LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

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Off-Line Model Order Reduction for On-Line approach of Low Frequency Electromagnetic Devices

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Context

To model low frequency electromagnetic devices, the Finite Element (FE) Method combined with a time-stepping scheme is widely used to discretize Maxwell's equations. Then, with a fine mesh and a small time step, the computation time of the large-scale system obtained from the discretization of the Non-Linear Partial Differential Equations can be prohibitive. To reduce the duration of numerical simulations, Model Order Reduction (MOR) methods have been developed in the literature. The Proper Orthogonal Decomposition (POD) and the Proper Generalized Decomposition (PGD) are the most popular methods to solve problems in engineering.

Objective

In order to build a reduced model validated on the full operating range of an electrical device, several methods can be used. A mathematical approach based on a greedy algorithm can be developed, but this technic does not take into account physical aspect. We propose an approach based on the expertise of the engineer. In electrotechnic, typical tests are used to determine parameters of equivalent circuit models which describes the behavior of the device on the whole range of operation. It means that these typical tests are representative of key operating configurations. Then, the idea is to consider the same approach to construct a reduced model of a FE original model. During the offline step, classical tests are considered to construct the reduced model. On the online step, the reduced model can be used to study an electrical device on its electrical environment for different operating points. The aim of the project is to investigate different methods of MOR methods for an offline/online approach. In term of application, transformer and electrical machine will be studied.

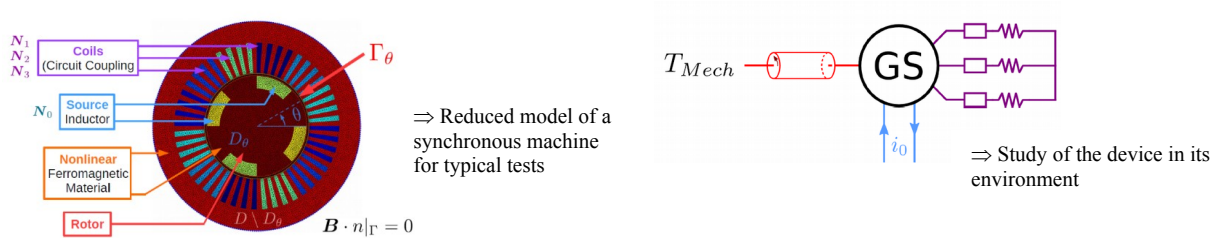

Figure 1: Offline/Online approach

Work steps

The first step is to study the MOR approaches developed for electromagnetic devices. The second step consists to program different MOR methods in the case of an offline/online approach with academic examples. Finally, the more efficient method will be used to study an industrial device.

Key word

Finite Element Method, Model Order Reduction, Offline/Online approach

References
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