
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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

Activities and Publications Report

PhD Student: Salvatore Tessitore

Student ID: DR993883

PhD Cycle: XXXV

PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 01/11/2019

PhD program student's end date: 31/10/2022

Supervisor: Leopoldo Angrisani

e-mail: Leopoldo.angrisani@unina.it

Co-supervisor: Annalisa Liccardo

e-mail: annalisa.liccardo@unina.it

PhD scholarship funding entity:

No scholarship.

General information

Salvatore Tessitore received the Master’s Degree in Electrical Engineering in 2019 from the University of Naples Federico II. He attended a curriculum in Measurements within the PhD program in Information Technology and Electrical Engineering. He enrolled into the ITEE PhD program without a grant.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1	Sensori e trasduttori di misura	MSc course	9	Prof. Schiano Lo Moriello Rosario, DII	University of Napoli Federico II
1	Innovation management, entrepreneurship and intellectual property	Ad Hoc Course	5	Prof. Pierluigi Rippa, DII	University of Napoli Federico II
1	Introduzione ai microcontrollori e controlli dei motori elettrici	Ad Hoc Course	3	Ing. Alan Smith, STMicroelectronics	STMicroelectronics
1	Misure su sistemi wireless	MSc course	9	Prof. Leopoldo Angrisani	University of Napoli Federico II
2	Laboratorio di Misure	MSc course	6	Prof. Schiano Lo Moriello Rosario, DII	University of Napoli Federico II
2	Statistical data analysis for science and engineering research	MSc course	4	Prof. Roberto Pietrantuono	University of Napoli Federico II

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
1 st	ITALO GORINI 2020	Napoli, Italy	3	4 st – 9 th September	GMEE
2 nd	ITALO GORINI 2021	Napoli, Italy	3	6 st – 10 th September	GMEE

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 st	Computational Biology: Large scale data analysis to understand the molecular based of human diseases.	0.2	Prof. Michele Ceccarelli	University of Napoli Federico II	DIETI
1 st	How to get published with the IEEE	0.4	Dr.ssa Eszter Lukacs	IEEE	IEEE

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1 st	Introduction to convolutional neural networks: analysis and algorithms	0.7	Dr Davide Ruggiero	R&D ST Microelectronics	ST Microelectronics
1 st	Large Scale Training of Deep Neural Networks	0.4	Giuseppe Fiameni, PhD.	University of Napoli Federico II	DIETI
1 st	Design e Nuove tecnologie. Possibili scenari per fronteggiare l'emergenza	0.2	Amleto Picerno Ceraso	Innovation Village	DIETI
1 st	La programmazione europea e la ricerca. La gestione di un progetto di ricerca	0.4	Ing. Filippo Ammirati	Innovation Village	DIETI
1 st	Health 4.0 – La rapidità della medicina e la velocità del cambiamento del nostro mondo	0.4	Paolo Netti	Innovation Village	DIETI
1 st	Realtà Virtuale e salute reale. Health 4.0 – Dal bit alla mente: spazi virtuali per la salute	0.5	Valentino Megale	Innovation Village	DIETI
1 st	Planning 5G under EMF constraints: challenges and opportunities	0.4	Prof. Luca Chiaraviglio	University of Rome Tor Vergata	DIETI
1 st	Joint Design of Optics and Post-Processing Algorithms Based on Deep Learning for Generating Advanced Imaging Features	0.4	Raja Giyres	IEEE Computational Imaging Technical Committee	IEEE
1 st	Virtual Seminars on "Sensing"	0.8	Prof. Carlo Forestiere	University of Napoli Federico II	DIETI
1 st	In dato veritas. Bugie e verità della data analysis	0.4	Innovation Village	Innovation Village	DIETI
1 st	Bias from the wild". Part of the CVLP Computer Vision and Machine Learning on-line seminar series	0.4	Prof. Nello Cristianini	University of Bristol	DIETI
1 st	Noninvasive Mapping of Electrical Properties using MRI	0.3	Prof. Riccardo Lattanzi	University of New York	DIETI
2 nd	Battery Management Systems	0.4	Prof. Francesco Bonavolontà	University of Napoli Federico II	DIETI
2 nd	Dai mainframe all'IoT: una retrospettiva	0.4	Prof. Antonino	University of Napoli Federico II	DIETI

