POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 41st cycle

THEMATIC Research Field: PHYSICS-AWARE MACHINE LEARNING BASED MODELLING FOR REAL-TIME BATTERY MANAGEMENT AND STATE EVALUATION

Monthly net income of PhDscholarship (max 36 months)
1500.0 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	The battery industry gains visibility among the solution towards the green transition in the EU. For its effective implementation, a well-designed Battery Management System is an important requirement. The most critical parameters are the State of Charge, State of Health and the Remaining Useful Life of the battery. Machine Learning techniques drive the attention as solutions with high performance for the modelling of the systems among the academia and the industry. Optimization Theory and Computational intelligence techniques, multi-physics modelling and simulation will be applied to battery storage systems. Based on experimental data, methods for the State of Charge and ageing estimation of batteries will be developed and tested in industrial applications.
Methods and techniques that will be developed and used to carry out the research	To tackle this topic, Machine Learning (ML) based method, possibly exploiting physics-informed neural networks, deep-learning and particle filters (but not limited to) should be properly designed and set up. By monitoring at least, the main parameters (i.e., voltage, current, and cell temperature) the corresponding for each ageing procedure parameter should be designed and performed. Finally, the proposed framework will first be applied and verified to a single cell and afterwards, the extended framework to a battery pack will be assessed.
Educational objectives	The aim is to form a highly qualified engineer in a highly

	motivated and qualified research group, gaining experience, knowledge and skills in cutting edge technologies of the implementation of computational methods in the renewable energy, power generation, and system optimization field, involvement in international and EU projects as well as in the cooperation with leading industries and R&D institutions. The candidate will learn how to identify critical aspect specifically link to mathematical modelling of energy production and use. The candidate will learn how to communicate the results of the Ph.D. research presenting results and analysis in a scientific and industrial context.
Job opportunities	After the completion of the PhD programme, the candidate will be qualified to work in both Academia and the Industry as a Battery Engineer, Power Electronics Engineer, in the sector of Energy Storage and in the general field of Machine Learning.
Composition of the research group	4 Full Professors 4 Associated Professors 2 Assistant Professors 10 PhD Students
Name of the research directors	Prof. Sonia Leva, Prof. Emanuele Ogliari

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	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.