
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

**DOTTORATO DI RICERCA / PhD PROGRAM IN
INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING**

Activities and Publications Report

PhD Student: **Antonio Di Pasquale**

Student DR number: DR995136

PhD Cycle: XXXVI

PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 01/11/2020

PhD program student's end date: 31/10/2023

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PhD scholarship funding entity: Università Federico II

General information

Antonio Di Pasquale received in the year 2019 the Master of Science degree in Electrical Engineering from the University of Cassino and Southern Lazio. He attended a curriculum in Power Systems within the PhD program in Information Technology and Electrical Engineering. He received a grant from Università Federico II.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1 st	Probability Calculus and Elements of Stochastic Modelling	Ad hoc course	6	Prof. Massimiliano Giorgio (UNINA)	MERC
1 st	Numerical Treatment of PDEs	Ad hoc course	6	Prof. Francesco Calabrò (UNINA)	MERC
1 nd	Scientific Programming and Visualization with Python	Ad hoc course	2	Prof. Alessio Botta	DIST - UNINA Polytechnic and Fundamental Sciences School
1 rd	Matrix Analysis for Signal Processing with MATLAB Examples	Ad hoc course	2	Proff. Antonio De Maio, Augusto Aubry, Dr. Vincenzo Carotenuto	ITEE
3 rd	Operational Research Mathematical Modelling, Methods and Software Tools for Optimization Problems	Ad hoc course	4	Prof. Adriano Masone	ITEE

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
1 st	European PHD School 2021: Power Electronics, Electrical Machines, Energy Control and Power	From remote	4	12/07/2021 - 16/07/2021	University of Cassino
2 nd	Ph.D. School F. Gasparini	Naples	6	24.02.22 - 28.02.22	Create Consortium

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 st	Patent Searching Best Practices with IEEE	0.2	Dr. Eszter Lukacs	IEEE	ITEE

Activities and Publications – Final Report

UNINA PhD in Information Technology and Electrical Engineering – XXXVI Cycle

PhD candidate: Antonio Di Pasquale

	Xplore				
1 st	How to Get Published with IEEE	0.3	Dr. Paul Henriques	IEEE	ITEE
1 st	Modellistica dinamica di una rete elettrica zonale di distribuzione in corrente continua	0.2	Prof. Giorgio Sulligoi	External seminar at University of Trieste	AEIT
1 st	Introduction to Underwater Robotics	0.4	Dr. Fabio Ruggiero - DIETI - Unina	University of Naples Federico II	DIETI
1 st	21 MATLAB Features You Need Now	0.3	Dr. Loren Shure	MathWorks	MathWorks
1 st	MATLAB for Analyzing and Visualizing Geospatial Data	0.4	Dr. Loren Shure	MathWorks	MathWorks
1 st	Deep Learning Overview for Signals and Time Series	0.4	Dr. Loren Shure	MathWorks	MathWorks
1 st	Qiskit: state of the art and tools for Quantum Computers from IBM	0.4	Prof. A. S. Cacciapuoti	University of Naples Federico II	DIETI
1 st	SAR Polarimetry: Theory, Machine Learning & Applications	0.4	Prof. A. Iodice	University of Naples Federico II	DIETI
2 nd	All roads lead to WebRTC: an introduction to Janus	0.4	Dr. Lorenzo Miniero	Meetecho, company consulting services	ITEE
2 nd	The Spatial structure of Bi-photon States	0.2	Dr. Alessandro D'errico	University of Ottawa	QST Seminar
2 nd	La CATENARIA RIGIDA: Applicazione sulle linee RFI	0.4	Eng. Claudio Spalvieri	RFI	Collegio Ingegneri Ferroviari Italiani
2 nd	Potential and challenges of next generation railway signaling systems: Moving Block and Virtual Coupling	0.2	Eng. Joelle Aoun	University of Technology (TU Delft)	ITEE
2 nd	History of Fusion	0.6	Prof. Piero Martin	Università di Padova	Università di Padova
2 nd	La Sostenibilità del Trasporto Pubblico Locale su Ferro: Elementi di Efficientamento	0.7	Prof. Mario Pagano	University of Naples Federico II	DIETI - UNINA
2 nd	Inkjet printing	0.2	Prof. Detlef Lohse	University of Twente	Ecolé Polytechnique Fédérale de Lausanne (EPFL)
2 nd	MATLAB Campus-Wide	0.2		MathWorks	UNINA Polytechnic

