



POLITECNICO DI TORINO

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RESEARCH TOPICS

- Design and performance evaluation of electrical machines
- Design tools for synchronous machines
- Thermal modeling and losses in electrical machines
- Advanced control solutions for electrical drives
- Wireless battery chargers
- Special topics in power electronics and electrical drives

DESIGN AND PERFORMANCE EVALUATION OF ELECTRIC MACHINES

Keywords: analytical methods, modeling, inductance computation, performance prediction computation, optimization.

This topic is dedicated to analytical or analytical-numerical approaches to the prediction of electric machine performance and parameters based on design data. Then, the machine design is optimized and the results are verified with Finite Element Analysis and experimental testing. This research activity includes also the magnetic materials and their influence on the electrical machine design.

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DESIGN TOOLS FOR SYNCHRONOUS MACHINES

Keywords: design optimization, finite element analysis, open-source CAD

The aim of this research topic is to improve the capabilities of the open-source tool SyR-e. Nowadays, the software supports the machine designer during the design process of synchronous reluctance and permanent magnets machines using simple models (analytical and FEA-based) for the preliminary machine sizing and optimization algorithm for the final machine geometry. At the end of the design process, the machine performance can be evaluated using FEA simulations, to validate the design inputs and get the information useful for the control strategy.

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THERMAL MODELING AND LOSSES IN ELECTRICAL MACHINES

Keywords: thermal modeling, lumped parameters, overload, thermal analysis, winding

This line of research is dedicated to the study and identification of simplified thermal models that can be used for the temperature estimation during transients. The thermal modeling has been applied to induction starter-generators, railway traction motors and fractional-slot surface mount permanent magnet motors.

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ADVANCED CONTROL SOLUTIONS OF ELECTRICAL DRIVES

Keywords: digital control, model predictive control, multiphase drives, self-commissioning.

This research topic is related to advanced digital control solutions for electrical drives and includes:

- Sensorless control of AC machines – for augmented performance of motor control without using position sensors.



- Self-commissioning and plug-in control of AC machines – for self-tuning motor control schemes able to detect at standstill the motor parameters.
- Control of multiphase AC drives – to get fault-tolerant, modular control solutions for multi-three phase electrical drives for safety-critical applications.
- Model predictive control of AC drives – to obtain tuning free control schemes while obtaining high dynamic torque response.

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WIRELESS BATTERY CHARGERS

Keywords: wireless power transfer, wireless battery charging while driving, resonant DC/AC converters.

This topic is dedicated wireless power transfer for battery charging, including the charging for a moving vehicle. This research activity is related to the design of the power electronics, including the required infrastructure for DC power distribution.

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SPECIAL TOPICS IN POWER ELECTRONICS AND ELECTRICAL DRIVES

Keywords: on-line junction temperature estimation, overvoltage, EMI, long supply cables, testing, efficiency maps, flux linkage maps.

This activity is dedicated to particular issues in power electronics and drives, such as:

- On-line junction temperature estimation of SiC MOSFETs – for reliable operation with real-time current limitation for keeping the junction temperature within acceptable limit.
- Effects of long supply cables between the inverter (using Si and SiC technology) and the motor – for precise overvoltage estimation at motor terminals to predict the voltage stress of the motor insulation.
- Advanced testing of electrical drives – for accurate torque-speed maps, efficiency maps and flux linkage maps for permanent magnet machines and synchronous reluctance machines.

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