Thesis offer:
Surrogate modeling of stochastic simulators

Telecom ParisTech, Chair C2M, University Paris Saclay.

Context.

This PhD thesis offer is associated to Telecom ParisTech, Chair of Characterization, modeling and mastering EMF of Telecom ParisTech (http://www.telecom-paristech.fr) and a collaborative research project with ETH Zurich, Chair of Risk, Safety and Uncertainty Quantification (http://www.sudret.ibk.ethz.ch)

The Telecommunication infrastructure design nowadays is using advanced computational tools to predict and optimize the coverage prediction and the Key Performance indicators of the systems and architectures. Taking advantage of progress in high performance calculation (HPC), simulators are nowadays able to handle complex problems, but simulations have to be performed many times to explore the design space, quantify the uncertainty of KPI and optimize the design.

Despite the progress in HPC, perform thousands of simulations is still impossible. Large efforts have been carried out over the last decade to develop surrogate models, using for instance the Kriging or the Polynomial Chaos Expansion methods, to avoid this computational burden [1].

Surrogate modeling in EMF simulation has emerged a decade ago, especially for numerical dosimetric evaluation that is often using Finite Difference in Time Domain (FDTD) and computational models of human bodies [2, 3, 4, 5, 6, 7] to quantify the power absorbed by biological tissues.

Most of the efforts have been dedicated to deterministic simulators. To handle increasing complexity simulators can be also stochastic. In contrast to deterministic ones, which yield a unique output for each set of input parameters x, stochastic simulators contain some source of randomness and the same input parameters create different outputs. For instance in the telecommunication domain, stochastic geometry have been used to build stochastic cities [8] governed by a limited number of input parameters (e.g. density of buildings, building height, width of streets, density of antennas, etc.). In this case at a given input x, the output of the stochastic simulator, e.g the one based on stochastic geometry, is not one value (e.g. a KPI) but becomes a probability density function that we need to characterize. As explained previously running thousands to millions of times a simulator is not feasible. To overcome this limitation, surrogating stochastic simulators is an emerging question [9]

Research lines.

The PhD works will investigate the surrogate modeling of parameter representing the output distribution using a parametric representation and a surrogate modeling of hyper-parameters governing the output distribution. Sensitivity analysis will be investigated [10,11] and different types of indices based on distributions will be studied [12,13]. At the end the works will investigate the possibility to extend initial work to the Polynomial Chaos description of the output.

Supervision:

The supervision will be performed by Joe Wiart, Telecom ParisTech, LTCI CNRS, University Paris Saclay and Bruno Sudret, ETH

Applicant profile:

Candidates should have completed a Master engineering, applied mathematics, statistics, or related disciplines.

The applicant should demonstrate both theoretical and computational skills. Implementations in Matlab are expected.

CV and motivation letter in English or French should be sent to joe.wiart@telecom-paristech.fr

Conditions.

The position is a 3-year contract, expected to start in 2016.

The main location is Telecom ParisTech, Paris, France.

Net salary: 1500 €/month

References

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