ETICS 2018

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

CNRS UPMC Station Biologique Roscoff

June 3-8 2018 http://www.sb-roscoff.fr/

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

Pr. Sankaran Mahadevan (Vanderbilt University, Nashville, USA): recent developments in Uncertainty Aggregation (forward problem) and Uncertainty Reduction (inverse problem).

Dr. Andrei Bursuc (SafranTech, France): Deep Learning, a journey from feature extraction and engineering to end-to-end pipelines.

Pr. Nicolas Gayton (Université Clermont Auvergne, Institut Pascal, France): Concepts and methods for robust and/or reliable design.

Pr. Fabrizio Ruggeri (Institute for Applied Mathematics and Information Technologies, Italy): Introduction to Robust Bayesian Analysis.

Dr Merlin Keller, Jerome Stenger (EDF R&D, France): Practical session on Robust Inference using the Python Mystic framework for global optimization.

Organization

CEA DAM — EDF R&D — CMLA ENS Cachan

Under the scientific labeling of the GdR MASCOT-NUM

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Schedule

Sunday, June, 3d: Train from Paris to Roscoff

Monday, June, 4th:

9:00 - 9:30	Opening and Welcome speech	Jean Giorla
9:30 – 10:45	Garantir par la simulation, comment l'incertitude crée la confiance - Guaranteed by simulation, how uncertainty creates trust	Guillaume Perrin
11:15 – 12:30	Validation des outils de calcul scientifique au moyen de la statistique - Validation of scientific computing tools using statistics	Mathieu Couplet
14:00 – 17:30	Uncertainty Aggregation: Variability, Statistical Uncertainty, and Model Uncertainty	Sankaran Mahadevan, (visio)

Tuesday, June, 5th:

9:00 – 12:30	Deep Learning: a journey from feature extraction and engineering to end-to-end pipelines	Andrei Bursuc
14:00 – 17:30	Deep Learning: a journey from feature extraction and engineering to end-to-end pipelines	Andrei Bursuc
18:30- 20:00	Poster session	All

Wednesday, June, 6th:

9:00 – 12:30	Concepts and methods for robust and/or reliable design	Nicolas Gayton
14:00 – 18:30	Social event	All

Thursday, June, 7th:

9:00 – 12:30	Concepts and methods for robust and/or reliable design	Nicolas Gayton
14:00 – 17:30	Introduction to Robust Bayesian Analysis	Fabrizio Ruggeri

Friday, June, 8th:

9:00 – 12:30	Practical session on Robust Inference using the Python Mystic framework for global optimization	Merlin Keller Jerome Stenger

Train from Roscoff to Paris

ABSTRACTS

Pr. Sankaran Mahadevan (Laboratory for Systems Integrity and Reliability, Vanderbilt University, Nashville, USA)

Uncertainty Aggregation: Variability, Statistical Uncertainty, and Model Uncertainty

Model-based simulation is attractive for the performance and reliability analysis of engineering systems, since full-scale testing is often unaffordable. However, model-based simulation involves many approximations and assumptions, and thus confidence in the simulation result is an important consideration in risk-informed decision-making. Sources of uncertainty are both aleatory and epistemic, stemming from natural variability, information uncertainty, and modeling approximations at multiple levels. Information uncertainty arises from sparse and imprecise data, measurement and data processing errors, and qualitative information. Model uncertainty arises due to unknown model parameters, model form assumptions, and solution approximation errors. This lecture will present recent methods for the quantification of uncertainty from multiple sources, and their aggregation towards the behavior prediction of multi-physics, multi-scale systems. Multiple activities such as calibration, verification and validation are conducted as part of the model development process at multiple levels, and methods to aggregate the results of these activities towards overall uncertainty quantification will be presented.

Dr. Andrei Bursuc (SafranTech, France)

Deep Learning: a journey from feature extraction and engineering to end-to-end pipelines

Recent developments in neural network approaches (more known now as "deep learning") have dramatically changed the landscape of several research fields such as image classification, object detection, speech recognition, machine translation, and many more. Due its promise of leveraging large (sometimes even small) amounts of data in an end-to-end manner, i.e. train a model to extract features by itself and to learn from them, deep learning is increasingly appealing to other fields as well: medicine, time series analysis, biology, simulation.

In this lecture we attempt to demystify deep learning and kick start you into using it in your own field of research. We will follow the evolution of feature engineering from hand-made features to end-to-end pipelines illustrating at each point the sources of inspiration, the change in paradigms and the solutions brought by deep learning. During this course, you will gain a better understanding of the basis of deep learning and get familiar with its applications and the practical aspects of its implementations.

Pr. Nicolas Gayton (Université Clermont Auvergne, CNRS, SIGMA Clermont, Institut Pascal, France)

Concepts and methods for robust and/or reliable design

In this lecture, we will review the different ways to formulate a robust / reliable design problem, as the Reliability-Based Design Optimization (RBDO) for example, and to assess the partial derivatives of a failure probability with respect to deterministic optimization variables (hyper-parameters of random variables, or model variable). We will describe the numerical methods used to solve such a problem in the context of expensive computations and we will present some toy illustrations.

Pr. Fabrizio Ruggeri (Institute for Applied Mathematics and Information Technologies, Italy)

Introduction to Robust Bayesian Analysis

The talk will discuss motivations for the need of performing sensitivity analyses with respect to prior (as well as model and loss functions) in a Bayesian framework. The practical impossibility of eliciting a unique prior can be addressed by considering classes of priors, compatible with experts' opinions, and studying the posterior behaviour of the quantities of interest. Some methods will be presented, as well as some applications, especially from the engineering sector.

Dr Merlin Keller and Jerome Stenger (EDF R&D, France)

Robust inference allows to compute bounds on interest quantities that account for imprecise probability distributions. It requires optimizing a possibly irregular criterion over a possibly large dimensional space.

The goal of this practical session is to show how such complex optimization can be solved numerically using the Python Mystic package:

http://trac.mystic.cacr.caltech.edu/project/mystic/wiki.html

Several toy and/or industrial case-studies will be treated; we will focus on robust inference for tail probabilities and quantiles.