Approximate transports can also be used to "precondition" and accelerate standard Monte Carlo schemes. Within this framework, one can describe many useful notions of low-dimensional structure associated with inference: for instance, sparse or decomposable transports underpin modeling and computation with non-Gaussian Markov random fields, and low-rank transports arise frequently in inverse problems.

We will also describe recent work specializing transport maps to the problem of nonlinear filtering in high-dimensional state-space models. The idea is to transform a forecast ensemble into samples from the current filtering distribution via a sequence of nonlinear transport maps, computed via convex optimization. Construction of the maps is regularized by leveraging potential structure in the filtering problem---e.g., decay of correlations, approximate conditional independence, and local likelihoods---thus extending notions of localization to nonlinear updates. The proposed framework can be understood as a non-Gaussian generalization of the ensemble Kalman filter.

This is joint work with Alessio Spantini, Daniele Bigoni, Ricardo Baptista, and Matthew Parno.

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### Aurélien Bellet - Similarity and distance metric learning

Similarity between objects plays an important role in both human cognitive processes and artificial systems for recognition and categorization. How to appropriately measure such similarities for a given task is crucial to the performance of many machine learning, pattern recognition and data mining methods. This session is devoted to metric learning, an area of machine learning which aims at automatically learning similarity and distance functions from data. In the lecture, I will review the main ideas, formulations, algorithms and statistical guarantees of metric learning. In the practical session in Python, we will apply metric learning to some synthetic and real datasets. We will use metric-learn, the reference toolbox for metric learning in Python.

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### Bernard Bercu – Asymptotic behavior of stochastic algorithms with statistical applications

This course is dedicated to the analysis of the asymptotic behavior of stochastic algorithms. We shall focus our attention on the well-know Robbins-Monro and Kiefer-Wolfowitz algorithms. We establish the almost sure convergence and we investigate the asymptotic normality of these two stochastic algorithms.

The proofs rely on the strong law of large numbers and the central limit theorem for martingales. Four statistical applications are also provided. The first one concerns the parametric estimation of quantiles and superquantiles. The second one is devoted to the non-parametric estimation of probability density functions. The third one deals with the semi-parametric estimation in shape invariant models. The last one is devoted to stochastic approximation of entropically regularized Wasserstein distances between two probability measures.