Activities and Publications Report

PhD Student: Michela Russo

Student DR number: DR995854

PhD Cycle: XXXVII
PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 01/11/2021
PhD program student's end date: 31/10/2024

Supervisor: Prof.ssa Maria Romano

e-mail: mariarom@unina.it

PhD scholarship funding entity:
No scholarship

General information

Michela Russo received in year 2021 the Master Science degree in Biomedical Engineering from the University of Napoli Federico II. She attended a curriculum in Biomedical Engineering within the PhD program in Information Technology and Electrical Engineering. She enrolled into the ITEE PhD program without a grant.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1st	Ultra-High Field Magnetic Resonance Imaging	Ad hoc course	3	Prof. Giuseppe Ruello	ITEE
1st	Statistical Data Analysis for Science and Engineering	Ad hoc course	4	Prof. Pietrantuono Roberto	ITEE
1s	Big Data Architecture & Analytics	Ad hoc course	5	Prof. Sperlì Giancarlo	ITEE
1s	Data Science for Patient Records Analysis	Ad hoc course	3	Prof Marcello Cinque	ITEE
1s	Imprenditorialità accademica	Ad hoc course	4	Prof. Pierluigi Rippa	ITEE
1s	Machine Learning for Science and Engineering Research	Ad hoc course	5	Proff. A. Corazza, F. Isgrò, R. Prevete, C. Sansone, G. Pezzulo	ITEE
2nd	Muscle-based Human	Ad hoc course	2.6	PhD Daniele Esposito	ITEE
2rd	On the challenges and impact of Artificial Intelligence in the Insurance domain	Ad hoc course	3	PhD Lorenzo Ricciardi Celsi	ITEE
2rd	Using deep learning properly	Ad hoc course	4	PhD Andrea Apicella	ITEE
3rd	From Virtual histology to neural science	Ad hoc course	3	Prof Paolo Gargiulo	ICTH
3rd	Strategic orientation for stem research & writing	Ad hoc course	5	Chie Shin Fraser	ITEE

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
3rd	Neurotechnologies to understand and restore the nervous system	Bressanone, Italy	5	16-19 September 2024	Gruppo Nazionale di BioIngegneria (GNB)

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1st	Cybersecurity-AKKA	0.4	Dr. Luigi Villa - Sara Belluccini - Matteo Pracchia	Akka Technology	Prof. D. Cotroneo, Prof. S.P. Romano, Dr. R. Natella, DIETI - Unina
1st	Vehicular Hacking AKKA	0.3	Dr. Luigi Guida - Luigi Villa	Akka Technology	Prof. D. Cotroneo, Prof. S.P. Romano, Dr. R. Natella, DIETI - Unina
1st	Possible Quantum Machine Learning Approaches in HEP	0.4	Dr. Michele Grossi	CERN, Geneve, Switzerland	Prof. A. S. Cacciapuoti, DIETI - Unina
1st	Connecting to the dots-Splunk	0.4	Dr. Antonio Forzieri	EMEA Cyber Security Specialization and Advisory Splunk Inc	Prof. D. Cotroneo, Prof. S.P. Romano, Dr. R. Natella, DIETI - Unina
1st	From present to future in digital healthcare	0.4	Prof. Paolo Gargiulo	University of Reykjavik Iceland	University of Reykjavik Iceland
1st	Single cell omics leverage Machine Learning to dissect tumour microenvironment and cancer immune editing	0.4	Dr. Raoul J.P. Bonnal	IFOM - the FIRC Institute of Molecular Oncology	Prof. Anna Corazza, DIETI, Unina
1st	The learning landscape in deep neural networks and its exploitation by learning algorithms	0.3	Prof. Riccardo Zecchina	Department of Computing Sciences Università Bocconi, Milano, Italy	CQB
1st	Systems biology as a compass to understand tumour-immune interactions in humans	0.3	Davide Bedognetti	Human Immunology Department and Cancer Program Sidra Medicine, Doha, Qatar	CQB
1st	Computational analysis of cancer genomes	0.3	Prof. Nùria Lòpez-Bigas	ICREA Research Professor Institute for Research in Biomedicine Barcelona, Spain	CQB
1st	Project Vāc: Can a Text-to-Speech Engine Generate Human Sentiments?	0.3	Prof. V.K.Gurbani,	Illinois Institute of Technology - USA	Dip. Fisica, "Ettore Pancini" - DIETI, Unina
1st	Towards a Political Philosophy of AI	0.4	Mark Coeckelbergh	University of Wien	DIETI, Unina

