Informatics Research
Institute of Toulouse

Monday 22 May 2017
14h00 – 15h00
INP-ENSEEIHT, Salle des thèses

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Université de Montpellier

Meeting SPOT : Data Analytic UQ cascade for aircraft shape design

Seminar

Abstract: We present an original framework for uncertainty quantification (UQ) in optimization. It is based on a cascade of ingredients with growing computational complexity for both forward and reverse uncertainty propagation. The approach is merely geometric. It starts with a complexity-based splitting of the independent variables and the definition of a parametric optimization problem. Geometric characterization of global sensitivity spaces through their dimensions and relative positions by the principal angles between global search subspaces bring a first set of information on the impact of uncertainties on the functioning parameters on the optimal solution. Joining the multi-point descent direction and the quantiles on the optimization parameters permits to define the notion of Directional Extreme Scenarios (DES) without sampling of large dimension design spaces. One goes beyond DES with Ensemble Kalman Filters (EnKF) after the multi-point optimization algorithm is cast into an ensemble simulation environment. This formulation accounts for the variability in large dimension. The UQ cascade ends with the joint application of the EnKF and DES leading to the concept of Ensemble Directional Extreme Scenarios (EDES) which provides more exhaustive possible extreme scenarios knowing the Probability Density Function of our optimization parameters. The presentation also addresses the issue of reduced order modelling through convolutional neural networks and shows how these can be used for the solution of direct and inverse problems. The different ingredients are illustrated on different industrial applications with particular emphasis on aircraft shape design in the presence of operational and geometrical uncertainties is addressed.

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