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	sull'evoluzione delle architetture di calcolo		Mazzeo		
2 nd	IIT ENEA TECH; Dove Andiamo Domani “deep tech”	0.2	ENEA	ENEA	DIETI
2 nd	Artificial Intelligence and 5G combined with holographic technology: a new perspective for remote health monitoring	0.4	Dr. Pietro Ferraro, Dr. Pasquale Memmolo		DIETI
2 nd	Distributional Semantics Methods: How Linguistic features can improve the semantic representation	0.3	Picariello lecture	Picariello lecture	DIETI
2 nd	Electrification 2021 – Project Work	0.6	Ing. Federico Ricavi	AEA srl – Loccioni	Prof. Annalisa Liccardo – Prof Santolo Meo
2 nd	Eguaglianza di genere a bilancio	0.4	Federica Web Learning	University of Napoli Federico II	University of Napoli Federico II
2 nd	Measuring food system	0.2	Prof.essa Angela Albarosa Rivellese	University of Napoli Federico II	University of Napoli Federico II
2 nd	Diabete autoimmune dell'adulto	0.2	Prof.essa Angela Albarosa Rivellese	University of Napoli Federico II	University of Napoli Federico II
2 nd	Ethics of quantification	0.4	Picariello lecture	Picariello lecture	DIETI
2 nd	End-to-End Optimization of Augmented Experience Services over Cloud-Intregrated 5G Network	0.8	Dr. Jaime Llorca	University of New York	University of Napoli Federico II
2 nd	Introduction to Underwater Robotics	0.4	Prof. Gianluca Antonelli	University of Cassino	Dr Fabio Ruggero (DIETI)
2 nd	Ablazione a radiofrequenza e mappaggio elettroanatomico	0.3	Eng. Federico Sotgiu and Eng. Veronica Raniello	SPE Electronics	Prof. Giuseppe Ruello
2 nd	Short and ultrashort, high voltage electric pulses for biological and medical application	0.3	Dott.ssa Stefania Romeo	CNR	Prof. Giuseppe Ruello (DIETI)

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2 nd	L'avvincente storia degli acceleratori	0.3	Prof. Vittorio Giorgio Vaccaro	Istituto Nazionale di Fisica Nucleare	Prof. Giuseppe Ruello (DIETI)
2 nd	Introduzione alle applicazioni della RM in medicina	0.3	Prof Artuto Brunetti	Dipartimento di Scienze Biomediche Avanzate (UNINA)	Prof. Giuseppe Ruello (DIETI)
2 nd	Amino acids in the mirror: Enigmatic role of D-aspartate	0.3	Prof. Francesco Errico	Dipartimento di Agraria (UNINA)	Dr Elia di Schiavi (IBBR-CNR)
2 nd	5G: l'architettura, le applicazioni e la rete di accesso radio	0.4	Eng. Francesco Mollica	Vodafone Italia S.p.A.	Prof. Nicola Pasquino
2 nd	Synchronization in complex networks, hypergraphs and simplicial complexes	0.2	Stefano Boccaletti	CNR	Prof Marco Coraggio
2 nd	Strategie terapeutiche innovative in campo immunologico	0.3	Dott.ssa Emanuela Signori	CNR-IFT	Prof. Giuseppe Ruello (DIETI)
2 nd	Risk assessment in real life: experiences from the railway domain	0.3	Emilia Di Martino, Diego Gerbasio, Claudio Mazzariello, Aniello Paolillo	Hitachi Rail STS	Prof. Valeria Vittorini
2 nd	A stochastic first-order trust region method with inexact restoration for nonconvex optimization	0.2	Natasa Krejic	University of Novi Sad, Serbia	Dipartimento di Matematica e Applicazioni (UNINA)
2 nd	Explicit numerical integrators that conserve energy or dissipate entropy	0.2	David Ketcheson, King Abdullah	University of Science and Technology (KAUST), Saudi Arabia	Dipartimento di Matematica e Applicazioni (UNINA)
2 nd	Scaled inexact and adaptive generalised FISTA for convex imaging problems	0.2	Luca Calatroni	Laboratoire d'Informatique. Signaux et Systemes de Sophia-Antipolis, France	Dipartimento di Matematica e Applicazioni (UNINA)
2 nd	No equations, no variables, no space, no time: data and the modelling of complex system	0.2	Yannis Kevrekidis	John Hopkins University, USA.	Dipartimento di Matematica e Applicazioni (UNINA)

