



PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 39th cycle

**PNRR 117 Research Field: INNOVATIVE THERMAL MANAGEMENT SOLUTIONS AND
MODELLING TECHNIQUES FOR AUTOMOTIVE ELECTRIC DRIVES**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

With the recent policies to tackle climate change (e.g. European Green-Deal) the demand for cost-effective and highly-efficient electric motors is expected to surge, as they are one of the enabling technologies for zero-emission vehicles.

The cooling of electric motors and converters is seen as one of the key barriers currently limiting the performance and compactness of an electric drive and ultimately affecting its overall cost.

This PhD project will look at solutions to improve the thermal management of electric motors and converters for automotive via: i) more accurate modelling techniques for losses and heat-rejection performance prediction, to then inform optimised design procedures; ii) use of new cooling configurations based on different fluid media (e.g. multi-fluid oil/water); iii) use of phase-change materials to improve the transient overload capability.

In accordance with art. 2 and 7.3 of DM 117 02-03-2023, the project aligns with the guidelines and priorities of PNRR targeting decarbonisation of the transport sector (cf. Mission 2 – “Green Revolution & Ecological Transition”). The project is fully aligned with the “Programma Nazionale per la Ricerca - PON 2021-2027” – Area 5 (Climate, Energy & Sustainable Mobility), in particular Cross-cutting Action A4 (Green Vehicles & Networks), Priority: Propulsion systems based on



	electric technologies.
Methods and techniques that will be developed and used to carry out the research	The proposed research project will involve a literature analysis in the areas of electric motor drives, materials, and thermal management, followed by multiphysics modelling studies using analytic and numeric (e.g. finite-element) techniques. These will then feed into the design and optimisation of electric motor prototypes based on typical application requirements for automotive. The project will also include experimental activity to validate the proposed modelling techniques.
Educational objectives	The project will allow the PhD candidate to develop strong research and technical skills in the areas of electromagnetics / electric drives, and thermal management. These will include proficiency in advanced modelling techniques and use of state-of-the art simulation software and lab instrumentation. During their work on the project, the candidate will also sharpen their soft-skills in technical writing, communication, and project planning.
Job opportunities	During the project, the candidate will spend a period in industry at supporting company Mavel EDT Spa, which specialises in design and construction of electric drives for automotive. At the end of the project the candidate will have a strong technical background supplemented with some industrial experience which will facilitate taking on jobs in industry both in engineering and R&D divisions, particularly within the automotive sector and related OEMs
Composition of the research group	1 Full Professors 3 Associated Professors 0 Assistant Professors 3 PhD Students
Name of the research directors	Prof. Matteo Iacchetti

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Mavel edt S.p.A. unipersonale Via Gressoney 29 11026 Pont-Saint-Martin (AO)
By number of months at the company	18
Institution or company where the candidate will spend the period abroad (name and brief description)	Mavel Pechino 3/F, Building 2, Guosheng High Tech Park, 9 Taihe 3rd Road, Beijing Economic-Technological Development Area, Beijing 100176 China
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. This amount is equal to 10% of the annual gross amount, for 3 years. Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations. Computer availability: individual use. Desk availability: individual use.