PhD in Information Technology and Electrical Engineering
Università degli Studi di Napoli Federico II

PhD Student: Fabrizio Lo Regio

Cycle: XXXVIII

Training and Research Activities Report

Year: First

Fabrizio Lo Regio

Tutor: prof. Leopoldo Angrisani

Date: December 12, 2023

1. Information:

- **PhD student: Fabrizio Lo Regio**
- **DR number: 996972**
- **Date of birth: 10/12/1997**
- **Master Science degree: Biomedical Engineering**
  University: University of Naples Federico II
- **Doctoral Cycle: XXXVIII**
- **Scholarship type: PNRR Partenariato Esteso PE14, RESearch and innovation on future Telecommunications systems and networks (RESTART)**
- **Tutor: Prof. Leopoldo Angrisani**

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
Study on: Broadband Power Line Communication, Quantum Technologies. State of art recognition about quantum technologies for measurement and Traction Power Line Communication Laboratory activity: development of techniques to characterize the transmission lines	Research		5	01-01-2023 / 28-02-2023		
Accurate and Efficient Numerical Modeling Methods for Superconducting Circuit Quantum Information Processing Devices	Seminar	1	0.2	03/04/2023	Prof. Thomas E. Roth	Y
Enhancing qubit readout with Bayesian Learning	Seminar	1	0.2	05/04/2023	Dr Nicola Lo Gullo	Y
The state of the art of AI and Physics-Based Simulations in drug discovery	Seminar	1	0.2	17/03/2023	Andrea Beccari	Y
How to publish under the CARE-CRUI Open Access Agreement with	Seminar	1	0.2		Nino Grizzuti	05/04/2023

IEEE						
Study on: Broadband Power Line Communication for the future telecommunication systems, Quantum Technologies. State of art recognition about quantum technologies for measurement and Traction Power Line Communication Laboratory activity: Brain Computer Interface with Augmented Reality headset	Research		5	1.3.2023/30.4.2023		
Statistical data analysis for science and engineering research	Course		4	02/2023	Prof. Roberto Pietrantuono	Y
Unleash the impact of your research with video and graphical abstracts, Tullio Rossi	Seminar	1	0.2	12/5/2023	Prof. Nicola Moccaldi	Y
The Dynamics of Social Systems With Higher-order Interactions	Seminar	1	0.2	11/5/2023	Giacomo Ascione	N
Quantum communication with continuous variables of light	Seminar	1	0.2	20/06/2023	Dr. Cosmo Lupo	N
Nanoneuro: The power of nanoscience to explore the frontiers of neuroscience	Seminar	1	0.2	03/5/2023	Prof. Carlo Forestiere	Y
Models of human motor coordination – a critical assessment and some open problems	Seminar	1	0.2	29/6/2023	Giacomo Ascione	N
Modelling and Understanding Human Behavior and Action Decisions for predictive human-machine systems	Seminar	1	0.2	20/06/2023	Simone Mancini	Y
Study on: Broadband Power Line Communication for the	Research		5	1.5.2023/30.6.2023		

future telecommunication systems, Quantum Technologies. State of art recognition about quantum technologies for measurement, Traction Power Line Communication, and Brain Computer Interface with Augmented Reality headset Laboratory activity: Brain Computer Interface with Augmented Reality headset, Broadband Power Line Communication for Traction Line						
Data uncertainty	Course		6	28/07/2023	Prof. Leopoldo Angrisani	Y
Study on: Broadband Power Line Communication for the future telecommunication systems, Quantum Technologies. State of art recognition about quantum technologies for measurement, Traction Power Line Communication, and Brain Computer Interface with Augmented Reality headset Laboratory activity: Brain Computer Interface with Augmented Reality headset, Broadband Power Line Communication for Traction Line	Research		5	1.7.2023 /31.8.2023		
International Ph.D. School "Italo Gorini" 2023	Doctoral School		4	04-08/09/2023	Associazione gruppo di misure elettriche ed elettroniche (GMEE)	Y
Analyzing the Impact of Quantum Computing on Future Wireless Networks	Seminar	1	0.2	12/9/2023	IEEE	Y

Flocks, schools, and crowds: Behavioral dynamics of collective motion	Seminar	1	0.2	5/10/2023	Scuola superiore meridionale	N
2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering - IEEE MetroXRAINE2023	Seminar		4.4	25-27/10/2023	Prof. Pasquale Arpaia	Y
Study on Quantum Technologies. State of art recognition about quantum technologies for measurement, Brain Computer Interface with Augmented Reality headset, inputs of Augmented Reality headsets Laboratory activity: Brain Computer Interface with Augmented Reality headset, Augmented Reality headsets characterization	Research		5	1.9.2023/31.10.2023		
Lecturer for "Voltmetri digitali" in the bachelor's degree course "Fondamenti di misure" of Professor Mauro D'Arco	Tutorship		0.2	17/10/2023	Prof. Mauro D'Arco	
Support to master students for the thesis work development	Tutorship		0.8	1.9.2023/31.10.2023		
Progettazione europea	Course		1.6	9-10/2023	REACT-EU	N
Progettazione degli esperimenti	Course		1.6	10-11/2023	Prof. Pasquale Arpaia	Y
Conference "Scaling-up digital solutions for active and Healthy living: implementing across scientific disciplines, industrial sectors and	Seminar		3.3	13-15/11/2023	Prof. Maria Triassi	Y

scenarios" (AHL - Napoli 2023)						
Study on Quantum Technologies. State of art recognition about quantum technologies for measurement, Brain Computer Interface with Augmented Reality headset, inputs of Augmented Reality headsets Laboratory activity: Brain Computer Interface with Augmented Reality headset, Broadband Power Line Communication for Traction Line, Augmented Reality headsets characterization	Research		6	1.11.2023 – 31.12.2023		
Support to master students for the thesis work development	Tutorship		1	1.11.2023 – 31.12.2023		

