UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

DOTTORATO DI RICERCA / PHD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

Activities and Publications Report

PhD Student: Mattia Ribera

Student DR number: DR996625

PhD Cycle: XXXVIII
PhD Chairman: Prof. Stefano Russo

PhD program student's start date: 01/11/2022
PhD program student's end date: 31/10/2025

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PhD scholarship funding entity:

Università Federico II

General information

Mattia Ribera received in year 2022 the Master degree in Automation Engineering from the University of Napoli Federico II.

Within the PhD program in Information Technology and Electrical Engineering, he attended a curriculum in Electrical Engineering.

He received a grant from Università Federico II.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organizer(s)
1st	Reti Elettriche Intelligenti - Generatori, convertitori e dispositivi di accumulo	MSc course	6	Prof. Diego Iannuzzi	UNINA
1st	Statistical data analysis for science and engineering research	Ad hoc course	4	Prof. Roberto Pietrantuono	ITEE
1st	Electric And Hybrid Vehicles	MSc course	6	Prof. Diego Iannuzzi	UNINA
1st/2nd	Percorso per il rafforzamento delle competenze sulla progettazione europea	Ad hoc course	3.4	Dr. Tommaso Foglia, Dr. Federico Porcedda, Dr. Veronica Rocco	ITEE
2nd	Numerical Methods for Thermal Analysis, Modeling and Simulation: Application to Electronic Devices and Systems"	Ad hoc course	4	PhD. Antonio Pio Catalano	ITEE
2nd	How to boost your PhD"	Ad hoc course	5	Dr. Antigone Marino	ITEE
2nd	Using Deep Learning Properly	Ad hoc course	4	Prof. Andrea Apicella	ITEE
2nd	Sviluppo di convertitori e dispositive di accumulo per smart grids	MSc course	6	Prof. Marino Coppola	UNINA
2nd	Operational Research: Mathematical Modelling, Methods and Software Tools for Optimization Problem	Ad hoc course	4	Prof. Adriano Masone	ITEE

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organizer(s)
1st	MATLAB Campus-Wide License per la formazione nelle discipline STEM	0.2	Alessio Conte, Federico Seri	MathWorks	MathWorks
1st	Industry 4.0 Fundamentals in Bosh Applications	2	Eng. Martino Bruni, Prof. Mariagrazia Dotoli	BOSH, POLIBA	BOSH, POLIBA
1st	Accurate and Efficient Numerical Modeling Methods for Superconducting Circuit Quantum Information Processing Devices	0.2	Prof. Thomas E. Roth	Purdue University	Prof. Carlo Forestiere,DIETI
1st	Analysis and Control of Functional Brain Networks	0.2	Prof. Fabio Pasqualetti	UC Riverside	DIETI
1st	Evolution of the 3D chromatin architecture in acute leukemia	0.2	Prof. Aristotelis Tsirigos	NYU	DIETI
1st	How to Publish Under the CARE-CRUI Open Access Agreement with IEEE	0.3	Prof. Nino Grizzuti, Eszter Lukacs, Prof. Stefano Bianco	CARE-IEEE	UNINA
1st	Learning gene association networks using single-cell RNA-seq data: a graphical model approach	0.2	Prof. Davide Risso	UNIPD	UNINA
1st	The right ST sensor for you condition monitoring applications	0.2	Pasi Myllymaki,Vladimir Janousek	STMicroelectronics	STM
1st	La mobilità del future: sostenibile, sicura e connessa	0.8	Ing. Marco Toro	Nissan	DIETI
1st	Ensuring SESIP L3 security for low-power, high-performance Bluetooth LE 5.3 solutions	0.2	STMicroelectronics		
1st	Controllo di posizione di un PMSM con Simulink e Microchip 32-bit MCUs	0.2	Mathwork Team		
1st	Webinar STM Give your edge AI model a performance boost with the NVIDIA TAO Toolkit and STM32 AI solutions	0.2	STMicroelectronics		
1st	Modeling Phased Array Systems with MATLAB	0.2	Mathwork Team		
1st	Research in Energy Storage Systems for	0.4	Dr. Matilde D'Arpino	OHU	

