ParisTech Arts et Métiers Sciences et Technologies

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Energy, Processes
Subfield: Electrical Engineering
Title: Model Order Reduction for Uncertainty Quantification in Computational Electromagnetics
ParisTech School: Arts et Métiers Sciences et Technologies
Advisor(s) Name: Stéphane Clénet
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Lab location: *Lille*
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Short description of possible research topics for a PhD:
To go further in the improvement of the performances of electromagnetic devices, e.g., in terms of energy efficiency or robustness, models, able to describe the device in the "real world" during its whole life cycle, are required. These models must account for imperfections, like those introduced by the manufacturing processes or due to aging. These imperfections are often difficult to characterize, or they are intrinsically dispersive because they change with time leading to uncertainties on the parameters of the model (dimensions, physical properties of the material...). "Real world" model must account for uncertainties. The objective of the PhD is to develop methods to quantify the effect of uncertainties in the case of numerical models based on the finite element method in the field of low frequency computational electromagnetics. These methods are hardly used to study "real world" applications since they require a huge computation time. Recent advances in applied mathematics in the field of model order reduction will be leveraged to overcome this issue.

Required background of the student: Numerical Analysis – Scientific Programming (Experience in Electrical Devices is not required)

A list of 5 (max.) representative publications of the group:
1. D. E. Abdelli, T. T. Nguyen, S. Clénet and A. Cheriet, "Stochastic Metamodel for Probability of Detection Estimation of Eddy-Current Testing Problem with Random Geometry," in IEEE Transactions on Magnetics, vol. 55, no. 6, pp. 1-4, June 2019, Art no. 6200604, doi: 10.1109/TMAG.2019.2893421.
2. T. Henneron, A. Pierquin and S. Clénet, "Surrogate Model Based on the POD Combined With the RBF Interpolation of Nonlinear Magnetostatic FE Model," in IEEE Transactions on Magnetics, vol. 56, no. 1, pp. 1-4, Jan. 2020, Art no. 7501504, doi: 10.1109/TMAG.2019.2949751.
3. D. Zhou, T.T. Nguyen, E. Breaz. D. Zhao, S. Clénet, F. Gao, "Global parameters sensitivity analysis and development of a two-dimensional real-time model of proton-exchange-membrane fuel cells," in Energy Conversion and Management vol. 162, pp. 276-292, doi: 10.1016/j.enconman.2018.02.036
4. M. Al Eit, S. Clénet and T. Henneron, "Finite-Element Model Reduction of Surface-Mounted Permanent Magnet Machines by Exploitation of Geometrical Periodicity," in IEEE Transactions on Magnetics, vol. 54, no. 9, pp. 1-11, Sept. 2018, Art no. 7402411, doi: 10.1109/TMAG.2018.2830753.
5. M. Farzamfar, A. Belahcen, P. Rasilo, S. Clénet and A. Pierquin, "Model Order Reduction of Electrical Machines With Multiple Inputs," in IEEE Transactions on Industry Applications, vol. 53, no. 4, pp. 3355-3360, July-Aug. 2017, doi: 10.1109/TIA.2017.2681967.