Activities and Publications – Final Report

UNINA PhD in Information Technology and Electrical Engineering – XXXVI Cycle

PhD candidate: Antonio Di Pasquale

	License per la formazione nelle discipline STEM				and Fundamental Sciences School
3 rd	Title Analysis and control of functional brain networks	0.2	Prof. Fabio Pasqualetti	University of California at Riverside	SSM
3 rd	How to Publish Under the CARE-CRUI Open Access Agreement with IEEE	0.4	Nino Grizzuti, Eszter Lukacs, Stefano Bianco	IEEE	IEEE
3 rd	La mobilità del futuro: sostenibile, sicura e connessa	0.8	Ing. Marco Toro	Nissan Italia	DIETI
3 rd	Exploring Advanced Aerial Robotics: A Journey into Cutting-Edge Projects and Neural Control	0.2	Eugenio Cuniato	Autonomous System Lab - ETH Zürich	ITEE
3 rd	Sistemi Di Ricarica Elettrica	0.4	Eng. Lorenzo Dell'Aquila	ABB	DIETI
3 rd	Research in Energy Storage Systems for Automotive, Aerospace and Grid-connected Systems at The Ohio State University Center for Automotive	0.4	Prof. Matilde D'Arpino	Ohio State University Center for Automotive	DIETI
3 rd	Progettazione e produzione di Macchine elettriche ad elevate prestazioni per il settore aereospaziale	0.8	Eng. Francesco Fiume	Electro Motor Solutions srl	DIETI
3 rd	IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors	0.3	Rachael Berrington	IEEE	IEEE
3 rd	Compact Converters using GaN HEMTs for Pulsed Power Applications	0.3	Harish Sarma Krishnamoorthy	IEEE PELS	IEEE PELS
3 rd	Safeguarding Next-Generation Power Electronics Systems: A Cyber-Physical Security Perspective	0.3	Jin Ye	IEEE PELS	IEEE PELS

Research activities

Antonio Di Pasquale participated in the research on

- i. **Modelling of DC railway systems:** this research primarily revolves around the investigation and development of steady-state models specifically designed for traction power flow analysis. This activity also includes studies on the dynamic behaviour of these systems during short-circuit conditions.
- ii. **Optimal control strategies for urban rail systems:** this activity focuses on developing centralised control strategies for efficient management of urban rail systems, aligning with the smart grid concept. These strategies are formulated as optimal traction power flow problems, considering variables such as energy storage systems' charging/discharging power, train regenerative braking power, and traction substations' voltage.
- iii. **Harmonic power-flow study of polyphase grids with converter-interfaced distributed energy resources:** this research focuses on the harmonic power flow model for AC distribution grids, especially in the context of increasing renewable energy resources. It assesses mathematical properties and conditions guaranteeing the existence and uniqueness of solutions for the harmonic power flow problem.
- iv. **Scheduling algorithms for ultra-fast recharge of plug-in electric vehicles:** this research involves the development of online scheduling algorithms to find optimal ultra-fast charging power profiles for multiple vehicles in the same charging station.

Tutoring and supplementary teaching activities

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1 st	20	3	37	0
2 nd	6	2.9	51.1	0
3 rd	4	4.1	51.9	0

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2 nd	Ecolé Polytechnique Fédérale de Lausanne (EPFL)	Prof. Mario Paolone	12/09/2022 – 31/10/2022	Research on the mathematical properties of harmonic power flow in polyphase grids with converter-interfaced distributed energy resources, ensuring the existence and uniqueness of the solution.
3 rd	Ecolé Polytechnique Fédérale de Lausanne (EPFL)	Prof. Mario Paolone	01/11/2022 – 12/12/2022	Research on the mathematical properties of harmonic power flow in polyphase grids with converter-interfaced distributed energy resources, ensuring the existence and uniqueness of the solution.

PhD Thesis

In the PhD Thesis, Antonio Di Pasquale concentrated on the analysis and enhancement of urban rail systems. The primary research objectives are to establish a detailed system model customised for steady-state traction power flow analyses and to develop optimal centralised control strategies in line with modern smart grid concepts.

