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

PhD Student: Danilo Amitrano

Cycle: XXXIX

Training and Research Activities Report

Academic year: 2024-25 - PhD Year: Second

Tutor: Prof. Maurizio Boccia

Firmato digitalmente da
MAURIZIO BOCCIA
CN = MAURIZIO BOCCIA
O = Università degli Studi di
Napoli Federico II
C = IT

Co-Tutor: Prof. Adriano Masone

Date: 20/01/2026

1. Information:

- ➢ **PhD student:** Danilo Amitrano

- ➢ **DR number:** 997214

- ➢ **PhD Cycle:** XXXIX

- ➢ **Date of birth:** 04/07/1998

- ➢ **Master Science degree:** Management Engineering

- ➢ **University:** University of Naples Federico II

- ➢ **Scholarship type:** PNRR - DM 117; Partner company: MASIFRAN s.r.l.

- ➢ **Period abroad:** Dpt. of Statistics and Operations Research of Cádiz University; In this second year I spent approximately 165 days (1 November 2024 – 14 December 2024, 8 February – 8 June 2025) of the 6 months of research abroad.

- ➢ **Suspension period:** 15 July – 6 October, 2025

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
Modelos Matemáticos para la Predicción de Tsunamis: Retos y Avance	Seminar	1	**0.2**	11/11/2024	Prof. A. M. Rodriguez - Chia	Y
Analisis de sistemas de transporte: datos y modelos	Seminar	1	**0.2**	11/11/2024	Prof. A. M. Rodriguez - Chia	Y
Explainable Scientific Machine Learning Theoretical and Practical Perspectives	Seminar	1	**0.2**	20/02/2025	SSM – Scuola Superiore Meridionale	Y
Dynamic Risk Assessment in Industrial Applications Leveraging Bayesian Inference for Enhanced Decision-Making	Seminar	1	**0.2**	04/03/2025	Dr. Francesco Vitale	Y
Numerical bifurcation analysis for delay equations	Seminar	1	**0.2**	07/03/2025	Prof. Gabor Orosz and Prof. Wim Michiels	Y
The Bi-objective Cable-Trench Problem	Seminar	1	**0.2**	13/03/2025	Dpt. of Statistical Sciences Sapienza, University of Rome	Y

Emergent dynamics of nonequilibrium systems with nonreciprocal couplings	Seminar	1	**0.2**	27/03/2025	SSM – Scuola Superiore Meridionale	Y
On the Security of Semantic Watermarking to Detect AI-Generated Content	Seminar	1	**0.2**	29/04/2025	Prof. Luisa Verdoliva (DIETI, UniNA)	Y
Trasporto ottimale: dalla teoria alla realtà	Seminar	1.5	**0.3**	13/03/2025	Università di Catania – PRIN 2022, ACHILLES	Y
I pilastri della trasformazione digitale	Course	12	**3**	02/04/2025, 03/04/2025, 04/04/2025, 14/04/2025, 15/04/2025, 16/04/2025, 16/05/2025	Dr. Francesco Tortorelli	Y
Optimizing On Demand Warehousing Systems	Seminar	1	**0.2**	07/05/2025	CIRRELT / MobilOpt	Y
Multi-Neighborhood Search for Combinatorial Optimization	Seminar	1	**0.2**	09/05/2025	Prof. Claudio Sterle, Prof. Maurizio Boccia, Prof. Adriano Masone (DIETI, UniNA)	Y
Multi-Layer Network Design and Planning Consolidation-Based Transportation Systems	Seminar	2	**0.4**	13/05/2025	Prof. Guido Perboli (Politecnico di Torino)	Y
How complex is to schedule the Italian Serie A Problems and methods in sports timetabling	Seminar	2	**0.4**	15/05/2025	Prof. Claudio Sterle, Prof. Maurizio Boccia, Prof. Adriano Masone (DIETI, UniNA)	Y
Column generation applied to the estimation of non-parametric discrete-choice models	Seminar	1	**0.2**	26/05/2025	Dpt. of Information Engineering (DEI), University of Padova	Y
Analysis of a two-dimensional birth-death process for the dynamics of B cell antigen receptors	Seminar	1	**0.2**	29/05/2025	Prof. Alfonso Suarez Llorens – Escuela de Doctorado de la	Y

					Universidad de Cadiz	
Variance comparison via the PMVT and the centered mean residual lifetime order	Seminar	1	**0.2**	29/05/2025	Prof. Alfonso Suarez Llorens – Escuela de Doctorado de la Universidad de Cadiz	Y
Superconducting Radio Frequency Cavities for Quantum Computing and Communication	Seminar	1	**0.2**	24/06/2025	Prof. Edo Giusto (DIETI, UniNA)	Y
Innovation and Entrepreneurship	Course	16	**3**	05/06/2025, 12/06/2025, 19/06/2025, 26/06/2025, 13/10/2025	Prof. Pierluigi Rippa e Prof. Simonetta Primario	Y
A Gentle and Incomplete Introduction to Bilevel Optimization	Seminar	1	**0.2**	15/10/2025	5th EUROYoung Workshop, Naples, Italy	Y
Optimization in Transportation and Logistics	Seminar	1	**0.2**	16/10/2025	5th EUROYoung Workshop, Naples, Italy	Y
Local Explainability in Machine Learning	Seminar	1	**0.2**	16/10/2025	5th EUROYoung Workshop, Naples, Italy	Y
Exact and ML-guided Matheuristic approaches for a Truck-and Drone delivery problem	Seminar	1	**0.2**	17/10/2025	5th EUROYoung Workshop, Naples, Italy	Y
Deep Learning and Telecommunications	Course	12	**4**	27/11/2024, 03/12/2024, 06/12/2024, 11/12/2024, 13/12/2024, 16/12/2024, 30/10/2025	Prof. Cristian Tommasino (UniNA)	Y
Verso nuovi paradigmi per la collaborazione uomo-macchina, orchestrazione, prototipazione e formazione per l'industria manifatturiera e il made in Italy	Seminar	2	**0.4**	17/11/2025	Prof. Marcello Cinque	Y
Bilevel optimization and reinforcement learning for last-mile delivery problems	Seminar	1	**0.2**	16/01/2026	Workshop TFLT 2026	Y