1) Courses, Seminar, Doctoral School, Research, Tutorship
2) Choose: Y or N

2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	**0**	**0**	**5**	**0**	**5**
Bimonth 2	**0**	**0.9**	**5**	**0**	**5.9**
Bimonth 3	**4**	**1.2**	**5**	**0**	**10.2**
Bimonth 4	**6**	**0**	**5**	**0**	**11**
Bimonth 5	**4**	**4.8**	**5**	**1**	**14.8**
Bimonth 6	**3.2**	**3.3**	**6**	**0.6**	**12.1**
Total	**17.2**	**10.2**	**31**	**1.6**	**60**
Expected	**20 - 40**	**5 - 10**	**10 - 35**	**0 – 1.6**	

3. Research activity

Study on Broadband Power Line Communications (BPLC). In the optic of green environment and circular economy, this technology exploits the existing infrastructure of the power grid, enabling a cost-efficient and streamlined deployment approach, by harnessing the inherent potential of the electrical distribution network to facilitate data transmission capabilities. BPLC can increase the safety and maintenance of the network on which the technology is applied, and the increase in the offered services and their quality, raise the demand for robust communication technologies. This is of extremely importance for the improvement of the services quality and for the resource optimization. BPLC technology should support the transmission of network-data and other sensor-derived information, enabling the implementation of useful policies to reduce maintenance costs and operations, so playing a critical role in predictive maintenance. This can be possible thanks to the sensing and communication integration. Due to the lack of knowledge about noise and non-intentional emissions in high-frequency data transmission channels, regulations and standards, with experimental campaigns, statistical and deterministic models and channel characterization are needed in order to ensure a reduced Electro Magnetic (EM) emission in the considered environment. In order to reduce the EM exposure, the frequency selectivity and other features of the communication channel have been analyzed with different methods, such as statistical and scattering approaches. Different methods have been developed and used in literature to enhance the robustness of communication despite the high-noise scenarios and the frequency selectivity of the channels. Student focused on fundamentals, architecture, possible applications, differences from the use environment. The study was focused on the characterization of the transmission channel with its different methods, pros and cons of each methodology, and on regulations and standards.

The student conducted literature research for a critical evaluation of the state of the art, especially in the railway sector, in which the Broadband Traction Power Line Communication (BTPLC) technology arises. This conducted to a paper review on BTPLC systems with the comparison of different solutions developed in literature, with a focus on the BTPLC channel characterization, its theoretical approaches and methods. The student conducted laboratory activities in order to apply the different approaches, proposed in literature for the BPLC channel. The student participated in an experimental campaign on a traction line for the channel characterization of the traction line.

The student also conducted literature research for a critical evaluation of the state of the art in Reactive Brain Computer Interface (BCI) based on Steady State Visually Evoked Potentials (SSVEP), Augmented Reality (AR), and wireless EEG acquisition headset, as integrated sensing and communication system. About it, the student conducted a literature review in order to create the fundamentals about an integrated use of Reactive BCI and AR headset for a merged sensing and communication technology.

In addition, other activities have been conducted in the AR field for the use of AR headset as measurement instruments, with the aim of developing integrated sensing and communication systems and optimizing the resources in different field, like healthcare. Last activities encompass the quantum measurement field, with the recognition of the state of art about quantum technologies for measurement and quantum communication systems.

4. Research products:

Angrisani, L., Arpaia, P., De Benedetto, E., Duraccio, L., Regio, F. L., & Tedesco, A. *IEEE Sensors Journal*. Published. 2023. "Wearable Brain-Computer Interfaces based on Steady-State Visually Evoked Potentials and Augmented Reality: a Review"

Angrisani, L., Arpaia, P., De Benedetto, E., Duraccio, L., Regio, F. L., & Tedesco, A. 2023 IEEE INTERNATIONAL CONFERENCE ON Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering. Accepted. 2023. "Expanding the Frontiers of Wearable Brain-Computer Interfaces Combining Augmented Reality and Visually Evoked Potentials"

Angrisani, L., D'Arco, M., De Benedetto, E., Duraccio, L., Lo Regio, F., IEEE Energies. Published. 2023. "Broadband Power Line Communication in Railway Traction Lines: A Survey"

Angrisani, L, De Benedetto, E., Duraccio, L., Lo Regio, F., Ruggiero, R., Tedesco, A., IEEE Sensors, Published, 2023, "Infrared Thermography for Real-Time Assessment of the Effectiveness of Scoliosis Braces"

Lo Regio, F., Angrisani, L., De Benedetto, E., Duraccio, L., & Tedesco, A., International Instrumentation and Measurement Technology Conference – IEEE I2MTC 2024, Submitted, 2023, "Experimental procedure for metrological characterization of AR-based eye-tracking interfaces"

5. Conferences and seminars attended

Speaker at 2023 IEEE INTERNATIONAL CONFERENCE ON Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering; paper "Expanding the Frontiers of Wearable Brain-Computer Interfaces Combining Augmented Reality and Visually Evoked Potentials", 25-27/10/2023

Ph.D. School Italo Gorini, IGO, Firenze (FI) 04-09-2023 / 08-09-2023

Rapporteur at Conference "Scaling-up digital solutions for active and Healthy living: implementing across scientific disciplines, industrial sectors and scenarios" (AHL - Napoli 2023), 13-15/11/2023

6. Activity abroad:

None

7. Tutorship

Lecturer for "Voltmetri digitali" in the bachelor's degree course "Fondamenti di misure" of Professor Mauro D'Arco
Support to master students for the thesis work development