



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: 2023-24 - PhD Year: First

Tutor: Prof. Maurizio Boccia

Date: October 31, 2024

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

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 first year I spent approximately 15 days (14 October 2024 – 31 October 2024) of the 6 months of research abroad.

2. Study and training activities:

Activity	Type	Hours	Credits	Dates	Organizer	Certificate
<i>Programming for Everybody (Getting Started with Python)</i>	Course	19	0.0	-	Dr. Chuck, University of Michigan. Coursera online platform.	Y
<i>Ensuring Electronic Reliability Against CERN's Radiation Environment</i>	Seminar	2	0.4	01/12/23	Prof. Francesco Fienga, DIETI-Unina	Y
<i>Balancing-Based Model Reduction for Delay Systems</i>	Seminar	1	0.2	01/12/23	Prof. Nathan van de Wouw, Eindhoven University	Y
<i>The New OROps: Build more decision models, not more decision tools</i>	Seminar	1	0.2	04/12/23	The AIROYoung board & Logistics & Optimization Group of the Universidade Federal da Paraíba	Y
<i>Adaptive Radar Detection</i>	Seminar	1	0.2	06/12/23	IEEE – Aerospace and Electronic Systems Society	Y
<i>Ensemble optimal control problems governed by Boltzmann models</i>	Seminar	1	0.2	07/12/23	SSM – Scuola Superiore Meridionale	Y
<i>Sensor Location Optimization for Effective and Robust Beamforming</i>	Seminar	1	0.2	07/12/23	IEEE – Aerospace and Electronic Systems Society	Y

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

<i>Energy – Efficient Data Science</i>	Seminar	1	0.2	13/12/23	Prof. Elio Masciari, DIETI-Unina	Y
<i>Strategic Orientation for STEM Research and Writing</i>	Course	24	5	07/12/23, 15/12/23, 12/01/24, 19/01/24, 09/02/24, 23/02/24	Sig.ra Adriana D'Auria, DIETI - Unina	Y
<i>Computational Approaches for Solving General Systems of Nonlinear Equations in the Cloud</i>	Seminar	1	0.2	18/01/24	SSM – Scuola Superiore Meridionale	Y
<i>HOMINIS</i>	Seminar	5	1	21/02/24	Prof. Carlo Sansone; Eng. Stefano Marrone, DIETI - Unina	Y
<i>Using Deep Learning properly</i>	Course	12	4	23/01/24, 25/01/24, 30/01/24, 01/02/24, 06/02/24, 08/02/24	Andrea Apicella, Ph.D., DIETI – Unina	Y
<i>A Branch and Bound Algorithm for Bilevel Optimization Utilizing Reinforcement Learning</i>	Seminar	1	0.2	07/03/24	Istituto di Analisi dei Sistemi ed Informatica “Antonio Ruberti” – Consiglio Nazionale delle ricerche (IASI – CNR)	Y
<i>Control Theory & Robust Distributed Optimization: Some Insights</i>	Seminar	1	0.2	21/03/24	SSM – Scuola Superiore Meridionale	Y
<i>Analytic center selection of optimization-based controllers for robot ecology</i>	Seminar	1	0.2	09/04/24	Prof. Bruno Siciliano, DIETI - Unina	Y
<i>SINTEF Railway Optimization: Theory and Applications</i>	Seminar	1	0.2	16/04/24	SINTEF and Gurobi Optimization	Y
<i>Big Data Architecture and Analytics</i>	Course	20	5	06/05/24, 07/05/24, 13/05/24, 14/05/24,	Prof. Giancarlo Sperli, DIETI – Unina	Y

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

				16/05/24, 20/05/24, 21/05/24		
<i>Machine Learning: "Algorithms, Data Structures and Machine Learning"</i>	Course	46	6	07/03/24, 08/03/24, 14/03/24, 15/03/24, 21/03/24, 22/03/24, 04/04/24, 05/04/24, 11/04/24, 12/04/24, 18/04/24, 19/04/24, 02/05/24, 03/05/24, 09/05/24, 10/05/24, 16/05/24, 17/05/24, 23/05/24, 24/05/24, 31/05/24, 06/06/24, 07/06/24	Prof. Carlo Sansone, DIETI – Unina	Y
<i>IEEE Authorship & Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors</i>	Seminar	1.5	0.3	07/05/24	IEEE – Advanced Technology for Humanity	
<i>Intelligenza Artificiale e Regole del Mercato</i>	Seminar	2	0.4	14/05/24	5G Academy's Seminar Series	Y
<i>Social Network Analysis: Methods and Applications</i>	Seminar	2	0.4	07/06/24	Prof. Giancarlo Sperli, DIETI – Unina	Y
<i>On the Single Allocation hub location problems: New formulations and Solving Method</i>	Seminar	1	0.2	26/06/24	Prof. Claudio Sterle; Prof. Maurizio Boccia; Prof. Adriano Masone, DIETI - Unina	Y
<i>Using support vector machines for feature selection and outlier detection</i>	Seminar	1	0.2	26/06/24	Prof. Claudio Sterle; Prof. Maurizio Boccia; Prof. Adriano Masone, DIETI - Unina	Y

