Consortium Industrie Recherche pour l'Optimisation et la QUantification d'incertitude pour les données Onéreuses

POST-DOCTORAL PROPOSAL

Code transposition

INRIA Saclay

Numerical simulations are more and more used to understand and optimize complex physical systems. These codes are often costly and depend on parameters that must be calibrated so that the code predictions are as close as possible to the behavior of the actual systems. This calibration is done from input and output data sets, drawn from a certain experimental domain. However, we note that, even after calibration, there is always a prediction uncertainty or model error that must be quantified. Strategies such as the one proposed in [2] allow to calibrate the codes and to quantify their prediction uncertainties.

However, in some situations, conventional methods of calibration and uncertainty quantification cannot be implemented. This may occur, for example, when one changes scale (the available experimental data are in a domain far from the domain of interest), when one must take into account a new input or when one has to consider a new output of the code (input or output that were not measured during the data acquisition phase).

In problems for which the only uncertainties are related to physical parameters identified and included in the code, parametric error transport methods can be implemented, as for example in neutronics [1]. But in the presence of a model error, the inference of the error structure on a new output for example requires new tools, as for example the idea of integrated error transport suggested in [3]. Preliminary work carried out within the CIROQUO consortium (Consortium Industrie Recherche pour l'Optimisation et la QUantification d'incertitude pour les données Onéreuses) proposes strategies involving generalized forms of Gaussian process-based models that the postdoc will have to study, discuss, implement and compare.

The postdoc will have two test cases. A first test case concerning a problem of impact calculation of an object on a plate is provided by CEA/DAM, with several situations of increasing difficulty. A second test case dealing with a problem of load and stress estimation on wind turbines is provided by IFPEN.

[1] N. Dos Santos, Optimisation de l'approche de representativite et de transposition pour la conception neutronique de programmes experimentaux dans les maquettes critiques, thesis, Univ. Grenoble, 2013.

[2] M. C. Kennedy and A. O'Hagan, Bayesian calibration of computer models, J. R. Statist. Soc.B 63, pp. 425-464 (2001).

[3] K. Sargsyan, X. Huan, and H. N. Najm, Embedded Model Error representation for Bayesian model calibration, Int. J. Uncertainty Quantification 9, pp. 365-394 (2019).

Practical information : The work will take place at INRIA Saclay, within the Centre de Mathématiques Appliquées (CMAP) at Ecole Polytechnique.

The duration of the contract is 12 months, the envisaged start date is fall 2022 but is flexible.

The postdoc will also benefit from strong interactions with other members of the CIROQUO consortium, in particular at CEA/DAM (Cedric Durantin, Gilles Defaux) and IFPEN, which are proposing the two test cases.

Contact : For more information and to apply: contact Josselin Garnier (CMAP, INRIA and Ecole Polytechnique) josselin.garnier@polytechnique.edu

Requested skills :

- doctoral degree or equivalent in Mathematics

- proven strong background in uncertainty quantification or statistical learning theory

- substantial experience in numerical programming (Python preferred).