PhD position at IFP Energies nouvelles (IFPEN)
in Mathematics

Active learning with functional inputs: application to wind turbine reliability design

Many applications at IFPEN rely on computationally expensive simulators which take scalar variables as inputs, but also functional variables representing, for example, the geometry of mechanical pieces, or spatio-temporal environmental conditions (such as wind). In this context of costly simulators, it is often necessary to use a surrogate model to evaluate efficiently the output of interest for a large number of input parameter values. This substitution model is generally built adaptively by an active learning methodology, from simulations associated with an initial design of limited size. This design is then enriched using criteria adapted to the operational objective, such as optimization of the quantities of interest or estimation of the set of feasible parameters. In the presence of functional variables in the simulator inputs, meta-modeling and experimental design approaches need to be adapted. Conventional approaches are based on dimension reduction or feature extraction methods, the functional variables being represented in the reduced space thus defined. This preliminary step of dimension reduction necessarily induces a loss of information that needs to be quantified and even controlled during the procedure.
The aim of this thesis is to develop active learning approaches for the construction of a substitution model taking functional and scalar variables as inputs, working directly in the functional space of the inputs, and therefore without preliminary dimension reduction. The methods developed will be evaluated on several applications of shape optimization and for the estimation of feasible domains in wind turbine design and CO2 capture processes.

Keywords: Active learning, uncertainties, optimization, design of experiments

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PhD location	LJK, INRIA, Grenoble, France IFPEN, Rueil-Malmaison, France
Duration and start date	3 years, starting in the fourth quarter 2024 (Novembre 4)
Employer	IFPEN
Academic requirements	University Master degree in Mathematics
Language requirements	English level B2 (CEFR)
Other requirements	Statistics, Machine learning, optimization, programming in R and/or Python

To apply, please send your cover letter and CV to the IFPEN supervisor indicated here above.

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