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

<i>Including elastic demand in the hub line location problem</i>	Seminar	1	0.2	28/06/24	Prof. Claudio Sterle; Prof. Maurizio Boccia; Prof. Adriano Masone, DIETI - Unina	Y
<i>The maximal covering location problem with edge downgrades</i>	Seminar	1	0.2	28/06/24	Prof. Claudio Sterle; Prof. Maurizio Boccia; Prof. Adriano Masone, DIETI - Unina	Y
<i>3rd Metaheuristics Summer School "AutoDL meets HPC"</i>	Doctoral School (Course)	30	6	15/07/24, 16/07/24, 17/07/24, 18/07/24	Prof. Mario Pavone, University of Catania	Y
<i>From ACE Technologies to Sustainable, Accessible and Equitable Urban Mobility: An Optimization Journey</i>	Seminar	2	0.4	16/09/24	Prof. Stefania Santini, DICEA - Unina	Y
<i>1st EUROYoung (Mini)PhD School on "Planetary Wellbeing"</i>	Doctoral School (Seminar)	15	3	04/09/24 05/09/24 06/09/24	Prof. Alberto Santini, Pompeu Fabra University in Barcelona. Prof. Vanesa Guerrero Lozano, Carlos III University of Madrid.	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
Bimonth 1	0	1.6	5	0	6.6
Bimonth 2	5	1.2	7	0	13.2
Bimonth 3	4	0.8	5	0	9.8
Bimonth 4	11	1.9	5	0	17.9
Bimonth 5	6	0	2	0	8
Bimonth 6	0	3.4	4	0	7.4
Total	26	8.9	28	0	62.9
Expected	30 - 70	10 - 30	80 - 140	0 - 4.8	

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

3. Research activity:

During the first year of my doctoral studies, I delved into the specific application fields of the research projects I would develop throughout my program. My focus was on: *Operations Research and Optimization*, I studied the fundamentals and advanced topics in this field, with a particular emphasis on exact methods for solving mixed-integer linear programming problems. Additionally, I acquired and refined my proficiency in the Python programming language and in the use of specific mathematical libraries and solvers, such as Gurobi; *Data Mining and Machine Learning*, I studied key concepts and advanced techniques in data mining and machine learning: Input (Concepts, Instances, Attributes), Output (Knowledge Representation), Basic Methods (Classification Rules, Clustering, Linear Models), Performance Evaluation (Training, Validation, and Testing), Advanced Models (non-linear SVM, MLP, SVR), Advanced Data Transformation Techniques (PCA, SMOTE, ECOC), Deep learning and Neural Networks (Transfer learning, Fine tuning, CNN, RNN, GAN), Ensemble Learning (Bagging, Boosting, Stacking).

My projects focused primarily on solving optimization problems in the *last-mile logistics* (LML) sector. I evaluated the introduction of innovative and/or eco-friendly solutions. In particular, I addressed the '*Traveling Salesman Problem with Drones and Lockers (TSP-DL)*', that considers the introduction of drones and parcel lockers into standard delivery operations; and the '*Flying Sidekick Traveling Salesman Problem (FS-TSP)*', which evaluates the introduction of drones alone.

So, my first research project centered on the "*Traveling Salesman Problem with Drones and Lockers (TSP-DL)*". I developed a novel arc-based integer linear programming formulation for this problem and evaluated its performance on two sets of benchmark instances and a real-world dataset. The encouraging results led to the preparation of a research paper, which was presented at the *8th AIROYOUNG WORKSHOP* (hosted by the University of Calabria, Arcavacata di Rende (CS), February 14 - 16, 2024) and subsequently submitted to the international journal *Networks* (Under second revision).

Subsequently, I shifted my attention to the "*Flying Sidekick Traveling Salesman Problem (FS-TSP)*". I proposed a novel metaheuristic approach that leveraged machine learning techniques to classify nodes as either drone-served or truck-served. This approach was evaluated and demonstrated the potential of machine learning in solving complex optimization problems. A presentation on this work was prepared for *ODS2024* (the International Conference on Optimization and Decision Science, Badesi (Sardinia), September 8 - 12, 2024).

Finally, in preparation for my six-month research visit to the Department of Statistics and Operations Research at Cádiz University, I started a study of the "*Covering Tour Problem with Arc Upgrades (CTPAU)*" and its related models. Once the problem had been studied, the various phases of the innovative approach, based on machine learning techniques, to be developed for solving the CTPAU were defined.

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

4. Research products:

- Danilo Amitrano*, Maurizio Boccia, Adriano Masone, Claudio Sterle.
"A new formulation for the Traveling Salesman Problem with Drone and Lockers".
SUBMISSION: to the journal Networks
STATUS: Under second revision

5. Conferences and seminars attended:

- WORKSHOP
NAME: 8th AIROYoung WORKSHOP
PLACE: University of Calabria, Arcavacata di Rende, Calabria (IT)
DATE: February 14 – 16, 2024
PRESENTED PAPER: *"A new formulation for the TSP with Drone and Lockers"*
- CONFERENCE
NAME: ODS 2024 – International Conference on Optimization and Decision Science
PLACE: Badesi, Sardinia (IT)
DATE: September 8 – 12, 2024
PRESENTED PAPER: *"A classification based metaheuristic approach for the Flying Sidekick TSP"*

6. Activity abroad:

The objective of my research project abroad is to develop an innovative classification-based approach to solve a particular tour covering problem: the "Covering Tour Problem with Arc Upgrades (CTPAU)". This project will be 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 is planned to be carried out in two phases: the first, lasting two months, will start on October 14, 2024, and end on December 13, 2024; while the second, lasting four months, will take place during the first semester of 2025 (approximately between February and May, 2025).

In this first year I spent approximately 15 days (14 October 2024 – 31 October 2024) of the 6 months of research abroad. In this preliminary phase, a thorough literature review on the Covering Tour Problem with Arc Upgrades (CTPAU) has been conducted. In parallel, a MILP model has been developed to solve small and medium-sized instances, and a set of specific instances has been constructed to train a classifier. Furthermore, analyses of the problem's key parameters are ongoing to define an initial set of relevant features.

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: XXXIX

Author: Danilo Amitrano

7. Activity in partner companies

I have not carried out any activity in partner companies during my first Ph.D. year.

8. Tutorship

I have not carried out any tutorship during my first Ph.D. year