
UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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

Activities and Publications Report

PhD Student: **Sarah Adamo**

Student DR number: DR995864

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. Mario Cesarelli

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Co-supervisor: Prof Giuseppe Cesarelli

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PhD scholarship funding entity:

CONSORTIUM GARR study fellowship (only for the first year and half of the second), not in collaboration with Unina.

The second half of the second year and the third year were no funded.

General information

Sarah Adamo received in year 2020 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
1 st	Statistical data analysis for science and engineering research	Ad hoc course	4	Prof. R. Pietrantuono	ITEE
1 st	Ultra-High Field Magnetic Resonance Imaging	Ad hoc course	3	Prof. G. Ruello	ITEE
1 st	Big Data Architecture and Analytics	Ad hoc course	5	Prof. G. Sperli	ITEE
1 st	Academic Entrepreneurship	Ad hoc course	4	Prof. G. Rippa	ITEE
1 st	Data Science for Patient Records Analysis	Ad hoc course	3	Prof. M. Cinque	ITEE
1 st	Interaction control in surgical and rehabilitation robotics	Ad hoc course	2.4	Prof. F. Ficuciello	ITEE
2 nd	Using Deep Learning Properly	Ad hoc course	4	Prof. A. Apicella	ITEE
3 rd	Biomedical Instrumentation and Photonics Laboratory for medicine	External course	9	Prof. M. Cesarelli	University of Sannio, Benevento (Italy)
3 rd	Strumentazione biomedica avanzata	External course	9	Prof. M. Cesarelli	University of Sannio, Benevento (Italy)
3 rd	Strumentazione biomedica avanzata – PART II	External course	6	Prof. M. Cesarelli	University of Sannio, Benevento (Italy)

Attended PhD Schools

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Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 st	Telemedicina, e-Health e Mobile Health: si può davvero usare il digitale nel percorso assistenziale?	0.4	Prof. G. D’Addio	University of Naples “Federico II”	ITEE
1 st	From present to future in Digital Healthcare	0.4	Prof. P. Bifulco	University of Naples “Federico II”	ITEE
1 st	Single cell omics leverage Machine Learning to dissect tumor microenvironment and cancer immune editing	0.4	Prof. Ceccarelli	University of Naples “Federico II”	University of Napoli Federico II
1 st	The learning landscape in deep neural networks and its exploitation by learning algorithms	0.3	Prof. Ceccarelli	University of Naples “Federico II”	University of Napoli Federico II
1 st	Systems biology as a compass to understand tumor-immune interactions in humans	0.3	Prof. Ceccarelli	University of Naples “Federico II”	University of Napoli Federico II
1 st	Can a Text-to-Speech Engine Generate Human Sentiments?	0.4	Picariello Lectures	University of Naples “Federico II”	ITEE
1 st	Towards a Political Philosophy of AI	0.4	Picariello Lectures	University of Naples “Federico II”	ITEE
1 st	An introduction to Deep Learning for Natural Language Processing	0.4	Prof. F. Cutugno	University of Naples “Federico II”	ITEE
1 st	Assessing postural control and motion sickness using electrophysiological signals	0.4	Prof. P. Gargiulo	University of Reykjavik	
1 st	Population and medical genomics applications to human traits and diseases	0.2	Prof. Ceccarelli	University of Naples “Federico II”	University of Napoli Federico II
1 st	Symbiotic Control of Wearable Soft Suits for human motion assistance and augmentation	0.4	Prof. F. Ficuciello	University of Naples “Federico II”	University of Napoli Federico II
1 st	Probing and infusion biomedical knowledge for pre-trained language models	0.4	Prof. F. Cutugno	University of Naples “Federico II”	ITEE
2 nd	Cybercrime and information warfare: national and international actors	0.4	Dr. Paganini, Proff. Romano, Natella	University of Naples “Federico II”	University of Napoli Federico II
	Donne e STEM: Il mio impegno in WIE	0.4	Prof.ssa Cassioli		

2 nd	Threat Hunting & Incident Response	0.4	Dr. Kurdin, Proff. Romano, Natella	University of Naples “Federico II”	University of Naples “Federico II”
2 nd	Analysis and control of functional brain networks	0.2	Prof. Pasqualetti	University of Naples “Federico II”	University of Naples “Federico II”
3 rd	Robotics Meets AI & 5G – The Future is now!	0.4	Prof. Siciliano	University of Naples “Federico II”	ITEE
3 rd	Artificial Intelligence for Ocean Dynamics	0.4	Prof. Buongiorno Nardelli	University of Naples “Federico II”	ITEE

Research activities

Sarah Adamo participated in the research of different aspects regarding healthcare. Her studies mainly focused on the implementation of Machine Learning models, both supervised and unsupervised, to support the management of chronic and disabling diseases in terms of protocols and treatments unknown yet. For this purpose, the research provided the comparison of different techniques proposed in literature in order to identify the most appropriate to the problem. Moreover, she participated also in the research of acquisition and processing of biosignals through the gait analysis in patients affected by Parkinson’s Disease at the Ruggi Hospital of Salerno. Otherwise, at the IRCCS Maugeri she participated in the research of the management of patients both in terms of risk management and telemonitoring, through the study of specific cases and the definition of models to support clinicians and patients.

Finally, she also participated in the research of processing and analysis techniques of biosignals for the schematization of models for biological processes, through the comparison and the implementation of several circuitual models proposed in literature to describe phenomena of cellular response.

Tutoring and supplementary teaching activities

Two MSc thesis tutoring.