1st	Explainable Natural Language Inference	0.2	Dr. Marco Valentino	University of Manchester, Manchester, United Kingdom	Prof. Francesco Cutugno, DIETI, Unina
1st	An Introduction to Deep Learning for Natural Language Processing	0.2	Dr. Marco Valentino	University of Manchester, Manchester, United Kingdom	Prof. Francesco Cutugno, DIETI, Unina
1st	Using Delays for Control	0.2	Prof. Emilia Fridman	Tel Aviv University - Israel	Prof. Stefania Santini - DIETI - Unina
1st	Towards AI-Driven Cancer Precision Medicine	0.3	Prof. Olivier Elemento	Director, Englander Institute for Precision Medicine Associate Director, Institute for Computational Biomedicine	CQB
1st	Assessing postural control and motion sickness using electrophysiological signals	0.4	Prof. Paolo Gargiulo	University of Reykjavik Iceland	University of Reykjavik Iceland
1st	Population and medical genomics applications to human traits and diseases	0.2	Prof. Nicole Soranzo	Human Technopole	CQB
1st	Symbiotic Control of Wearable Soft Suits for human motion assistance and augmentation	0.4	Prof. Lorenzo Masia	Institut für Technische Informatik (ZITI), Heidelberg University, Germany	Prof. Fanny Ficuciello, DIETI, Unina
1st	Probing and infusion biomedical knowledge for pre-trained language models	0.4	Dr. Zaiqiao Meng	University of Glasgow - UK	Prof. Francesco Cutugno, DIETI, Unina
1st	New paradigms for 3D modelling and surgical planning	0.2	Prof. Paolo Gargiulo	University of Reykjavik Iceland	University of Reykjavik Iceland
2nd	Complex network systems: introduction and open challenges	0.4	Pietro De Lellis	University of Naples, FEDERICO II, DIETI.	University of Naples, FEDERICO II, DIETI.
2nd	Cybercrime and information warfare: national and international actors	0.4	Dr. Pierluigi Paganini,	Cibhorus S.r.l.	Proff. S.P. Romano, R. Natella, DIETI, Unina
2nd	Privacy and Data Protection	0.4	Dr. Stefano Mele,	Partner at Gianni & Origoni	Proff. S.P. Romano, R. Natella, DIETI, Unina

				Head of Cybersecurity Law Department co-Head of Data Protection Department	
2nd	Durability of Fuel Cell Systems	0.4	Prof. Elodie Pahon		
2nd	Threat Hunting & Incident Response	0.4	Vladimir Kurdin	Group-IB	Prof. D. Cotroneo, Prof. S.P. Romano, Dr. R. Natella, DIETI - Unina
2nd	Nanoneuro: the power of nanoscience to explore the frontiers of neuroscience	0.2	Dr. Aitzol Garcia-Etxarri	Donostia International Physics Center - Spain	Prof. C. Forestiere, DIETI, Unina
2nd	Models of human motor coordination – a critical assessment and some open problems	0.3	Dr. Hohn Hogan		
2nd	Incorporating Eikona Models for Advanced Cardiac Simulations	0.2	MsC Cristian Alberto Barrios Espinosa	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	Computational Research Environment	0.3	MSc Lukas Baron	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	Literature discover & Management	0.2	MSc Lukas Baron	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	Sharing good practices and useful tools for efficient research software development	0.2	PhD Marie Houillon	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	Statistics for clinical studies and biomedical engineering	0.3	Prof. Maria Francesca Spadea	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	OCT Angiography – What is seen and what we learn	0.2	MSc. Simon Hoffmann	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
2nd	Learning 3D features descriptions for the registration in laparoscopic liver surgery	0.2	MSc Sara Schwab	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany

