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

PhD Student: Mario Noioso

Cycle: XXXIX

Training and Research Activities Report

Year: First

Tutor: prof.ssa Stefania Santini

Co-Tutor

Date: October 31, 2024

Training and Research Activities Report

PhD in Information Technology and Electrical Engineering

Cycle: **Author:**

1. Information:

- **PhD student: Mario Noioso**
- **DR number: DR997202**
- **Date of birth: 17/11/1995**
- **Master Science degree: Automation Engineering** **University: Federico II**
- **Doctoral Cycle: XXXIX**
- **Scholarship type: no scholarship**
- **Tutor: Stefania Santini**
- **Co-tutor**

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
Control Systems For Autonomous Ground Vehicles	Course	48	6	22/12/2023	Prof. Stefania Santini	Y
Balancing-based model reduction for delay systems	Seminar	1.5	0.3	01/12/2023	Dr. Nathan van de Wouw	Y
Ensemble optimal control problems governed by Boltzmann models	Seminar	1	0.2	07/12/2023	Dr. Alfio Borzi	Y
AI for RAILS – Deep Learning for Railway Safety and Maintenance: Methodologies and Applications	Seminar	2	0.4	27/11/2023	Dr. Lorenzo De Donato	N
Decentralized Bilevel Optimization	Seminar	1	0.2	12/02/2024	Dr. Shiqian Ma	Y
Micro-to-macro variational analysis of lattice energies	Seminar	1	0.2	22/02/2024	Prof. Marco Cicalese	Y
EACSL'24 Conference	Seminar	6	1	23/02/2024	EACSL	Y
Statistical Data Analysis for Science and Engineering Research	Course	12	4	29/04/2024	Prof. Roberto Pietrantuono	Y
Analytic center selection of optimization-based controllers for robot ecology	Seminar	1	0.2	09/04/2024	Dr. Gennaro Notomista	Y
Dynamics with implicit state-dependent delay and post-Newtonian gravitational models	Seminar	1	0.2	05/04/2024	Dr. Erik Verriest	Y
Smart Roads and Cooperative Driving	Course	48	6	26/06/2024	Prof. Angelo Coppola	Y
IEEE Authorship and Open Access Symposium	Seminar	1.5	0.3	07/05/2024	IEEE	Y

Observing topological effects with infrared light	Seminar	1.5	0.3	08/05/2024	Dr. Paolo Fachin	Y
Rewire the brain: The potential of neuroplasticity	Seminar	2	0.4	09/05/2024	Prof. Paola Marangolo	Y
5G & Digital Transformation	Seminar	4	0.8	10/05/2024	Dr. Maurizio Irlando	Y
Regolazione in tema di intelligenza artificiale alla luce del'AI act	Seminar	5	1	13/05/2024	Dr. Elvira Raviele	Y
Intelligenza Artificiale e regole del mercato	Seminar	1	0.2	14/05/24	Prof. Massimo Rubino De Ritis	Y
Verso una gestione smart della risorsa idrica	Seminar	1	0.2	14/05/2024	Dr. Enrica Menduni De Rossi	Y
Some aspects of virtual medicine and human space science research	Seminar	1	0.2	16/05/2024	Dr. Paolo Russo	Y
Superare le sfide della modellazione di sistemi grazie al Model-Based System Engineering	Seminar	1	0.2	21/05/2024	Mathworks team	Y
Optimization-Based Planning and Control for Multi-Limbed Walking Robots	Seminar	1	0.2	27/05/2024	Prof. Dario Bellicoso	Y
Accelerating Deep Neural Inferences on FPGAs	Seminar	0.5	0.1	27/05/2024	Dr. Vincenzo Maisto	Y
RISC-V and SoCs	Seminar	0.5	0.1	27/05/2024	Dr. Vincenzo Maisto	Y
Da Model-Based System Engineering a Model-Based Design	Seminar	1	0.2	29/05/2024	Mathworks team	Y
Social Network Analysis: Methods and Applications	Seminar	2	0.4	07/06/2024	Tanmoy Chakraborty	Y
Innovation and Entrepreneurship	Course	12	4	03/07/2024	Prof. Pierluigi Rippa	Y
Automotive Cyber Security Academy (ACSA)	Course	16	3.2	01/07/2024	Prof. Christiancarmine Esposito	Y
Topological Signal Processing and Learning	Seminar	1	0.2	17/07/2024	Dr. Sergio Barbarossa	Y
Design and Analyze a Quadcopter with Model-Based Systems Engineering (MBSE)	Seminar	1	0.2	29/08/2024	Mathworks team	Y
Machine Learning for Science and Engineering Research	Course	20	5	18/10/2024	Prof. Anna Corazza	Y
From ACE Technologies to Sustainable, Accessible and Equitable Urban Mobility	Seminar	2	0.4	16/09/2024	Dr. Mauro Salazar	Y