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1 st	21.4	4.4	38	//
2 nd	4	1.4	30	0.8
3 rd	24	0.8	55.8	//

The total of seminars credits was not in line since the activities were more focused on courses and research mainly relevant to the topic.

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
1 st	IRCCS Maugeri	Proff. M. Cesarelli, G. D'Addio	12months	On-field experiments on AI and telemonitoring
2 nd	IRCCS Maugeri	Proff. M. Cesarelli, G. D'Addio	6 months	On-field experiments on AI and telemonitoring

PhD Thesis

In the PhD Thesis, Sarah Adamo focused on the application of Artificial Intelligence (AI), and particularly of Machine Learning (ML), to chronic and disabling diseases.

In the last few years, the scenario of clinical research and diseases study has completely changed due to the introduction of AI in healthcare. Through the AI application, and particularly through the involvement of ML techniques, a new way of approaching the analysis of pathologies and diseases has been possible.

The management of patients affected by chronic and disabling disease represents nowadays a challenge for clinical research, since those patients are more frequently exposed to the occurrence of acute events and the worsening of clinical conditions and of the quality of life too. Moreover, there is still a lack of knowledge in several diseases, particularly for what may concern the early detection and the choice of the best treatment. For this reason, three main clinical case studies were involved in this research: long-term COVID-19 disease, asthma disease and Parkinson's Disease (PD).

Both supervised and unsupervised ML models were implemented in order to identify the best parameters that were able to predict an early diagnosis or a clinical outcome and to identify phenotypes with similar clinical characteristics. Starting from the acquisition of data, the definition of an effective outcome was fundamental for a better training of models.

Analyses gained good results in terms of evaluation metrics and identified parameters with a high predictive value: the 6-Minute-Walking-Test (6MWT) for the estimation of rehabilitation improvements in long-term COVID19, a new cut-off value of the eosinophils count for the identification of clinical clusters with specific characteristics impacting on the prediction of further exacerbations, the effectiveness of gait analysis variables in the prediction of a pre-dementia stage in PD.

In conclusion, these studies demonstrated to provide powerful methods for the identification of fundamental parameters in the management of chronic and disabling disease, thus supporting the clinical decision making.

Research products

Research results appear in 7 papers published in international journals, 2 contributions to international conferences.

List of scientific publications

International journal papers

Adamo, S.; Ambrosino, P.; Ricciardi, C.; Accardo, M.; Mosella, M.; Cesarelli, M.; d'Addio, G.; Maniscalco, M. *A Machine Learning Approach to Predict the Rehabilitation Outcome in Convalescent COVID-19 Patients*. J. Pers. Med. 2022, 12, 328.

D'Amato, M., Ambrosino, P., Simioli, F., **Adamo, S.**, Stanziola, A. A., D'Addio, G., ... & Maniscalco, M. (2022). *A machine learning approach to characterize patients with asthma exacerbation attending an acute care setting*. European Journal of Internal Medicine.

Amboni, M., Ricciardi, C., **Adamo, S.**, Nicolai, E., Volzone, A., Erro, R., Cuoco, S., Cesarelli, G., Basso, L., D'Addio, G., Salvatore, M., Pace, L., Barone, P. *Machine learning can predict Mild Cognitive Impairment in Parkinson disease*. Frontiers in Neurology.

Donisi, L., Ricciardi, C., Cesarelli, G., Coccia, A., Amitrano, F., **Adamo, S.**, & D'Addio, G. (2022). *Bidimensional and Tridimensional Poincaré Maps in Cardiology: A Multiclass Machine Learning Study*. Electronics, 11(3), 448. <https://doi.org/10.3390/electronics11030448>

Cesarelli, G., Petrelli, R., **Adamo, S.**, Monce, O., Ricciardi, C., Cristallo, E., ... & Cesarelli, M. (2023). *A Managerial Approach to Investigate Fall Risk in a Rehabilitation Hospital*. Applied Sciences, 13(13), 7847.

Cappiello, A., Abate, F., **Adamo, S.**, Tepedino, M. F., Donisi, L., Ricciardi, C., ... & Picillo, M. (2024). *Direct Current Stimulation of Prefrontal Cortex Is Not Effective in Progressive Supranuclear Palsy: A Randomized Trial*. Movement Disorders.

Clemente, F., Amato, F., **Adamo, S.**, Russo, M., Angelone, F., Ponsiglione, A. M., & Romano, M. (2024). *Circuit modelling in muscle tissue impedance measurements*. Heliyon, 10(7).

International conference papers

Adamo, S., Ricciardi, C., Ambrosino, P., Maniscalco, M., Biancardi, A., Cesarelli, G., Donisi, L. & D'Addio, G. (2022, June). *Unsupervised Machine Learning to Identify Convalescent COVID-19*

Phenotypes. In 2022 IEEE International Symposium on Medical Measurements and Applications (MeMeA).

Ponsiglione, A. M., Donisi, L., **Adamo, S.**, Tedesco, A., Ricciardi, C., Romano, M., & Amato, F. (2022, November). *A Sensitivity Analysis of Symbolic Dynamics indices for Fetal Heart Rate Monitoring*. In 2022 E-Health and Bioengineering Conference (EHB) (pp. 01-04). IEEE.

ORGANIZER OF SCIENTIFIC CONGRESS

2023 IEEE International Conference on Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRINE2023)

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

2022 National Conference of SIAMOC (Società italiana di Analisi del Movimento in Clinica)

Member of the organizing committee

Date 15/10/2024

PhD student signature



Supervisor signature