	Automotive, Aerospace and Grid-connected Systems at The Ohio State University Center for Automotive Research				Prof. Ciro Attaianese Dr. Luigi Pio Di Noia
2nd	**Le nuove tendenze nel settore del fotovoltaico: bifacciale, agrisolare e storage**	0.8	AEIT, UNINA		Prof. Mario Pagano
2nd	**MATLAB Expertise: Machine e Deep Learning**	0.4	Salvatore Capuozzo, Vincenzo Scognamiglio	ICTH & ITEE PhD programs	Mathworks
2nd	**Impacts of Italian Infrastructure for railway high speed**	0.4	Ing. Mario Tartaglia	FS Research Centre	Prof. Mario Pagano
2nd	**Power Solutions Workshop 2024**	1	CNR Stems, CalPower and ITECH		
2nd	**Machine Deception**	0.2	Dr. Henrik Skaug Sætra	UiO	Prof. Alessandra Rossi
2nd	**From ACE Technologies to Sustainable, Accessible and Equitable Urban Mobility: An Optimisation Journey**	0.2	Prof. Mauro Salazar	TU/e	Prof. Stefania Santini
2nd	**TA Springer Nature & CARE – CRUI: Research Integrity**	0.2	Elisa Magistrelli	Springer Nature	
3rd	**Solid State Transformers: Fundamentals, Insights and New Trends**	0.2	Prof. Andrea Cervone	KU Leuven	Prof. Luigi Pio Di Noia
3rd	**Vantaggi chiave della tecnologia ble di enocean con Opple BLE2: Energy Harvesting per il funzionamento senza batteria**	0.8	Prof. Laura Bellia	DIETI-AEIT	Prof. Mario Pagano

Research activities

During the PhD, he built the full skill set to study state-of-health estimation for lithium-ion batteries, from experimental data acquisition to the implementation of estimation algorithms. An initial plan to develop an in-house cycler with Peltier thermal control was discontinued due to component failures and the impractical duration and scale of the test plan. As a "plan B," he specified the cycling protocol to obtain the datasets to be generated at FAAM's gigafactory and converted conference encounters into research collaborations, which broadened access to multi-chemistry datasets and led to joint experiments and co-authorship opportunities.

To strengthen power-electronics competence, he learned TI C2000 microcontroller programming, supported several experimental setups for PNRR projects, and developed a prototype resolver interface for accurate speed measurement—benchmarked against a commercial device—with a manuscript under review and follow-up activities defined. He contributed to the structure and drafting of papers on multi-motor drives fed by a single inverter.

In parallel, he oversaw the upgrade of an Ultra-Fast Charging Station (UFCS) with an additional battery sized for extended lifetime. He designed UFCS simulators with embedded battery-aging mechanisms to track SoH evolution and to identify the factors that drive efficient energy management. His battery expertise also informed deliverables and plenary meetings in the I-STENTORE project. Technical skills in automation and bench-instrument programming enabled him to contribute actively to research and teaching setups and to accelerate project execution.

Tutoring and supplementary teaching activities

Four MSc thesis tutoring.

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	18.2	5.8	29	0
2nd	24.2	3.2	43	0
3rd	0	1	58	0

PhD Thesis

Lithium-ion batteries enable key use cases on two fronts: in e-mobility they power vehicles and support smart-charging infrastructure; in stationary applications they shave peaks, provide flexibility services, and enhance grid resilience. When coupled with variable renewables (photovoltaic and wind), storage acts as an energy buffer: it absorbs surplus generation, delivers power during shortfalls, mitigates intermittency, and shifts energy over time. In this setting, accurate SoH estimation is essential to ensure availability, safety, and sustainable lifecycle costs. This thesis develops and contrasts two complementary pipelines for SoH estimation using laboratory datasets across multiple lithium-ion chemistries.
The first is a model-based pipeline grounded in the Impulse Response (IR) concept and ARMAX modeling. The resulting models are organized into look-up tables (LUTs) indexed by state and operating conditions; the approach offers interpretability, diagnostic capability, and predictable behavior under controlled excitations.
The second is a data-driven pipeline that employs neural networks to map preprocessed voltage, current, temperature sequences to SoH.
The thesis details the processing flow and validates the method across different chemistries.

