



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

PhD Student: Mohammad Solki

Cycle: XL

Training and Research Activities Report

Year: First

M. Solki

Antonia Maria Tulino

Tutor: Prof. Antonia Maria Tulino

Co-Tutor: Prof. Jaime Llorca

Date: October 31, 2025

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Author: Mohammad Solki

1. Information:

- **PhD student:** Mohammad Solki
- **DR number:** DR1000196
- **Date of birth:** 23/09/1998
- **Master Science degree:** Data Science
- **Doctoral Cycle:** XL
- **Scholarship type:** TIM S.p.A & PNRR
- **Tutor:** Prof. Antonia Maria Tulino
- **Co-tutor:** Prof. Jaime Llorca

University: University of Naples Federico II

2. Study and training activities:

Activity	Type ¹	Hours	Credits	Dates	Organizer	Certificate ²
AI Code Generation: Foundations, Evaluation, and Security	Course	11	3	7-10-14-15-17-31/10/2025	Dr. Pietro Liguori, DIETI - UniNa	Y
Big Data Architecture and Analytics	Course	20	5	7-12-19-22-26-27-28/05/2025	Prof. Giancarlo Sperli, DIETI - UniNa	Y
How to boost your PhD	Course	18	5	08-15-22-29/01/ - 05-12/02/2025	Prof. Antigone Marino, CNR	Y
IoT Data Analysis	Course	12	4	28-31/01/ - 4-7-11-14-25/02/2025	Prof. Raffaele Della Corte, DIETI - UniNa	Y
Using Deep Learning Properly	Course	12	4	3-6-10-14-17-19/02/2025	Dr. Andrea Apicella, DIETI - UniNa	Y
2025 IEEE European School of Information Theory (ESIT)	Doctoral School	18	3.6	04/05/2025 to 09/05/2025	IEEE Information Theory Society	Y
5G & DIGITAL TRANSFORMATION: A VIEW FROM AN	Seminar	4	0.8	14/03/2025	Prof. Antonia Maria	Y

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UNCONVENTIONAL PERSPECTIVE SECOND EDITION					Tulino, DIETI – UniNa	
A Gentle and Incomplete Introduction to Bilevel Optimization	Seminar	1	0.2	15/10/2025	Prof. Maurizio Boccia, Prof. Claudio Sterle, Prof. Adriano Masone (DIETI, UniNa)	Y
AI Powered User interface design	Seminar	4	0.8	24/10/2025	Prof. Antonia Maria Tulino (DIETI, UniNa) - 5G Academy	Y
Can we Rely on AI? Reliability Issues in Artificial Neural Networks and Potential Solutions for Autonomous Vehicles	Seminar	1	0.2	16/01/2025	Dr. Edoardo Giusto, DIETI – UniNa	Y
ColorVideoVDP - how low-level human vision models help to design better quality metrics	Seminar	1	0.2	09/01/2025	EURASIP Journal on Image and Video Processing	Y
Dynamic Risk Assessment in Industrial Applications: Leveraging Bayesian Inference for Enhanced Decision-Making	Seminar	1	0.2	04/03/2025	Dr. Francesco Vitale, DIETI - UniNa	Y
Emergent behaviors and collective decisions in cyber-physical-human systems	Seminar	1	0.2	12/02/2025	SSM Scientific Colloquium	N
Estimations of Unimodular Signal Waveform and Uncertain Receive Signal Steering Vector for Robust Optimal	Seminar	1	0.2	02/10/2025	Prof. Massimo Rosamilia (DIETI, UniNA)	Y

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Receive Beamforming Design						
Exact and ML-guided Matheuristic approaches for a Truck-and-Drone delivery problem	Seminar	1	0.2	17/10/2025	Prof. Maurizio Boccia, Prof. Claudio Sterle, Prof. Adriano Masone (DIETI, UniNa)	Y
Explainable Scientific Machine Learning: Theoretical and Practical Perspectives metrics	Seminar	1	0.2	20/02/2025	SSM Scientific Colloquium	N
Guardians or Threats? AI at the Frontlines of Cybersecurity	Seminar	4	0.8	17/10/2025	Prof. Antonia Maria Tulino (DIETI, UniNa) - 5G Academy	Y
IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors	Seminar	1.5	0.3	15/10/2025	Rachel Berrington (Director, IEEE)	Y
Local Explainability in Machine Learning: A collective framework	Seminar	1	0.2	16/10/2025	Prof. Maurizio Boccia, Prof. Claudio Sterle, Prof. Adriano Masone (DIETI, UniNa)	Y
Metaverse and Digital Twin	Seminar	4	0.8	23/10/2025	Prof. Antonia Maria Tulino (DIETI, UniNa) - 5G	Y