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Research activities

During the three-year course, Salvatore Tessitore focused his research activity on a topic of great interest: the stability of European electricity grid. The basic idea was to study and learn the fundamentals and the state of the art on this topic so as to develop and propose useful solutions for the Italian TSO (Terna) to monitor and counteract the phenomenology that can affect grid stability. The successive step was the development of new proposals, i.e. the dynamic-order DMD, to monitor the inter-area modes of the European system and counteract the North-South mode involving the Italian power system. To develop and test the various methodologies, Dr. Tessitore first of all realized a benchmark to replicate in simulation the whole measurement chain (i.e. PMU, PDC) useful for the acquisition of field quantities to be analyzed. At the same time, Salvatore Tessitore studied and implemented several algorithms used in the literature for the measurement of inter-area oscillations, in order to identify the best solution for achieving the objective agreed with Terna and propose its application. In these years, Dr. Tessitore has participated in several European task forces with the purpose of analyzing the problem and sharing possible solutions to ensure the stability of the electric system in any operating conditions and for any event. Dr. Tessitore in March 2022 participated to the European task force where he was engaged in monitoring the stability of the European power system during the synchronization of the Ukrainian power system after the beginning of the well-known crisis.

Tutoring and supplementary teaching activities

Credits summary (*Sum up all earned credits*)

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1 st	29	5.9	35	0
2 nd	13	8.2	45	0
3 rd	0	0	60	0

Research periods in institutions abroad and/or in companies

No periods abroad.

PhD Thesis

The stability of the interconnected electrical system is the ability of the system to find a new equilibrium condition following a disturbance. Electrical system stability phenomena can be classified into three categories: rotor angle stability, frequency stability and voltage stability. In this doctoral research activity, the focus is on low-frequency oscillations (LFOs), which are phenomena related to rotor angle stability. Thanks to new technologies, measurement facilities and instrumentation based on Wide Area Measurement Systems (WAMS) technology, have become widespread in recent years and they are essential for monitoring and characterizing this type of phenomenology.

A description of the WAMS currently used by the Italian TSO (Terna) confirms that the detection of frequency oscillations is one of the main features/applications provided by these architectures. Real-time detection of dangerous frequency oscillations and subsequent estimation of related parameters (frequency, damping, amplitude, and phase) is critical in the framework described above. When potential divergent oscillations are detected, all necessary countermeasures must be implemented to restore safe and stable operating conditions (e.g., redispatching of generators, adjusting link line flows, reducing load, modifying network topology, etc.), and to ensure that the system is able to operate safely and stably. In this regard, several basic approaches for tracking electromechanical modes in an electrical system are reported in the literature. Some approaches use an electrical system model linearized around a certain equilibrium point to identify the characteristics of electromechanical modes through eigenvalue analysis. Others rely on estimated measurements of an updated model of the electrical system from direct measurements of the system from measurement devices installed on electrical grids.

From experience gained from working on the subject for a long time, it can be stated that there is no optimal algorithm applicable under all operating conditions, but, rather, each approach has its advantages. This means that, for example, one method might show good performance in phase and frequency estimation, while another might show excellent performance in damping and amplitude estimation. Also, one method might perform better than another for noise-free sampled signals, while it might deteriorate in efficiency when the signal-to-noise ratio (SNR) decreases. However, there are estimation techniques that are generally characterized by good performance compared with others. In this thesis work, different estimation techniques were first analyzed on both simulated and real data. Then, improved solutions were proposed over those reported in the literature, and finally, in relation to the monitoring or defense objective set with the Italian TSO, the most appropriate method was chosen for real-time application.

