ETICS 2021

École Thématique sur les Incertitudes en Calcul Scientifique
Research School on Uncertainty in Scientific Computing

September, 12-17, Keravel resort, Erdeven, France - https://www.keravelvacances.com/

Source : baiedequiberon.bzh

Objectives

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

Lecturers

- Prof. Bertrand Michel (Ecole Centrale de Nantes): Topological data analysis
- Prof. Chris Oates (Newcastle University): Minimum Discrepancy Methods in Uncertainty Quantification
- Prof. Clementine Prieur (Université Grenoble Alpes): Recent advances in global sensitivity analysis
- Several lectures from participants and PhD students

Organization

CEA DAM EDF R&D Centre Borelli ENS Paris Saclay

Under the scientific labeling of the GdR Groupement de Recherche MASCOT-NUM

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Registration:

Registration fees 900€ including accommodation and meals gala dinner, social event cost and transport by bus from and to the railway station

Schedule

Sunday, September, 12th: Travel (at the charge of each participant) to Erdeven – Bus from Auray at 17h45 (after TGV 8725 Paris Montparnasse 15h05 to Auray 17h40)

Monday, September, 13th:

9:00 - 9:15	Opening and Welcome speech	Bertrand Iooss Claire Cannamela
9:15 – 12:30	Recent advances in GSA – Part I	Clémentine Prieur
14:00 – 17:30	Minimum discrepancy methods in UQ – Part I	Chris Oates
19 :00 – 20 :00	Apéritif	All

Tuesday, September, 14th:

9:00 – 12:30	Recent advances in GSA – Part II	Clémentine Prieur
14:00 – 17 :30	Minimum discrepancy methods in UQ–Part II	Chris Oates
18:00 - 18 :40 18 :40 - 19 :00	Recent advances in GSA – Part III: - Kernel-based ANOVA - Cooperative game-theory and GSA	Sébastien da Veiga Marouane Il Idrissu

Wednesday, September, 15th:

9:00 – 12:30	Topological data analysis – Part I	Bertrand Michel
14:00 – 20 :00	Social event or free afternoon	All
20 :00	Gala dinner	All

Thursday, September, 16th:

9:00 – 12:30	Lectures from PhD students	
14:00 – 17:30	Topological data analysis – Part II	Bertrand Michel

Friday, September, 17th:

9:00 – 11:30	Lectures from participants	
13 :00	Bus to Auray (to get TGV 8722 to Paris at 14h14)	

Coffee breaks of 30mn every day at 10:30 and 15:30

ABSTRACTS

Prof. Bertrand Michel (Ecole Centrale de Nantes): Topological data analysis

With the recent explosion in the amount, the variety and the dimensionality of available data, identifying, extracting and exploiting their underlying structure has become a problem of fundamental importance for data analysis and statistical learning. Topological Data Analysis (TDA) is a recent field whose aim is to uncover, understand and exploit the topological and geometric structure underlying complex and possibly high dimensional data. It proposes new well-founded mathematical theories and computational tools that can be used independently or in combination with other data analysis and statistical learning techniques. TDA has been attracting a lot of interest during the recent years but it still appears difficult to access for data scientists with low expertise in topology or geometry.

The goal of this course is to give a short introduction to TDA that will be accessible to a large audience (with a minimal mathematical background). For that purpose, the focus will be put on the practical aspects of the field rather than very theoretical considerations. The course will be organized around the following topics that play a central role in TDA:
1. Mapper is a topological tool for data exploration and visualization.
2. Persistent homology: an introduction (simplicial complexes, filtrations, homology,...).
3. Applications of persistent homology in TDA: clustering, topological signatures, statistical aspects,...

No specific background in topology is required to follow the course. Practical sessions (with Python, Jupyter Lab and Gudhi library) will be organized to illustrate the concepts and help the audience to become familiar with the tools of TDA.

Part I: - Introduction to persistence homology and TDA - Pratical session (Python + Gudhi): filtrations and persistence homology
Part II: - Statistical aspects of TDA - Practical session (Python + Gudhi): Machine Learning and Statistics together with TDA.