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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	0.4	10	0	10.4
Bimonth 2	0	0.2	11	0	11.2
Bimonth 3	0	1.3	8	0	9.3
Bimonth 4	3	2	8	0	13
Bimonth 5	3	0.8	5	0	8.8
Bimonth 6	4	0.6	7	0	11.6
Total	10	5.3	49	0	64.3
Expected	30 - 70	10 - 30	80 - 140	0 – 4.8	

3. Research activity:

During the second year of my PhD, my research focused on Operations Research and Optimization, specifically investigating the integration of Machine Learning (ML) techniques into classical optimization approaches to address Last-Mile Logistics (LML) problems.

I concentrated on five graph-based problems: the Covering Tour Problem with Path Upgrades (CTPPU), the Flying Sidekick Traveling Salesman Problem (FSTSP), the Parallel Drone Scheduling Traveling Salesman Problem (PDSTSP), the Parallel Drone Scheduling Vehicle Routing Problem (PDSVRP), and the Truck and Drone Team Logistics (TDTL).

I developed a Local Search metaheuristic to solve the FSTSP, PDSTSP, and TDTL. Additionally, I designed a classification-based framework for the CTPPU, FSTSP, and PDSVRP. The core idea of this approach is to leverage ML to reduce optimization complexity by identifying a promising set of feasible solutions. Specifically, the binary or probabilistic outputs produced by the node classification step are exploited to simplify the mathematical model or to design an ad-hoc heuristic tailored to the problem.

I am currently finalizing the implementation of this framework for the PDSVRP.

4. Research products:

* Danilo Amitrano*, Maurizio Boccia, Adriano Masone, Claudio Sterle,
  <u>TITLE</u>: «*A new formulation for the Traveling Salesman Problem with Drone and Lockers*»
  <u>JOURNAL</u>: Networks, published by WILEY
  <u>STATUS</u>: Published 26 April 2025
  <u>PRESENTED AT</u>: 8th AIROYoung WORKSHOP, University of Calabria, Arcavacata di Rende, Calabria (IT), February 14 – 16, 2024

- Danilo Amitrano*, Maurizio Boccia, Adriano Masone, Claudio Sterle,
  TITLE: *«A classification-based metaheuristic approach for the Flying Sidekick TSP»*
  STATUS: Published 29 April 2025; IFAC – PapersOnLine, Elsevier
  PRESENTED AT: ODS 2024 – International Conference on Optimization and DecisionScience, Badesi, Sardinia (IT), September 8 – 12, 2024

- Danilo Amitrano*, Maurizio Boccia, Adriano Masone, Claudio Sterle,
  TITLE: *«An exact approach for a Local Container Drayage Problem with Truck Platooning Mode»*
  STATUS: Published 29 April 2025; IFAC – PapersOnLine, Elsevier

- Danilo Amitrano*, Maurizio Boccia, Gabriella Colajanni, Laura Scrimali,
  TITLE: *«Truck-Drone Delivery in Practice: A Local Search Metaheuristic with a Real-World Pharmaceutical Case Study»*
  STATUS: Submitted 22 December 2025; to Volume AIRO Springer Series "Transforming Freight Logistics and Transportation by Optimization and Data-Driven Methods" (Editors: F. Carrabs, R. Cerulli, F. Guerriero, M. Samà, C. Sterle).

- Danilo Amitrano*, Maurizio Boccia, Gabriella Colajanni, Laura Scrimali,
  TITLE: *«A classification-based heuristic approach for the CTPPU»*
  STATUS: Ongoing work

5. Conferences and seminars attended

- *WORKSHOP*
  NAME: 5th EUROYoung WORKSHOP
  PLACE: Naples, Campania (Italy)
  DATE: 15 – 17, October, 2025

- *WORKSHOP*
  NAME: WORKSHOP TFLT 2026
  PLACE: Naples, Campania (Italy)
  DATE: 16, Jenuary, 2026

6. Periods abroad and/or in international research institutions

The objective of my research project abroad was to develop an innovative classification-based approach to solve a particular tour covering problem: the "Covering Tour Problem with Path Upgrades (CTPPU)".

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This project was carried out through scientific cooperation with the Department of Statistics and Operations Research at Cádiz University, under the supervision of Full Professor A.M. Rodríguez-Chía.

This six-month research period abroad was carried out in two phases: the first, lasting two months, started on October 14, 2024, and ended on December 13, 2024; while the second, lasting four months, started on February 8, 2025 and ended on 8 June 2025.

In this second year, I spent approximately 145 days abroad (1 November 2024 – 14 December 2024 and 8 February – 8 June 2025), completing the required six-month research period. During this time, I worked on defining the training set, selecting the classifiers with the best performance, and conducting feature selection. Finally, I developed a customized CTPPU heuristic which, using the information derived from the binary and probabilistic classifications, efficiently identifies near-optimal solutions. The approach developed and the results obtained will be the subject of a scientific manuscript that I am currently preparing and that will be submitted to an international journal.