N° de dossier : 2019-R10-02

PHD POSITION AT IFP ENERGIES NOUVELLES (IFPEN) AND SATIE LAB

In Applied Mathematics and Physics – Electromagnetism

Topology optimization of electromagnetic devices Application to PM-assisted synchronous reluctance motors for electric traction applications

As part of the development of our electric powertrain solutions, in deep collaboration with an industrial counterpart, the "Electrified Systems" department at IFP Energies Nouvelles has developed over the past few years an expertise on PM-assisted Synchronous Reluctance machines (PMaSynRel).

So far, the chosen technical solution offers an excellent tradeoff between performances and cost. Indeed, in those PMaSynRel structures, low quantity of Rare Earth Material can be achieved along with good electromagnetic performances thanks to their quite high reluctance torque. This is a real benefit for an industrial application since risks of supply-chain disruptions for some rare earth materials are particularly strong.

In addition, designing PMaSynRel machines is a real challenge as the number of degrees of freedom is high. The effectiveness of "classical", or parametric, optimization to improve designs has been widely demonstrated in the literature. However, the latter approach is limited due to numerous priors on the shape and on the topology.

Topology optimization could allow us to go further in the design of our electrical machines and to overcome parametric optimization limitations. The main objective of this thesis is to improve electromagnetic performances of our PMaSynRel structures through the use of topology optimization methodologies. The first step of the thesis will be to develop and apply topology optimization methods to existing electrical machines to reduce torque ripples, improve the resistance to demagnetization field…Then we will extend the approach to innovative structures. Finally, it could worth considering a magneto-mechanic coupling to improve PMaSynRel behavior notably at higher speeds. Experiments may punctuate this thesis journey, as designs are improved.

The novelty of this subject will provide the selected candidate with a wide vision in different fields, such as applied mathematics and electrical machine design, in which IFPEN is a recognized research institute. The collaboration with the SATIE laboratory (ENS Rennes) will give the candidate the opportunity to further deepen the understandings of the obtained results, and to discover a complementary research environment.

Mots clefs: Applied mathematics and physics, Topology optimization, Electromagnetic and/or mechanical modeling.

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PhD Director	Hamid Ben Ahmed, Maitre de conférence à l'Ecole Normale Supérieure de Rennes
Doctoral school	Université Rennes1, Ecole doctorale MATHSTIC
IFPEN supervisors	Dr. Benjamin GAUSSENS, Research Engineer, Mobility and Systems Division Dr. Delphine Sinoquet, Research Engineer, Applied Mathematics Department
PhD Location	Mobility and Systems Division, IFP Energies nouvelles, Rueil-Malmaison, France
Duration and start date	3 years, starting preferably on October 1st, 2019
Employer	IFP Energies nouvelles, Rueil-Malmaison, France

Diploma	Master of Science degree in relevant disciplines (Applied mathematics, Physics, Electrical Engineering, Electromagnetic Design)
Languages	Fluency in English, French an asset but not mandatory (willingness to learn French)
Other skills	Software (Matlab, Office,…), Finite Element package knowledge (FEMM, Ansys Maxwell, Flux2D/3D), Optimization, Appetite for modeling or good coding proficiency, good communication skills an asset

Pour plus d'information ou pour soumettre votre candidature, voir www.theses.ifpen.fr ou contacter l'encadrant IFPEN.

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IFPEN met à disposition de ses chercheurs un environnement stimulant, avec des équipements de laboratoire et des moyens de calcul très performants. IFPEN a une politique salariale et de couverture sociale compétitive. Tous les doctorants participent à des séminaires et des formations qui leur sont dédiés.