TA Springer Nature & CARE - CRUI: Research Integrity	Seminar	1	0.2	08/10/2024	Dr. Gabor Orosz	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	**6**	**0.9**	**3.1**	**0**	**10**
Bimonth 2	**0**	**1.4**	**8.6**	**0**	**10**
Bimonth 3	**4**	**0.4**	**5.6**	**0**	**10**
Bimonth 4	**6**	**4.6**	**0**	**0**	**10.6**
Bimonth 5	**7.2**	**0.4**	**1.8**	**0**	**9.4**
Bimonth 6	**5**	**0.6**	**4.4**	**0**	**10**
Total	**28.2**	**8.3**	**23.5**	**0**	**60**
Expected	**30 - 70**	**10 - 30**	**80 - 140**	**0 – 4.8**	

3. Research activity:

The advent of cooperative connected and automated mobility (CCAM) has the potential to fundamentally change the mobility paradigm towards mobility as a service, contributing to more safe, efficient and comfortable transportation systems [1]. This new paradigm foresees the combination of different transport modes with the aim of offering a tailored mobility package, thus allowing a shift away from the existing ownership-based transport system toward an access-based one [2].

To make this visionary scenario a reality, different aspects are involved, going from regulatory issues, standardization and certification to technological issues. Among these aspects, the connectivity and the communication between different vehicles or infrastructure (V2X) plays a fundamental role.

About this topic, although current vehicles can already be considered connected devices, as many recent models are connected to external services for infotainment, security, comfort and maintenance purposes, a next step, involving the direct interaction among vehicles, pedestrians and road infrastructures, using various radio technologies, is still to be massively implemented [3].

The effective introduction of V2X communication, combined with the adoption of increasingly present artificial intelligence-based algorithms for solving the more traditional control and perception problems, is gradually converting the AVs (autonomous vehicles) into high complex and heterogeneous systems, whose safety and behaviour in the whole operational domain are difficult to assess.

This reason, combined with the inherent uncertainty and unpredictability of a dynamically changing environment (in terms of weather conditions, road parameters or traffic participants for example) in which the vehicle inserted, is giving rise to novel challenges for testing the AVs safety. These challenges may go beyond the scope of functional safety standards (reported in ISO 26262), leading to non-

functional faults and unreasonable risks, that fall within the scope of the safety of the intended functionality (SOTIF), standardized and dealt with in ISO 21448 [4].

SOTIF, emphasizing the risks associated with limitations of a system (or its functional modules) by focusing on enhancing safety in corner cases through a scenario-based approach [9], is a crucial bridge toward achieving widespread deployment of AVs. Primary objective of SOTIF concerns the identification of trigger conditions and the performance limitations intrinsically connected to these [5].

Due to the importance connected to properly identifying and solving SOTIF system-safety issues, this topic has been simultaneously addressed by both academic researchers and industrial developers, thus coming to the formalization of new methods (such as FTA [6] or STPA [7]) and the implementation of new test automations (such as PEGASUS [8] , or SAKURA) able to tackle this into the three main lifecycle phases: development, V&V (verification and validation), and operation.

Focusing on V&V phase, with the aim of determining system-level SOTIF issues for an ADAS system, that could lead to failures and/or loss of performances inside its ODD (operational design domain), where this last is defined as the operational region in which is guaranteed the safety by construction, aim of my project is to build a scenario-based test automation, able to "smartly" sample the configuration space.

With the idea of creating more realistic scenarios, able also to address possible faults deriving from the V2X domain, test automation will include an environmental model embedding V2X features as well.

Among different simulation environments that could be used to test the ADAS in a defined testing scenario, the agent-based autonomous driving simulator CARLA [10] has been chosen.

Once the simulation environment has been properly interfaced with MATLAB environment, a first implementation of ACC (adaptive cruise control) running on this latter (and representing a first sample inside the defined configuration space) has been executed and assessed.

References

[1] Ringhand, M., Anke, J., Schackmann, D. (2024). Understanding Mobility Needs and Designing Inclusive CCAM Solutions: A Literature Review and Framework. In: Stephanidis, C., Antona, M., Ntoa, S., Salvendy, G. (eds) HCI International 2024 Posters. HCII 2024. Communications in Computer and Information Science, vol 2118. Springer, Cham.

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[10] Dosovitskiy, A., Ros, G., Codevilla, F., Lopez, A., & Koltun, V. (13--15 Nov 2017). CARLA: An Open Urban Driving Simulator. In S. Levine, V. Vanhoucke, & K. Goldberg (Eds.), *Proceedings of the 1st Annual Conference on Robot Learning* (pp. 1–16). Retrieved from https://proceedings.mlr.press/v78/dosovitskiy17a.html

4. Research products

5. Conferences and seminars attended

6. Activity abroad

7. Activity in partner companies

8. Tutorship