2nd	Generating vectorcardiography heartbeat signal using an autoencoder	0.2	MsC Cristian Alberto Barrios Espinosa	Karlsruhe Institute of technology (KIT), Germany	Karlsruhe Institute of technology (KIT), Germany
3rd	Regolazione in tema di intelligenza artificiale alla luce dell'AI act	0.4	Elvira Raviele	University of Naples FEDERICO II in collaboration with 5G ACADEMY	ITEE
3rd	Perché digital, in un mondo che sembra già' estensivamente digitale e perchè trasformare – tim	0.8	Maurizio Irlando & Gabriele Elia	University of Naples FEDERICO II in collaboration with 5G ACADEMY	ITEE
3rd	Ensuring Electronic Reliability Against CERN's Radiation Environment	0.4	Dr Salvatore Danzeca	CERN, Geneva	Prof. Francesco Fienga, DIETI-Unina PhD Francesco Fienga

Research activities

Michela Russo participated in research of the human mobility and postural control in individuals suffering from neurodegenerative disorders, such as Parkinsonism. A key aspect of her contribution involved identifying specific gait patterns in patients with typical and atypical Parkinsonism to discover potential biomarkers. These biomarkers support clinical decision-making by aiding in diagnosis and predicting both motor and non-motor symptoms of the disease. The integration of wearable and non-wearable sensors for gait measurement, combined with artificial intelligence approaches, enhances the ability to analyse gait patterns effectively. This methodology also incorporates advanced markerless video-based techniques, which improve the capture and analysis of gait without physical markers. These techniques provide an accessible and cost-effective solution for gait analysis, making it feasible for widespread clinical use. Together, these technologies offer valuable insights into disease stage monitoring and progression, which is crucial for timely interventions. Her research aims to fill a scientific gap by providing quantitative information about human movement, ultimately enhancing the early detection and personalized management of neurodegenerative conditions. Her research has the potential to improve patient outcomes and enhance quality of life, making a significant contribution to the field of neurorehabilitation by deepening the understanding of movement disorders.

Tutoring and supplementary teaching activities

Michela Russo has had the opportunity to tutor several BSc and MSc theses in biomedical engineering, particularly particularly within SSD ING-INF/06: Fondamenti di Bioingegneria (Foundations of Bioengineering), Elaborazione di Segnali e Dati Biomedici (Biomedical Signal and Data Processing), and Management delle Strutture Sanitarie (Healthcare Structure Management).

In details:

- Co-supervisor: Diodati G., Interplay between gait-pattern in Parkinsonism's and non-motor mental symptoms, Bachelor's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2022.
- Co-supervisor: Falconio A., Assessment of kinematics and kinetics variables of gait in Parkinson's Disease: A systematic review, Bachelor's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2022.
- Co-supervisor: Cipullo A., Evaluating the role of kinematic and kinetic features of gait to detect mild cognitive impairment in patients affected by Parkinson's disease, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2022.
- Co-supervisor: Aprea S., Using the kinematic and kinetic features of gait to distinguish Parkinson's disease from progressive supranuclear palsy, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2022.
- Co-supervisor: Mestizia M., Kinematic variables for detect the gait-pattern of the Parkinson's disease patients with cognitive impairments, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2023.
- Co-supervisor: D'aurea B., Employing Gait Analysis to enhance the detection of subjective cognitive symptoms through a Machine Learning Approaches, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2023.
- Co-supervisor: Viola V., Gait analysis and clustering in Parkinson's disease: exploring clinical phenotypes variability, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2023.
- Co-supervisor: Capone M., Challenges and solution in recognising PSP and PD: A gait analysis-based machine learning model, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2024.
- Co-supervisor: Adduono F., Cluster analysis for the identification of motor and non-motor phenotypes in de Novo Parkinson's disease using Machine learning techniques, Master's degrees in Biomedical Engineering, University of Naples FEDERICO II, 2024.

