Dipartimento Energia
Power Electronics Innovation Center (PEIC)
Politecnico di Torino

We are looking for a master student to work on the

Design of Variable-Flux Permanent Magnet Machines for Traction Application

Background

Traction electrification is contributing to the supply shortage and price surge of rare-earth permanent magnets (RE-PMs) such as NdFeB alloys. The study of RE-free motors is an open challenge for electrical engineers and material scientists, especially in the automotive sector. One of the promising solutions is to use RE-free permanent magnets, such as AlNiCo- or FeN-based alloys. These materials offer high remanence but low coercivity, allowing the demagnetization and re-magnetization of the magnets during the motor operation.

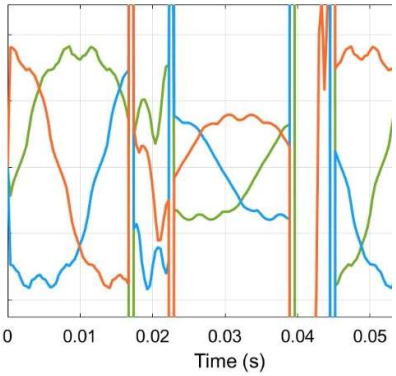

Figure 1 – Voltage waveform after a demagnetization and remagnetization cycle

The aim of the thesis is to study the design of Variable-Flux Permanent Magnet Synchronous Motors (VF-PMSM) suitable for seamless regulation of the PM magnetization state during operation. The thesis work will be integrated in a wider research project on VF-PMSM, in cooperation with Volvo Cars and a PhD student from PoliTO and co-founded by Volvo Cars. The work will be developed inside the design environment SyR-e (https://github.com/SyR-e/syre_public) the open-source design and simulation framework developed in Matlab from PEIC members. At the moment, SyR-e covers standard, constant magnetization PMSMs.

Your tasks

- Literature review on the design and applications of PMSM with variable flux magnets
- Identification of the best indicators for the design of VF-PMSM;
- Identification of the best geometry for the design of VF-PMSM;
- Simulation of VF-PMSM with specific FEA software and simplified modeling for design purposes
- Design comparison of a VF-PMSM with a traction motor based on NdFeB magnets

Necessary skills

- Knowledge of electrical machines and electric drives
- Basic Matlab programming;
- Problem-solving and attitude to team-working;
- Previous experience in FEA simulation (FEMM, JMAG) is a plus.

What you will learn

- To analyze state-of-the-art technical literature;
- The basic principle of electrical machine design;
- How to set up and FEA simulation of electric motor and use the FEA results to estimate the motor performance figures. Use of FEMM and JMAG;
- To work in a team and cooperating on a common project.

Duration of the thesis: 6 months or more

Application: We are looking forward to receiving your application. Please include your CV and a short explanation why you fit the position (Italian or English). Send your application to Simone Ferrari (simone.ferrari@polito.it) and Gianmario Pellegrino (gianmario.pellegrino@polito.it)