MECHANICAL ENGINEERING

MUR DM117/Stellantis - Optimization of the interaction between battery & power electronic systems in BEVs/ FCEVs through electrical, thermal and vibrational analysis

Funded By	CENTRO RICERCHE FIAT [P.iva/CF:07084560015] Ministero dell'Università e della Ricerca - MUR [P.iva/CF:96446770586] Dipartimento DIMEAS
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Context of the research activity	The need to present vehicles with zero polluting emissions and low environmental impact on the market has stimulated the automotive industries to develop and propose alternative solutions to the conventional internal combustion engine propulsion system. In this context, purely electric, hybrid and hydrogen-based or alternative fuel-based vehicle architectures have have gained a relevant attention on the market. These solutions exploit electric machines to produce the driving action and regenerate and battery-based storage systems as main or auxiliary energy sources. Research activities in this field are very intense and have the objective of reaching greater levels of efficiency and performance, with particular attention paid to the electrical requirements. However, other aspects more closely related to the mechanical, thermal and vibrational behavior of the structure that supports the power electronics are also of particular interest. Furthermore, the analysis of the electrical interaction between the battery system and the new generation power electronics in high voltage propulsion systems is of particular importance. Progetto finanziato nell'ambito del PNRR - DM 117/2023 - CUP E14D23002030004
	The aim of the present activity is to address these needs by proposing: a) optimization solutions of the mechanical assembly of power electronics through multi-domain analysis to guarantee the correct cooling, the structural integrity and a low level of vibrations and b) experimental characterization of the combined system of power electronics and battery for evaluation of the

Objectives	electrical performances and of the cell degradation dynamics. The innovative contributions are: 1) Optimization of power driver housing in terms of structural and thermal performance 2) Optimization of battery system monitoring and diagnostics based on the analysis of next generation power driver-battery electrical interaction. 3) Integration of power driver and battery thermal management liquid circuits. In this activity framework, the PhD student will be involved in the following tasks: 1) Computer aided design of the power electronic system, including structural, electrical, and thermal properties and functions. 3D CAD software (Solidworks) will be adopted. 2) Experimental characterization of the power electronic along with the related housing in a laboratory environment for vibrational behavior assessment. Mechanical shaker and acquisition/processing digital tools will be adopted. 3) Experimental test and performance assessment of electrical behavior of the systems including power driver and battery prototypes. 4) Mobility period of at least 6 months at qualified internationally recognized universities or research centers.

Skills and competencies for the development of the activity	Modelling and simulation in Matlab/Simulink. CAD and CFD numerical modeling capabilities