Furthermore, she contributed to laboratory setup activities for movement analysis at the Hospital San Giovanni di Dio e Ruggi d'Aragona in Salerno, enhancing the research environment and facilitating the study of human mobility.

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	24	6.4	38	0
2nd	9.6	4.5	41	1.12
3rd	13	1.2	50	1.24
Total	46.6	12.1	129	2.36

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2nd	Karlsruhe Institute of technology (KIT), Germany	Prof. Maria Francesca Spadea	Sept-Dec 2023	As part of the PhD, research abroad was conducted, focusing on advanced computer vision techniques for human silhouette reconstruction from video. The main objective was to develop a low-cost markerless motion capture system. This approach seeks to address the limitations of traditional motion capture systems, which require expensive equipment and physical sensors, by providing an accessible solution that leverages advanced algorithms to accurately track body movements without the use of markers.

PhD Thesis

In this PhD thesis, Michela Russo explored gait as one of the most relevant biomarkers for predicting and monitoring neurodegenerative and motor disorders, including Parkinsonism. These disorders, such as Parkinson's disease, often present alterations in gait that manifest as rigidity, bradykinesia (slowness of movement), and postural instability. In addition to motor symptoms, non-motor symptoms like depression, anxiety, and cognitive decline are common and often precede observable changes in gait, contributing to a deterioration in mobility and overall quality of life. The PhD thesis conducted by Michela Russo addressed critical research questions related to the application of gait analysis in clinical decision-making for PD. The first question explored how gait analysis could aid in diagnosing, identifying biomarkers, and characterizing gait patterns to distinguish between the various phenotypes of this heterogeneous disease. This approach aims to enhance diagnostic accuracy and improve clinical outcomes for patients by bridging the gap between qualitative and quantitative assessments.

The second research question focused on the integration of artificial intelligence (AI) techniques into gait analysis to enhance the accuracy and predictive power of assessments in neurodegenerative diseases. By incorporating detailed gait metrics into machine learning (ML) and deep learning (DL) models, the study aimed to improve diagnostic precision and patient quality of life. A comprehensive analysis of gait data was deemed essential for leveraging AI in disease management, facilitating advances in identifying critical biomarkers and refining therapeutic strategies.

Her research topics aimed to address a significant gap in the literature by providing clinicians with quantitative details relevant to neurodegenerative diseases. This focus is particularly important, as early intervention can greatly enhance disease management and improve the overall quality of life for patients.

Research products

Research results appear in *6* papers published in international journals, *6* contributions to international conferences, *1* contribution to national conferences.

List of scientific publications

International journal papers

- Franco, A*., **Russo, M*.,** Amboni, M., Ponsiglione, A. M., Di Filippo, F., Romano, M., & Ricciardi, C.
  *These authors contributed equally to this work

  The Role of Deep Learning and Gait Analysis in Parkinson's Disease: A Systematic Review,

  MDPI Sensors,
  24(18), 5957,2024, DOI: https://doi.org/10.3390/s24185957

- **Russo, M.,** Amboni, M., Volzone, A., Cuoco, S., Camicioli, R., Di Filippo, F., & Ricciardi, C.

  Kinematic and Kinetic Gait Features Associated With Mild Cognitive Impairment in Parkinson's Disease,
  IEEE Transactions on Neural Systems and Rehabilitation Engineering,
  Volume (32), 2676-2687, 2024, DOI: 10.1109/TNSRE.2024.3431234

- Clemente, F., Amato, F., Adamo, S., **Russo, M.,** Angelone, F., Ponsiglione, A. M., & Romano, M.

  Circuital modelling in muscle tissue impedance measurements,
  Heliyon, *10*(7), 2024, DOI: https://doi.org/10.1016/j.heliyon.2024.e28723.

- **Russo, M**., Amboni, M., Barone, P., Pellecchia, M. T., Romano, M., Ricciardi, C., & Amato, F.

  Identification of a Gait pattern for detecting mild cognitive impairment in Parkinson's disease,
  MDPI Sensors,
  23(4), 1985, 2023, DOI: https://doi.org/10.3390/s23041985.