Beyond the method-specific conclusions, the work closes with a comparative analysis that highlights key differences not only in final performance, but also in pre-processing requirements, computational cost, and implementation choices.

Research products

List of scientific publications

International journal papers

- P. Franzese, D. Iannuzzi, R. Merolla, M. Ribera, I. Spina,

  Artificial Neural Networks for Residual Capacity Estimation of Cycle-Aged Cylindric LFP Batteries, Batteries, vol. 11 (7), 2025, Article 260, DOI: 10.3390/batteries11070260.

- Dannier, G. Brando, M. Ribera, I. Spina,

  Li-Ion Batteries for Electric Vehicle Applications: An Overview of Accurate State of Charge/State of Health Estimation Methods, Energies, vol. 18 (4), 2025, Article 786, DOI: 10.3390/en18040786.

International conference papers

- G. Brando, D. Iannuzzi, M. Ribera,

  State of Health Estimation of Cycle-Aged Cylindric LFP Batteries using ARMAX Modeling,

  2024 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM 2024), 2024, pp. 668–673, DOI: 10.1109/SPEEDAM61530.2024.10609193.

- Andreotti, A. Di Pasquale, S. Meo, M. Pagano, M. Ribera,

  An AHP Approach for the Optimal Sizing of On-Board Energy Storage in DC Rail Transit Systems,

  2024 IEEE International Conference on Artificial Intelligence and Green Energy (ICAIGE 2024), 2024,

  DOI: 10.1109/ICAIGE62696.2024.10776749.

- S. Barcellona, M. Ribera, E. Fedele, L. Piegari, L. Codecasa, D. Iannuzzi,

  State of Health Estimation of $LiCoO_2$ Cells based on Impulse Response and ARMAX Identification,

  2024 IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles and International Transportation Electrification Conference (ESARS-ITEC 2024), 2024,

  DOI: 10.1109/ESARS-ITEC60450.2024.10819863.

- S. Barcellona, S. Colnago, E. Fedele, D. Iannuzzi, L. Piegari, M. Ribera,

  Cycle Aging Effect on the Open Circuit Voltage of a $LiFePO_4$ Battery,

  2023 IEEE Vehicle Power and Propulsion Conference (VPPC 2023) – Proceedings, 2023,

  DOI: 10.1109/VPPC60535.2023.10403323.

- D. Iannuzzi, M. Ribera, P. Satariano, E. Fedele, F. Pagliarini, P. Cennamo, F. Orsini, L. Petrazzuoli, M. Spinelli,

  Capacity Fade Estimation of LiFePO Cells Based on Improved Impulse Response Method: Experimental Results,

  2023 IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles and International Transportation Electrification Conference (ESARS-ITEC 2023), 2023,

  DOI: 10.1109/ESARS-ITEC57127.2023.10114873.

- P. Franzese, M. Ribera, D. Iannuzzi,

  Design Comparative Analysis of Distributed and Concentrated Electrical Power Conversion Systems for Multi-Slot Ultra-Fast Chargers,

  IET Conference Proceedings, 2023 (18), pp. 182–190, 2023, DOI: 10.1049/icp.2023.2702

- M. Ribera, M. Coppola, A. Dannier, and D. Iannuzzi,

  Aging Effect on Temperature Behaviour in Li-ion Battery Cell: a Case of Study,

  31st International Workshop on Thermal Investigation of ICs and Systems (THERMINIC 2025), Naples, Italy, Sept. 24–26, 2025, to appear in the proceedings

Date 23/10/2025

PhD student signature Mattia Ribera

Supervisor signature Diego Iannuzzi