Publications

Research results appear in 3 papers published in international journals, 5 contributions to international conferences, 2 contributions to national conferences.

List of scientific publications

International journal papers

- Liccardo, A., Tessitore, S., Bonavolonta, F., Cristiano, S., Di Noia, L.P., Giannuzzi, G.M., Pisani, C., “Detection and Analysis of Inter-Area Oscillations Through a Dynamic-Order DMD Approach” (2022), *IEEE Transactions on Instrumentation and Measurement*, 71, art. no. 9004914.
DOI: 10.1109/TIM.2022.3186371
- Bonavolontà, F., Di Noia, L.P., Liccardo, A., Tessitore, S., Lauria, D., “A PSO-MMA Method for the Parameters Estimation of Interarea Oscillations in Electrical Grids” (2020), *IEEE Transactions on Instrumentation and Measurement*, 69 (11), art. no. 9107075, pp. 8853-8865.
DOI: 10.1109/TIM.2020.2998909
- Bonavolontà, F., Di Noia, L.P., Lauria, D., Liccardo, A., Tessitore, S., “An optimized HT-based method for the analysis of inter-area oscillations on electrical systems” (2019), *Energies*, 12 (15), art. no. 2935.
DOI: 10.3390/en12152935

International conference papers

- Liccardo, A., Bonavolonta, F., Pisani, C., Giannuzzi, G., Tessitore, S., Cristiano, S., “DMD Dynamic Order Algorithm for the Estimation of Inter-area Oscillations” (2022), *2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion, SPEEDAM 2022*, pp. 412-417.
DOI: 10.1109/SPEEDAM53979.2022.9842132
- Giannuzzi, G.M., Lauria, D., Pisani, C., Tessitore, S., “An optimization procedure for power system stabilizer tuning” (2022), *2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion, SPEEDAM 2022*, pp. 112-117.
DOI: 10.1109/SPEEDAM53979.2022.9842034
- Liccardo, A., Tessitore, S., Pisani, C., Bonavolonta, F., Cacciapuoti, S., Giannuzzi, G.M., “A WAMS emulation framework for the characterization of measurement algorithms on electrical transmission networks” (2021), *2021 IEEE International Workshop on Metrology for Industry 4.0 and IoT, MetroInd 4.0 and IoT 2021 - Proceedings*, art. no. 9488461, pp. 572-577.
DOI: 10.1109/MetroInd4.0IoT51437.2021.9488461
- Carlini, E.M., Giannuzzi, G.M., Zaottini, R., Pisani, C., Tessitore, S., Liccardo, A., Angrisani, L., “Parameter Identification of Interarea Oscillations in Electrical Power Systems via an Improved Hilbert Transform Method” (2020), *UPEC 2020 - 2020 55th International Universities Power Engineering Conference, Proceedings*, art. no. 9209805.
DOI: 10.1109/UPEC49904.2020.9209805
- Angrisani, L., Bonavolonta, F., Di Noia, L.P., Lauria, D., Liccardo, A., Tessitore, S., Ruggiero, D., “A novel PSO-CWA algorithm for the estimation of inter-area oscillation parameters” (2020) *I2MTC 2020 - International Instrumentation and Measurement Technology Conference, Proceedings*, art. no. 9128935.
DOI: 10.1109/I2MTC43012.2020.9128935

National conference papers

- Liccardo, A., Bonavolonta, F., Pisani, C., Giannuzzi, G., Tessitore, S., “Analisi delle oscillazioni inter-area tramite DMD a ordine dinamico” (2022), *Atti del VI Forum Nazionale delle Misure*.
- Bonavolonta, F., Di Noia, L.P., Lauria, D., Liccardo, A., Tessitore, S., “Un metodo PSO-MMA per la stima dei parametri delle oscillazioni inter-area nelle reti di trasmissione dell’energia elettrica (2020), *Atti del IV Forum Nazionale delle Misure*.

Patents and/or spin offs

Awards and Prizes

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Date 18/10/2022

PhD student signature

Salvatore Tessitore

Supervisor signature

Amp

Co-Supervisor signature

Alessandro