ICT PHD

Research project for a PhD curriculum in ICT –Electronics and Telecommunication

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Proposed Title of the research:
High Performance rare earth free Electric Motors for a sustainable and greener agriculture

Keywords: (5)
Electrical Machine; Green Transportation, Sustainability, LCA, Electrification

Research objectives: --(max 10 rows)

Recently, electric machines based on permanent magnets have gradually replaced more traditional solutions, in the automotive and renewable (wind generators). A modern low speed direct drive generators for wind turbines have a rare-earth magnet content up to 650 kg/MW. This has led to a concerns about rapid depletion of rare earth resources. The situation is aggravated by a geographical concentration of these strategic materials and a dependence of a strategic sector on countries with a high risk of reliability. Due to these economic, environmental and geopolitical problems, industry is exploring different technologies based on materials are more compatible from an environmental point of view and with greater availability to avoid jeopardizing the transition to electric mobility, which promises to reduce by 75% greenhouse gas emissions due to transport, and the production of electricity from renewable sources.

Proposed research activity -- (max 10 rows)

To ensure efficiencies close to machines that use rare earth magnets, it is necessary to develop a machine with high differences in inductance values in the d-q axes. The design of the machine will have to foresee high speeds to increase the power without excessively increasing its performance and this will require the study of new devices/materials to reduce the losses in iron and copper. The machine design must also consider the manufacturing process to reduce the environmental impact.
The objectives proposed for this research project are therefore set as follows:
State of art on the design of Rare-Earth free electrical machine, selection of best material candidates to replace Rare-Earth in Permanent Magnet, multi-physics design approach, FEM analysis for machine torque and power prediction, prototyping and experimental verification during secondment in EMAK S.p.A. for 12 months.

Supporting research projects (and Department)
This project will be carried out at the Department of Engineering “Enzo Ferrari” and will be supported by research funds provided by Silk EV.

Possible connections with research groups, companies, universities.

The project will see the involvement of EMAK, and the University of Nottingham UK (UoN), which will participate in the study and electromagnetic analysis of the proposed electrical machine. Dual Degree with UoN is possible as well.

(*) optional
(**) optional/to be completed on the second year