



UNIVERSITÀ DEGLI STUDI DI NAPOLI  
**FEDERICO II**

**itee**<sup>PhD</sup>  
information technology  
electrical engineering



**DIE**  
**TI**

**UNI**  
**NA**

# Antonio Di Pasquale

## Sustainable Mobility in Urban and Suburban Context

Tutor: Prof. **Mario Pagano**

Cycle: **XXXVI**

Year: **First**

# Background

- M.Sc. in Electrical Engineering – Università degli Studi di Cassino e del Lazio Meridionale
- Research group: Power Systems (ING-IND/33)
- PhD start date: 01/11/2020 (Academic Year 2020-2021)
- Scholarship type: “UNINA”

# Research field of interest

- Plug-in Electrical Vehicles: DC fast charging infrastructure
- Modelling and analysis of power systems
- Optimal strategies for railway system
- Power forecasting

# Summary of study activities (1/2)

- Ad hoc PhD courses

**Probability Calculus and Elements of Stochastic Modelling:** fundamentals of probability calculus and elements of stochastic modelling.

**Numerical Treatment of PDEs:** weak solution of PDEs, Galerkin methods, Finite Elements Elliptic and time-dependent problem.

**Scientific Programming and Visualization with Python:** fundamentals of Python programming.

**Matrix Analysis for Signal Processing with MATLAB Examples:** The course provides an overview on some topics in matrix theory together with their intrinsic interaction with and application to signal processing. The most important and "useful" tools, methods, and matrix structures are emphasized and complemented with MATLAB examples.

# Summary of study activities (2/2)

- Courses borrowed from MSc curricula

**Teoria dei sistemi (Prof. G. Antonelli – UNICAS):** Introduction state-space representation. Modal analysis. Controllability, observability, Kalman decomposition. State estimation.

- Doctoral School

**European PHD School 2021 Power Electronics, Electrical Machines, Energy Control and Power Systems** (12/07/2021 - 16/07/2021; virtual).

- Conferences

**2021 AEIT International Annual Conference**, 4-8 October 2021, online conference, presenting author.

# Research activity: Overview (1/3)



## ➤ Optimal strategies for railway systems:

**Optimization of train and a fleet of train speed profile** in terms of minimizing traction energy consumption, impact on the primary grid, in the respect of the timetable constraints.

Approaches are based on **analytical and numerical algorithms**. Models can be continuous, discrete or hybrid. The numbers of variables and constraints involved in the model can vary (e.g., time, space, acceleration, speed, assigned running time, and maximum acceleration).

# Research activity: Overview (2/3)

## ➤ Ultra-fast EV charging:

Typically, UFCS are equipped with Energy Storage Systems (ESSs) and by Renewable Energy Sources (RESs), in order to reach high power without undue stress on the grid. UFCS looks like a micro-grid where renewable, storage and grid power flows move in a LV distribution system in order to supply varying electrical loads.

Hence, this activity focuses on the management of the Ultra-fast charging stations, with particular attention to the scheduling of the recharge of one or more vehicles simultaneously.