Regarding the first objective, the thesis presents a comprehensive set of steady-state models that encompass various AC/DC substation configurations, the traction line, wayside and onboard energy storage devices, as well as train over-current and over-voltage protection systems. These models are employed in steady-state analyses of the system aimed at evaluating its behaviour under both local and centralised control. Additionally, the research addresses issues related to limited traction network receptivity, specifically, how to simulate the behaviour of local controllers when the network reaches its receptivity limit. In this context, a sensitivity matrix-based approach has been proposed.

Regarding the second objective, the thesis introduces a real-time centralised control approach to overcome the limitations of local control. Indeed, systems under local control, perform the regulation of powers, voltages, and currents relying on local measurement, which can lead to suboptimal power management. Conversely, by exploiting extensive data exchange with all connected devices, the centralised control pursues a global optimisation of the system. The central controller accomplishes this by solving an optimization problem whose objective function and constraints are defined by the adopted strategy. Particularly, the thesis proposes four control strategies, for four different configurations of the traction system. Controllable variables include energy storage systems’ charging and discharging power, trains’ regenerative power and reversible substations’ voltages. These variables are leveraged to achieve the global optimum for the traction system.

Finally, to evaluate the effectiveness of the proposed centralised control strategies, the Naples Metro Line 1 is employed as a real case study. Specifically, the numerical analysis compares the energy efficiency of the metro system under local control with that under centralised control. The comparison highlights that the adoption of the centralised control paradigm results in an increased network receptivity, which leads to a significant reduction in energy consumption.

Research products

Research results appear in 3 papers published in international journals and 13 contributions to international conferences.

List of scientific publications

International journal papers

1. Marilisa Botte, Luca D’Acierno, Antonio Di Pasquale, Fabio Mottola, Mario Pagano. Optimal motion of a rolling stock fleet under traction power system constraints. In IEEE Transactions on Transportation Electrification, 9(1), 1554-1563, 2022, IEEE. [doi: 10.1109/TTE.2022.3181790](https://doi.org/10.1109/TTE.2022.3181790).
2. Ciro Attaianese, Antonio Di Pasquale, Pasquale Franzese, Diego Iannuzzi, Mario Pagano, Mattia Ribera. A model-based EVs charging scheduling for a multi-slot Ultra-Fast Charging Station. In Electric Power Systems Research, 216, 109009, 2023, Elsevier. <https://doi.org/10.1016/j.epsr.2022.109009>
3. Marilisa Botte, Luca D’Acierno, Antonio Di Pasquale, Fabio Mottola, Mario Pagano. Optimal Allocation of Layover Time in a Smart DC Railway Metro Traction System. In IEEE Transactions on Vehicular Technology. (Accepted)

International conference papers

1. Amedeo Andreotti, Bianca Caiazzo, Antonio Di Pasquale, Mario Pagano. On Comparing Regressive and Artificial Neural Network Methods for Power System Forecast. In 2021 AEIT International Annual Conference. (AEIT), 1-6, 2021, IEEE. [doi: 10.23919/AEIT53387.2021.9626938](https://doi.org/10.23919/AEIT53387.2021.9626938).
2. Pasquale Franzese, Antonio Di Pasquale, Diego Iannuzzi, Mario Pagano. Electric Ultra Fast Charging Stations: a Real Case Study. In 2021 AEIT International Annual Conference (AEIT), 1-6, 2021, IEEE. [doi: 10.23919/AEIT53387.2021.9626929](https://doi.org/10.23919/AEIT53387.2021.9626929).
3. Amedeo Andreotti, Antonio Di Pasquale, Fabio Mottola, Mario Pagano, Daniela Proto. Voltage Quality of an AC Grid Supplying a Railway Power System with Energy Saving Strategy. In 2022 20th International Conference on Harmonics & Quality of Power (ICHQP), 1-6, 2022, IEEE. [doi: 10.1109/ICHQP53011.2022.9808421](https://doi.org/10.1109/ICHQP53011.2022.9808421).

