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

We are looking for a master student to work on

High-Performance Torque Control of Electrical Excited Synchronous Motors

Background

The electrification processes involving transports are leading to the development of various traction solutions using ac motors. Currently, most traction solutions for hybrid- and electric- vehicles use permanent magnet synchronous motors (PMSM) to maximize the power/density. However, PMSMs almost all use rare-earth permanent magnets (PMs), whose availability and cost increasingly depend on geopolitical and economic factors. According to this scenario, several car manufacturers have proposed alternative traction solutions using electrical excited synchronous motors (EESMs), whose schematic view is shown in Fig. 1.

Fig. 1. Schematic view of an EESM.

The EESM, in many cases also called wound-field synchronous motor, replace the PMs with an excitation winding placed on the rotor whose injected current can be regulated using slip rings or wireless power transfer solutions. This way, the magnetization level can be calibrated at any operating point to maximize motor efficiency.

Thesis goal

Currently, the technical literature reports few control algorithms for EESMs able to guarantee high-performance torque regulation in any operating condition, including flux weakening operation under voltage and current constraints imposed by the power electronics converter feeding the motor. **Therefore, the goal of this master thesis is to support the development of an innovative torque controller for EESMs characterized by the best dynamic performance of torque regulation in any possible machine's operating condition.** The experimental validation of the torque controller will be carried out on a traction EESM adopted by Renault Zoe R135 (see Fig. 2), rated 100 kW at 4200 rpm.

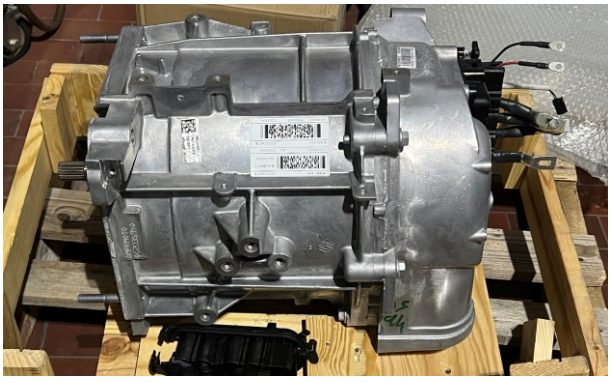

Fig. 2. View of the EESM adopted by Renault Zoe R135 and used for the experimental validation.

Your tasks

- Elaborate flux and torque maps of the EESM to evaluate its performance in any operating conditions
- Contribute to the development of a high-performance torque controller whose design is based on the advanced elaboration of flux and torque maps

- Preliminary validate the performance of the torque controller using advanced simulation tools
- Participate and contribute to the experimental validation of the developed torque controller

Necessary skills

- Basic knowledge of power electronics, electric machines, and drives
- Basic knowledge of digital control
- Basic knowledge of Matlab/Simulink
- Problem-solving skills
- C programming skills (preferred)

What you will learn

- Advanced knowledge of modeling and control of ac machines
- Advanced data elaboration methods using Matlab/Simulink
- Simulation skills using Matlab/Simulink and PLECS
- Experimental skills in terms of i) implementation of control algorithms on rapid prototyping platforms like dSPACE, ii) use of advanced measurement systems, and iii) organization and execution of experimental tests involving traction motors

Duration of the thesis: 6 months minimum

Application

We are looking forward to receiving your application. Please include your CV and a short motivation letter about why you fit the position (Italian or English). Send your application to: sandro.rubino@polito.it, radu.bojoi@polito.it, fabio.mandrile@polito.it.