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					Academy	
Optimisation-based Control of Flexible Resources in Sustainable Energy Networks	Seminar	1	0.2	05/02/2025	Prof. Luigi Glielmo, DIETI – UniNa	Y
Optimization in Transportation and Logistics	Seminar	1	0.2	16/10/2025	Prof. Maurizio Boccia, Prof. Claudio Sterle, Prof. Adriano Masone (DIETI, UniNa)	Y
Point Cloud Compression, Super-Resolving and Deblocking	Seminar	1	0.2	07/11/2024	EURASIP Journal on Image and Video Processing	N
Quality of Experience in XR: Bridging Metrics and User Perception	Seminar	1.5	0.3	16/10/2025	Prof. Antonio Capone (Fondazione RESTART)	Y
Revealing and Leveraging the Visual Information in Diffusion Models	Seminar	1	0.2	04/06/2025	EURASIP Journal on Image and Video Processing	Y
Robot Autonomy among Decision-Making Agents	Seminar	1	0.2	15/04/2025	Prof. Fabio Ruggiero, DIETI - UNINA	Y
Robotic Manipulation @Vanvitelli Robotics Lab: A bird's eye view on the last 5 years	Seminar	2	0.4	18/06/2025	Dr. Mario Selvaggio, DIETI - UniNa	Y
Service Enablement Platform: How to Deploy Service in the Cloud	Seminar	4	0.8	04/09/2025	Prof. Antonia Maria Tulino (DIETI, UniNa) - 5G Academy	Y

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The Good, the Bad, and the Ugly in Quantum Computing: Computational Power, Intrinsic Noise, and Transient Faults	Seminar	1	0.2	17/01/2025	Dr. Edoardo Giusto, DIETI – UniNa	Y
Trends in Image Aesthetics Assessment	Seminar	1	0.2	09/10/2025	EURASIP Journal on Image and Video Processing, Springer Nature	Y
Visual Data Compression in the AI Era	Seminar	1	0.2	04/09/2025	EURASIP Journal on Image and Video Processing, Springer Nature	Y
Workshop on “Radar Cross-Section Estimation and Measurements”	Seminar	4	0.8	17/10/2025	Prof. Amedeo Capozzoli, Prof. Claudio Curcio, Prof. Angelo Liseno (DIETI, UniNa)	Y

- 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
Bimonthly 1	0	0.2	7	0	7.2
Bimonthly 2	13	1.2	2.5	0	16.7
Bimonthly 3	0	1.2	5.5	0	6.7
Bimonthly 4	8.6	0.6	3	0	12.2
Bimonthly 5	0	0	7	0	7
Bimonthly 6	3	6	7	0	16
Total	24.6	9.2	32	0	65.8
Expected	20 - 40	5 - 10	10 - 35	0 - 1.6	35 - 86.6

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3. Research activity:

During my first year, my research focused on intelligent network control strategies for deadline-constrained services in next-generation networks. Building upon my master's thesis on Graph Neural Networks for routing optimization, I contributed to developing Multi-Agent Deep Reinforcement Learning (MA-DRL) approaches for the Delay-Constrained Maximum-Throughput (DCMT) network control problem.

My primary contribution involved investigating Graph Convolutional Networks (GCNs) within the MA-DRL framework developed by our research group. Unlike conventional Multi-Layer Perceptron (MLP)-based approaches, GCNs explicitly leverage network topology through message-passing mechanisms. I conducted comprehensive architectural analysis—including extensive grid searches over hidden layer dimensions and activation functions—identifying compact GCN configurations that effectively capture routing dynamics with significantly fewer parameters than MLPs.

I also contributed to developing model-based routing algorithms as practical alternatives to computationally intensive MA-DRL. Working with the group's "effective congestion" concept—a spatio-temporal metric considering temporal packet competition patterns—I contributed to evaluation of algorithms including Minimum Weight Path with Effective Congestion (MWP-EC) and Uniform Path Grouping (UPG) paired with Lowest Effective Lifetime First (LELF) scheduling.

Experimental validation across multiple network topologies (Hierarchical, Abilene, and 3×3 Grid) under varying traffic loads (30-120% of capacity) and lifetime constraints revealed promising results for GCN-based routing. However, performance varied across different network configurations and traffic conditions, indicating that further investigation is needed. Future work will explore additional variables—including network topology characteristics, congestion patterns, online off-policy learning, and deadline distributions—to better understand when topology-aware learning provides advantages and to develop more generalized solutions for deadline-constrained network control.

This research contributed to two IEEE ICC conference paper submissions on MA-DRL frameworks and congestion-aware routing policies for deadline-constrained networks. An extended journal version for Computer Networks is under preparation, synthesizing insights on when topology-aware learning provides the greatest benefits for network control.

4. Research products:

- **Solki, M., Vitale, V. N., Tulino, A. M., Molisch, A. F. & Llorca, J. (2025).** “Topology-Aware Routing for Deadline-Constrained Services via Graph Neural Networks.” **IEEE International Conference on Communications (ICC)**. Status: Submitted.
- **Vitale, V. N., Solki, M., Tulino, A. M., Molisch, A. F. & Llorca, J. (2025).** “Congestion-Aware Routing Policies for Deadline-Constrained Network Services.” **IEEE International Conference on Communications (ICC)**. Status: Submitted.

5. Conferences and seminars attended

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- **2025 IEEE European School of Information Theory (ESIT) – Ancona, Italy, May 4-9, 2025**
Attended the school organized by the IEEE Information Theory Society and presented a poster illustrating my ongoing PhD research

6. Activity abroad:

During the first year of my PhD, I did not undertake any study or research activities abroad.

7. Activity in partner companies:

I have not yet carried out any research or training activities within the partner company.

8. Tutorship

I have not been involved in any tutorship or supplementary teaching activities so far.