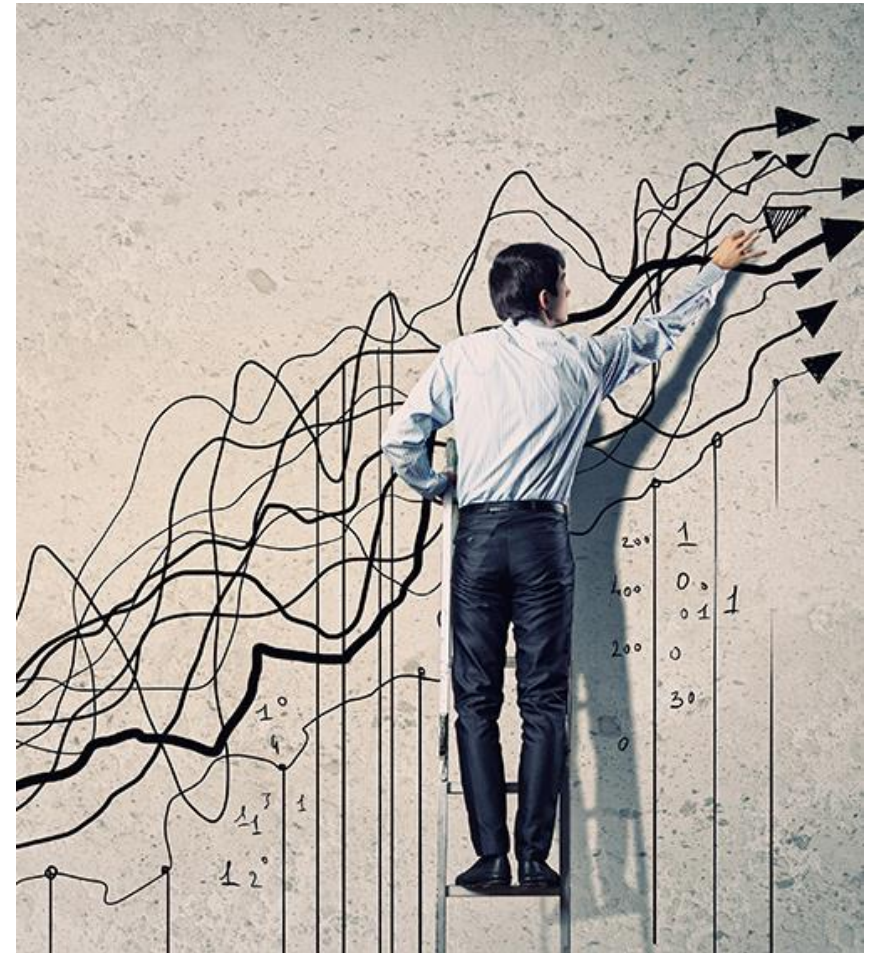


# Research activity: Overview (3/3)

## ➤ Power forecasting:

The **uncertainty** related to the nature of **Renewable Energy Sources** represents a hard challenge, for the Transmission System Operators (TSOs) and Distribution System Operators (DSOs), in order to manage the electric balance between power demand and supply and to improve the penetration of distributed renewable energy sources

Whilst **statistical methods** are the most popular for historical reasons, the current trend aims to evaluate the effectiveness of **AI methods** for accurate forecasts.





# What's next?

- Assess the benefits of the solutions proposed for the optimal management of railway systems on the distribution networks.
- Assess the effectiveness of the solution proposed for the scheduling of EVs recharge on the actual structure at the DIETI.
- Assess the real potential of ANN in terms of power forecasting, by analyzing a wide scenario as it could be the power forecasting of an entire nation.
- Address the short-circuit current calculation in a DC grid.
- Modeling of power grid signals in the presence of reduced system inertia (*in collaboration with EPFL Distributed Electrical Systems Lab*).

# Products

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|------|--|
| [C1] | Andreotti, A., Caiazzo, B., Di Pasquale, A., & Pagano, M. (2021). On Comparing Regressive and Artificial Neural Network Methods for Power System Forecast. <i>In 2021 AEIT International Annual Conference (AEIT)</i> . IEEE.  |
| [C2] | Franzese, P., Di Pasquale, A., Iannuzzi, D., & Pagano, M. (2021). Electric Ultra Fast Charging Stations: a Real Case Study. <i>In 2021 AEIT International Annual Conference (AEIT)</i> . IEEE.   |
| [C3] | Botte, M., D’Acierno, L., Di Pasquale, A., Mottola, F., & Pagano, M. Performance Improvements of Traction Power Systems by Coordinating the Motion of a Fleet of Metro Trains in terms of Layover Time. <i>In 2021 IEEE Vehicle Power and Propulsion Conference (VPPC)</i> . IEEE. |
| [J1] | M. Botte, L. D’Acierno, A. Di Pasquale, F. Mottola, M. Pagano, “Optimal Motion of a Fleet of Rolling Stocks in presence of Traction Power System Constraints”, <i>IEEE Transactions on Vehicular Technology</i> . <b>(Submitted)</b>   |
| [J2] | C. Attaianese, A. Di Pasquale, P. Franzese, D. Iannuzzi, M. Pagano, “An Optimal Power Scheduling for Multiple EV Parking Slots of Ultra Fast Charging Station”, <i>IEEE Transactions on Smart Grid</i> . <b>(Submitted)</b>  |

Thank you for the attention!