Prof. Chris Oates (Newcastle University): Minimum Discrepancy Methods in Uncertainty Quantification

These lectures focus on the general problem of constructing a discrete approximation to a probability distribution of interest. Our motivation comes from uncertainty quantification, where often we are required to perform computation using samples, or other "representative points", from a probability distribution, rather than using the distribution itself. The mathematical framework in which such problems are usually posed is called Discrepancy Theory; an elegant branch of mathematics that can be traced back to early attempts, by Weyl, Koksma and Hlawka, to quantify when a finite set of points are "well spaced".

In these lectures we will cover the mathematical essentials of Discrepancy Theory, before turning attention to computational methods for constructing a discrete approximation to a probability distribution of interest. Starting with the case where the distribution is known, we will study algorithms for discrepancy minimisation that are closely related to modern and powerful quasi Monte Carlo methods. Then, motivated by applications to Bayesian inference

in which the posterior is an intractable object, we study algorithms that seek to minimise a so-called Stein discrepancy. An important application of the latter is to improve the quality of Markov chain Monte Carlo output: surprisingly, we demonstrate that it is possible to correct for bias in the output of a Markov chain using a simple post-processing procedure based on Stein discrepancy.

Prof. Clementine Prieur (Université Grenoble Alpes): Recent advances in global sensitivity analysis

Many mathematical models use a large number of poorly-known parameters as inputs. Sensitivity analysis aims at quantifying the influence of each of these parameters (or of each subset of these parameters) on specific quantities of interest. More generally it helps in understanding model behavior, characterizing uncertainty, improving model calibration, etc. In these lectures I will focus on Global Sensitivity Analysis which is based on the modeling of input uncertain parameters by a probability distribution. There exist various measures built in that paradigm. During the first lecture, I will mainly present variance-based measures, in the framework of scalar, vectorial and functional outputs, in the framework of independent or dependent inputs. I will also present different alternatives for the estimation of these measures. Most of the estimation procedures rely on an input/output sample. For the applications for which not only the model but its derivatives can be evaluated, it is also possible to screen the inputs, that is to detect non-influential inputs at a lower cost than the one required for the estimation of variance based sensitivity measures. During the second lecture, we will go beyond variance-based measures, presenting moment free measures of sensitivity. Both lectures will include a practical session (R).

Extra lectures:

- Sébastien Da Veiga (Safran Tech): Kernel-based ANOVA decomposition – Application to global sensitivity analysis
- Marouane Il Idrissi (EDF R&D, 1st year PhD student): Cooperative game theory and global sensitivity analysis

Lectures from participants (30mn each):

- 9h00-9h30 - Isabelle Abraham (CEA/DAM): Maching learning et image : Utilisation du "scattering wavelet transform" sur des radiographies de confinement inertiel
- 9h30-10h - Clément Benard (SafranTech, 3rd year PhD student): A sensitivity analysis perspective of random forests
- 10h - Break
- 10h20-10h50 - Cécile Haberstich (CEA/DAM): Optimal designs for discrete least squares approximation
- 10h50 – 11h20 - Alejandro Ribes (EDF R&D): Melissa: a modular external library for in-situ sensitivity analysis

PhD students' slots:

- 9h-9h30 - Baptiste Kerleguer (CEA/DAM, 3rd year PhD student): Multi-fidelity surrogate modeling combining Bayesian neural network and Gaussian process regression
- 9h30-10h - Clément Gauchy (CEA/DES, 2nd year PhD student): Propagation of epistemic uncertainties and global sensitivity analysis in seismic risk assessment
- 10h-10h20 - Guillaume Chennetier (EDF R&D, 1st year): Rare event simulation for piecewise deterministic Markov processes
- 10h20 – Break
- 10h40-11h00 - Clément Duhamel (INRIA, 1st year PhD student): A SUR version of the Bichon criterion for excursion set estimation
- 11h00-11h20 - Elias Fekhari (EDF R&D, 1st year PhD student): Treatment of uncertainties in multi-physics model for wind turbine asset management
- 11h20– 11h40 - Bruno Vuillod (CEA/DAM, 1st year PhD student): Modeling multi-scales thermo-mechanical model