



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Pasquale Natale

XXX Cycle

Training and Research Activities Report – Third Year

Tutor: Diego Iannuzzi



1. Information

My name is Pasquale Natale and I graduated cum laude in Electrical Engineering at University of Naples Federico II. I am a Ph.D student in Information technology and Electrical Engineering (XXX cycle) at the same University and my tutor is Prof. Diego Iannuzzi. My fellowship is financed by Ansaldo STS S.p.A to perform research activities concerning the “methodologies and technologies for increasing the energy efficiency in light railway systems”.

2. Study and training activities

a) External Courses

- *Preparation course, attended at the university linguistic center, to get the FCE qualification (B2 English level). The final exam was successfully passed.*

b) Seminars

- “Software design diversity from conceptual models to practical implementations”, Peter Popov (0,4 CFU);
- “L’innovazione nel mercato IT”, Giovanni Pirollo, Aldo Francesco Fucito (0,8 CFU);
- “Power system stability and synchronization: application to the lost power grid system”, Navdeep M. Singh (0,3 CFU).

3. Research activity

My research activity concerns the methodologies for improving the energy efficiency in urban electrified railway transportation systems, in particular by means of energy storage systems and by the optimization of railway vehicles’ traction cycle.

During the last year my work mainly focused on the assessment and validation of two control strategies developed for wayside energy storage systems in urban rail application. In the follow my research activities are listed and briefly described:

- a) Experimental test of wayside supercap-based energy storage system for urban railway applications: this activity has been performed in collaboration with Ansaldo STS and Hitachi Rail Italy in continuation of the research project SFERE – “Sistemi Ferroviari: Eco-sostenibilità e Risparmio Energetico” (PON01_00595).

An algorithm for the line voltage control of the energy storage system was developed and experimentally assessed on a 1:1 scaled test bench built up in the laboratory of HRI.

The final goal of this research activity was the impact evaluation of the ESS on the simulated DC traction system.

- b) Study, simulation and experimental tests of an optimal control strategy for wayside energy storage systems in urban electrified transportation systems: during the last year this activity led to the evaluation of a simple control law in an analytical closed form for the energy storage system, starting from the resolution of an optimization problem aiming the minimization of the line losses. It was compared with other control strategies on a simple case study by means of numerical simulations in Matlab/Simulink environment; then it was experimentally assessed by means of tests performed with a on scale simulator of the physical system set up in the Trasportation Laboratory of DIETI. Finally, the control strategy was generalized for complex rail urban networks and verified by means of numerical applications on a proper tool developed in Matlab/Simulink environment. This tool automatically generates the mathematical model of the traction system by means of a special modelling approach.
- c) Study on recent research trends for the optimization of vehicles' speed profiles in rail application: This activity led to produce a conference work dealing with a survey on the most recent techniques and approaches for designing optimal Automatic Train Operation systems algorithms.
- d) Preparation of a technical proposal for the implementation of a smart metering platform in rail application: this activity was performed by working closely to the Innovation Unit of Ansaldo STS in the framework of the European research project "Shift2rail" and in partnership with the main European rail manufacturers. This led to draw up a technical proposal whose content will be developed and implemented in the next years.

4. Products

- a) Published works
- *F. Ciccarelli, D. Iannuzzi, D. Lauria and P. Natale, "Optimal Control of Stationary Lithium-Ion Capacitor-Based Storage Device for Light Electrical Transportation Network," in IEEE Transactions on Transportation Electrification, vol. 3, no. 3, pp. 618-631, Sept. 2017*
 - *P. Caramia, G. Lauro, P. Natale, M. Pagano, "Automatic train operation systems: a survey on algorithms and performance index" AEIT International Annual Conference, Cagliari 20-22 September 2017*
- b) Works in preparation
- *F. Ciccarelli, D. Iannuzzi, P. Natale, "Comparison of wayside ESS control strategies for urban rail application".*

Training and Research Activities Report – Third Year

PhD in Information Technology and Electrical Engineering – XXX Cycle

Pasquale Natale

5. Tutorship

I was involved in laboratory sessions on power electronics and within the M. Sc. Course “Propulsione dei veicoli elettrici” (total amount of 20 hours)

6. Credit summary

	Credits year 3						Summary
	1	2	3	4	5	6	
Estimated	Bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	
Modules	0	0	0	0	0	0	0
Seminars	1,1	1,2	0	0	0,3	0	1,5
Research	58,9	15	3,5	5	15	10	58,5
	60	16,2	3,5	5	15,3	10	60

Year	Lecture/Activity	Type	Credits	Certification	Notes
3	FCE preparation course	External course	0	x	I got the certification
3	Software design diversity from conceptual models to practical implementations	Seminar	0,4	x	
3	L'innovazione nel mercato IT	Seminar	0,8	x	
3	Power system stability and sincronization: application to the lost power grid system	Seminar	0,3	x	