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 – Second 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 for research in " methodologies and technologies for increasing energy efficiency in light railway systems".

2. Study and training activities

a) Courses
- *"Sistemi elettrici per i trasporti*", M.Sc. course, held by Prof. Guido Carpinelli (0 CFU)
- *"Misure per l'automazione e la produzione industriale"* M.Sc. course, held by Rosario Schiano Lo Moriello (9 CFU)

b) Seminars
- *"Security operations in una Telco, esperienze e riflessioni sul campo",* Fabio Zamparelli (0,4 CFU);
- *"The evolution of railway signaling system*", Giovanni Bargellini – Giovanni Trezza (0,6 CFU);
- *"Radar adaptivity: antenna based signal processing technique",* Alfonso Farina (0,5 CFU);
- *"Gielis transformations in the natural sciences and technology",* Johan Gielis (0,3 CFU);
- *"Perception-based surround sound recording and reproduction",* Enzo De Sena (0,3 CFU);
- *"Programmable network conjungations",* Roberto Bifulco (0,4 CFU);
- *"Title speech technology at trinity college – Dublin",* Loredana Cerrato (0,2 CFU);
- *"Microcontrollori di misura",* Alan Smith – Giovanni di Sirio (0,5 CFU);
- *"Challenging real-time measurement systems for immersive life-size augmented environment",* Giovanni Caturano (0,5 CFU);
- *"Il monitoraggio della qualità del servizio oltre gli indicatori standard: l'esperienza sulla rete mobile di Telecom Italia",* Alma Fazzolari (0,4 CFU);
- *"Embedded software validation",* Teoresi Group (0,4 CFU);
- *"Reti di telecomunicazioni in Campania: esperienze ed opportunità",* Francesco Castagna – Christian Pepe – Giuseppe Zonda (0,4 CFU);
- *"DDoS detection in cloud and campus networks",* Jill Jermyn (0,2 CFU);
- *"Automated generation of dynamic parking maps based on crowd-sensing",* Fabian Bock (0,2 CFU);

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- *"Extracting WinAPI call graphs for inferring malicious behaviours"*, Ricardo J. Rodriguez (0,2 CFU);

c) External courses
- *3rd edition of the summer school on smart grid: the integration of energy storage resources into today and tomorrow's grids*, 27-30 June 2016 , Salerno (Italy) (5 CFU);

3. Research activity

My research activity refers to 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 last year my work focused firstly on the state of the art about the design and modelling of DC electrified traction systems and about the different control strategies concerning the so-called "eco-drive".

After this step I worked on the following topics :

a) <u>Analysis, numerical simulation and experimental test of wayside supercap-based energy storage system for urban railway applications</u>: 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).

The final goal of this research activity is the study of the behaviour and the improvements of performances of the simulated DC traction system integrated with a supercap-based energy storage system installed along the track.

The improvement with respect to the tests already carried out in the contest of project SFERE consists in a new control strategy for the storage device and in the use of a real traction equipement in the test bench set up in HRI laboratory.

The activity is currently in progress.

b) <u>Study and simulation of a "real time" control strategy for wayside energy storage systems in urban electrified transportation systems</u>: during the second year this activity, has led to the evaluation of a very simple control law for the energy storage system, starting from the analytical resolution of an optimization problem aiming the minimization of line losses. The resulting optimal sizing of the storage system has been tested on a case study by means of numerical simulation in Matlab/Simulink environment and the robusteness of the control law has been performed by verifying the optimal response of the controlled system against the random variations of significant traction parameters.

This activity in currently in progress and the effectiveness of the proposed control strategy will be proved by means of proper tests performed with a on

scale simulator of the physical system set up in the Trasportation Laboratory of DIETI.

c) <u>Study and simulation of an energy saving approach for optimizing vehicles' speed profiles in metro application</u>: This activity has led to a procedure for detecting the optimal speed profile of a metro vehicle in terms of energy consumption while satisfying specified technical and operating constraints. The proposed procedure was applied to a real urban railway system and the results were compared to those ones obtained by maximizing the vehicle performances.

d) <u>Study and implementation of a tool for the simulation of a DC electrified traction network integrated with a wayside energy storage system</u>: This activity has led to the implementation of a tool in Matlab/Simulink environment for the simulation of the behavior of a complex DC railway network by the electrical point of view. Starting from supply line, track and vehicles features and from operating conditions, the tool generates the mathematical model of the physical system.
The next step will be the possibility to simulate the optimal integration of the traction system with an energy storage system, on the basis of a proper objective function.

4. Products

a) Published works
- *Caramia P., Mottola F., Natale P., Pagano M., "Energy Saving Approach for Optimizing Speed Profiles in Metro Application", International Conference on Electrical Systems for Aircraft, Railway and Ship Propulsion (ESARS)",* Toulouse (France) 02-04 November 2016

b) Works in preparations
- *Iannuzzi D., Lauria D., Natale P.,"A real-time control strategy for supercapacitor-based energy storage systems in light electrical transportation networks"*

5. Conferences and Seminars

6. 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)

7. Credit summary

	Credits year 2							
	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary
Modules	**9**		9		5			14
Seminars	**6**	1	1,5	1,2	1,4	0	0,4	**5,5**
Research	**45**	6	6,5	7	7	7	7	**40.5**
	60	7	17	8,2	13,4	7	7,4	60

Year	Lecture/Activity	Type	Credits	Certification	Notes
2	Misure per l'automazione e la produzione industriale	MS Module	9	x	
2	3rd edition of the summer school on smart grid: the integration of energy storage resources into today and tomorrow's grids	Doctoral school	5	x	
2	Sistemi elettrici per i trasporti	MS Module	0	\	I only attended the course
2	Security operations in una Telco, esperienze e riflessioni sul campo	Seminar	0,4	x	
2	The evolution of railway signaling system	Seminar	0,6	x	
2	Radar adaptivity: antenna based signal processing technique	Seminar	0,5	x	
2	Gielis transformations in the natural sciences and technology	Seminar	0,3	x	
2	Perception-based surround sound recording and reproduction	Seminar	0,3	x	
2	Programmable network conjungations	Seminar	0,4	x	
2	Title speech technology at trinity college – Dublin	Seminar	0,2	x	
2	Microcontrollori di misura	Seminar	0,5	x	
2	Challenging real-time measurement systems for immersive life-size augmented environment	Seminar	0,5	x	
2	Il monitoraggio della qualità del servizio oltre gli indicatori standard: l'esperienza sulla rete mobile di Telecom Italia	Seminar	0,4	x	
2	Embedded software validation	Seminar	0,4	x	

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2	Reti di telecomunicazioni in Campania: esperienze ed opportunità	Seminar	0,4	x	
2	DDoS detection in cloud and campus networks	Seminar	0,2	x	
2	Automated generation of dynamic parking maps based on crowd-sensing	Seminar	0,2	x	
2	Extracting WinAPI call graphs for inferring malicious behaviours	Seminar	0,2	x	

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