4. Emanuele Fedele, Antonio Di Pasquale, Diego Iannuzzi, Mario Pagano. Integration of Onboard Batteries and Supercapacitors Based on the Multi-Source Inverter for Light Rail Vehicles. In 2022 International Power Electronics Conference (IPEC-Himeji 2022-ECCE Asia), 698-704, 2022, IEEE. [doi: 10.23919/IPEC-Himeji2022-ECCE53331.2022.9807195](https://doi.org/10.23919/IPEC-Himeji2022-ECCE53331.2022.9807195).
5. Antonio Di Pasquale, Emanuele Fedele, Diego Iannuzzi, Mario Pagano. Contribution of Wayside Energy Storage Systems to Short Circuit Currents in DC Railway Traction Power Systems. In 2022 International Power Electronics Conference (IPEC-Himeji 2022-ECCE Asia), 1101-1106, 2022, IEEE. [doi: 10.23919/IPEC-Himeji2022-ECCE53331.2022.9807195](https://doi.org/10.23919/IPEC-Himeji2022-ECCE53331.2022.9807195).
6. Amedeo Andreotti, Antonio Di Pasquale, Mario Pagano, Nagananthini Ravichandran, Francesco Volpe. An Optimal Centralized Control Strategy for Regenerative Braking Energy Flow Exchanges in DC Railway Traction Systems. In 2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), 436-441, 2022, IEEE. [doi: 10.1109/SPEEDAM53979.2022.9841998](https://doi.org/10.1109/SPEEDAM53979.2022.9841998).
7. Antonio Di Pasquale, Mario Pagano, Carlo Petrarca, Francesco Volpe. Assessing a Health Index Algorithm for High Voltage Overhead Power Lines. In 2022 AEIT International Annual Conference (AEIT), 1-6, 2022, IEEE. [doi: 10.23919/AEIT56783.2022.9951791](https://doi.org/10.23919/AEIT56783.2022.9951791).
8. Amedeo Andreotti, Antonio Di Pasquale, Mario Pagano, Nagananthini Ravichandran, Francesco Volpe. Analysis of Lightning Transients in 2x25 kV 50 Hz Railway Traction System using EMTP. In 2022 AEIT International Annual Conference (AEIT), 1-6, 2022, IEEE. [doi: 10.23919/AEIT56783.2022.9951858](https://doi.org/10.23919/AEIT56783.2022.9951858).
9. Ciro Attaianese, Antonio Di Pasquale, Emanuele Fedele, Diego Iannuzzi, Mario Pagano, Mattia Ribera. Energy Efficiency Assessment for an Ultra-Fast Charging Station. In 2022 IEEE Vehicle Power and Propulsion Conference (VPPC), 1-7, 2022, IEEE. [doi: 10.1109/VPPC55846.2022.10003390](https://doi.org/10.1109/VPPC55846.2022.10003390).
10. Nagananthini Ravichandran, Amedeo Andreotti, Mario Pagano, Antonio Di Pasquale, Francesco Volpe. Interconnection Topologies for Floating Photovoltaic System to Enhance the Power Output by Reducing the Mismatch Losses. In 2022 IEEE PES 14th Asia-Pacific Power and Energy Engineering Conference (APPEEC), 1-6, 2022, IEEE. [doi: 10.1109/APPEEC53445.2022.10072079](https://doi.org/10.1109/APPEEC53445.2022.10072079).
11. Antonio Di Pasquale, Mario Pagano, Fabio Villone, Antonio Martinelli, Luigi Rufolo, Maurizio Santamaria, Francesco Vaccaro. Modelling and Determination of Short Circuit Traction Line Parameters for the Italian 3 kV DC Railway System. In 2023 IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles & International Transportation Electrification Conference (ESARS-ITEC), 1-6, 2023, IEEE. [doi: 10.1109/ESARS-ITEC57127.2023.10114847](https://doi.org/10.1109/ESARS-ITEC57127.2023.10114847).
12. Antonio Di Pasquale, Emanuele Fedele, Diego Iannuzzi, Mario Pagano. Centralised Control Strategy for an Urban Rail Network in the Presence of Onboard Storage Systems. In 2023 AEIT International Annual Conference (AEIT). (Accepted)
13. Nagananthini Ravichandran, Amedeo Andreotti, Antonio Di Pasquale, Mario Pagano, Daniela Proto, Erika Stracqualursi, Rodolfo Araneo, Luigi D’Orazio. Selection of Viable Distribution Line Surge Arrester for Prospective Optimal Protection. In 2023 AEIT International Annual Conference (AEIT). (Accepted)

Activities and Publications – Final Report

UNINA PhD in Information Technology and Electrical Engineering – XXXVI Cycle

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Date 20 October 2023

PhD student signature



Supervisor signature
