



INSTITUT
POLYTECHNIQUE
DE PARIS



Master internship “Dimension reduction strategy and comparison of surrogates for reliable based design optimization of high dimensional systems”

Scope of work

A recent thesis [*A. Cousin, 2021*] has formulated a new efficient Reliable Based Design Optimization (RBDO) method for complex structures with stationary Gaussian Process input and non-linear limit states of small probability. It is based on an Extreme Value reformulation and a dedicated Kriging with Active Learning iterations. Many applications however require considering a very large set of input parameters for instance when highly varying loading like turbulent wind or seismic waves need to be parameterized. Surrogate models like kriging then faces strong limitation due to the well-known curse of dimensionality. The internship will test different approaches of dimension reduction strategies on an academic oscillator such as kernel PCA, signal feature extraction [*Lataniotis, 2019*] or approaches tailored for UQ [*Tian et al, 2013*]. In addition, the replacement of the kriging active learning in the RBDO method of [*A. Cousin, 2021*] by other surrogate models like PC-Kriging [*Schöbi et al, 2014*] or SVR will be explored with open source libraries like the UQLab framework of ETH (<https://www.uqlab.com/>).

Alexis Cousin (2021). “Chance constraint optimization of a complex system: Application to the design of a floating offshore wind turbine”. Doctoral thesis of Institut Polytechnique de Paris.

C. Lataniotis (2019). “Data-driven uncertainty quantification for high-dimensional engineering problems”. Doctoral thesis of ETH Zurich.

Tian, S. V., Gareth M. J. (2013). “Interpretable dimension reduction for classifying functional data”.

Computational Statistics & Data Analysis 57, 282-296.

Schöbi, R., Kersaudy, P., Sudret, B., Wiart, J. (2014). “Combining Polynomial Chaos Expansions and Kriging”. [Research Report] ETH Zurich, Switzerland; Orange Labs research.

Supervision and how to apply

The position is for 6 months at the Centre de Mathématiques Appliquées (CMAP) of Ecole polytechnique under the supervision of Pr. J. Garnier with a collaboration of M. Munoz-Zuniga and M. Guiton of IFP Energies Nouvelles. A successful realization could be followed by a PhD position within the Applied Mathematics Department of IFPEN on RBDO for offshore wind turbine.

Strong knowledge in Gaussian Process, surrogates (Kriging, PCE) and statistics is required, programming skills in Python or R will be advantageous. To apply, please send before 2022 May 1st your CV, a cover letter, a reference letter and recent transcripts to the following emails with the title “Application to IFPEN/CMAP master internship”: josselin.garnier@polytechnique.edu; miguel.munoz-zuniga@ifpen.fr; martin.guiton@ifpen.fr