ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

Dumarey/DENERG - Next generation electric powertrains enabling true EV-revolution: thrilling, affordable, sustainable

Funded By	Dipartimento DENERG DUMAREY AutomotiveItalia S.p.A [P.iva/CF:09075820010]
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Context of the research activity	Design and advanced assessment of high-performance electrical machines for efficient and sustainable electric vehicle traction systems.
Objectives	The rapid transition toward sustainable mobility is driving an unprecedented growth in the adoption of electric vehicles, placing high-performance electric traction systems at the core of future transportation technologies. Electrical machines represent a critical component of electric powertrains, directly affecting vehicle efficiency, performance, reliability, and environmental impact. Consequently, the design of advanced electrical machines optimized for electric vehicle applications has become a key research challenge. Modern electric vehicles require traction machines capable of delivering high power density, high efficiency over a wide operating range, and excellent thermal and mechanical robustness, while minimizing cost and reliance on critical raw materials. Achieving these objectives demands advanced electromagnetic design techniques, and accurate multi-physics analysis frameworks that account for electromagnetic, thermal, and mechanical interactions. The proposed research aims to investigate the design and advanced analysis of high-performance electrical machines for sustainable electric vehicle traction applications. In particular, the impact of different electric motor topologies for road vehicles will be systematically evaluated in terms of overall performance, with a specific focus on drive-cycle efficiency. The research will address strategies to enhance machine efficiency and power density while minimizing losses and reducing material usage, through the exploration of alternative electrical machine design solutions. Advanced numerical modelling and simulation tools will be employed to assess the

	influence of various machine architectures on system-level performance under realistic and diverse driving conditions. The research will also investigate the integration of thermal management strategies on machine performance and reliability. The outcomes of this research will contribute to the development of more efficient, reliable, and sustainable electric traction systems, supporting the broader goals of energy efficiency, emission reduction, and technological innovation in the automotive sector.

Skills and competencies for the development of the activity	The PhD candidate is required to have a solid background in the electromagnetic principles underlying electric machine operation and energy conversion processes. Knowledge of electric machine design, as well as of their thermal and mechanical behaviour, will be regarded as a valuable qualification. Prior experience with modelling and simulation tools for electromechanical systems, such as finite element methods and multiphysics simulation platforms, as well as Python programming is highly desirable. In addition, the candidate is expected to demonstrate the ability to tackle scientific and technological challenges within a multidisciplinary framework, applying rigorous and systematic research methodologies. Special emphasis will be placed on the development of advanced and innovative solutions for electric propulsion systems in automotive applications.