- Abate, F., **Russo, M.,** Ricciardi, C., Tepedino, M. F., Romano, M., Erro, R., & Picillo, M.

  Wearable sensors for assessing disease severity and progression in Progressive Supranuclear Palsy,
  Parkinsonism & Related Disorders,
  109, 105345, 2023, DOI: https://doi.org/10.1016/j.parkreldis.2023.105345.

- **Russo, M**., Amboni, M., Volzone, A., Ricciardelli, G., Cesarelli, G., Ponsiglione, A. M., & Ricciardi, C.

  Interplay between gait and neuropsychiatric symptoms in Parkinson's Disease,
  European Journal of Translational Myology,

32(2), 2022, DOI: https://doi.org/10.4081/ejtm.2022.10463.

International conference papers

- **Russo, M.,** Mestizia, M ., Amboni, M ., Di Filippo, F ., Pisani, N ., De Marca, U., Capuano, R., Di Gregorio, M ., Romano, M ., Amato, F ., Ricciardi, C

  Subclinical Gait Differences in Multiple Sclerosis with mild disability: Spatiotemporal Analysis During Single and Dual Task,
  12th International Conference on E-Health and Bioengineering - EHB 2024
  Status: Accepted, Date Conference: November2024.

- **Russo, M.,** Pisani, N., Ricciardelli, G., Volzone, A., Romano, M., Barone, P., Amboni, M., Ponsiglione, A.M., Ricciardi, C.

  Quantitative Measures of Gait Kinematics in Camptocormia Parkinson's Disease,
  2024 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE)
  Status: Accepted, Date Conference: October 2024.

- Pisani, N., **Russo, M.,** Calabrese, M.C., Di Filippo, F., Cesarelli, G., Barone, P., Ricciardi, C., Amboni, M., Amato, F.

  Measurements of Postural Sway to Classify Freezing of Gait in Parkinson's Disease,
  2024 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE)
  Status: Accepted, Date Conference: October 2024.

- Pisani, N., **Russo, M.**, Abate, F., Avallone, A.R., Amato, F., Barone, P., Ricciardi, C., Cesarelli, M.

  Unsupervised Machine Learning Approach to Discover Subtypes of Progressive Supranuclear Palsy,
  2024 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE)
  Status: Accepted, Date Conference: October 2024.

- **Russo, M**., Ricciardi, C., Amboni, M., Volzone, A., Barone, P., Romano, M., & Francesco, A.

  A Cluster Analysis for Parkinson's Disease Phenotyping with Gait Parameters,

  2023 IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE) (pp. 882-887), IEEE,2023, DOI
  : 10.1109/MetroXRAINE58569.2023.10405572.

- **Russo, M.**, Ricciardi, C., Amboni, M., Picillo, M., Ricciardelli, G., Abate, F., ... & Romano, M.

  Performing a short sway to distinguish Parkinsonisms,

  2022 IEEE International Conference on Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE) (pp. 340-345), IEEE, 2022,
  DOI: 10.1109/MetroXRAINE54828.2022.9967668.

National conference papers

- **Russo, M.**, Ricciardi, C., Amboni, M., Picillo, M., Ricciardelli, G., Abate, F., ... & Romano, M.

  Postural control in Parkinsonisms during a short static sway,
  2022 Società Italiana di Analisi del Movimento in Clinica (SIAMOC), Gait & Posture,
  97:9-102022, DOI: https://doi.org/10.1016/j.gaitpost.2022.09.022.

Awards and Prizes

In 2022, Michela Russo was awarded *"The best performance of classification with supervised learning on EEG datasets acquired through the Helmet headset provided by AB MEDICA"* at Neural Data Processing Contest- 2022IEEEMetroXRAINE Conference.

ORGANIZER OF SCIENTIFIC CONGRESS

2023 IEEE International Conference on Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE2023)

Organizer Special Session: *"Simulation approaches and Artificial Intelligence for healthcare and biomedical engineering"*

Date 08/10/2024

PhD student signature _____

Supervisor signature _____