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UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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

## **Activities and Publications Report**

# PhD Student: **Marco De Luca**

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Student DR number: DR995860

**PhD Cycle: XXXVII**

PhD Cycle Chairman: Prof. Stefano Russo

**PhD program student's start date: 01/11/21**

**PhD program student's end date: 31/10/24**

**Supervisor: Prof. Anna Rita Fasolino**

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**PhD scholarship funding entity:**

Micron Semiconductor Italia S.R.L

## General information

Marco De Luca received in year 2021 the Master Science degree in Computer Engineering from the University of Napoli “Federico II”. He attended a curriculum in Software Engineering within the PhD program in Information Technology and Electrical Engineering. He received a grant from Micron Semiconductor Italia.

## Study activities

### Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1 <sup>st</sup>	Software Testing	MSc course	6	Prof. Porfirio Tramontana	University of Naples “Federico II”
1 <sup>st</sup>	Machine Learning e Big Data per la Salute	MSc course	9	Prof. Vincenzo Moscato	University of Naples “Federico II”
1 <sup>st</sup>	Big Data Architecture and Analytics	Ad hoc course	5	Prof. Giancarlo Sperli	ITEE
1 <sup>st</sup>	Imprenditorialità Accademica	Ad hoc course	4	Prof. Pierluigi Rippa, DII	ITEE
1 <sup>st</sup>	Natural Language Processing	MSc course	6	Prof. Francesco Cutugno	University of Naples “Federico II”
2 <sup>nd</sup>	Using Deep Learning Properly	Ad hoc course	4	Dr. Andrea Apicella	ITEE
3 <sup>rd</sup>	Ethics and AI held by the Italian Society for Ethics of AI	Ad hoc course	2.4	Maurizio Mori, Consulta di Bioetica Onlus Tiziana Catarci, DIAG, Università la Sapienza Roma Giovanni Sartor, CIRSFID, Università di Bologna Guido Boella, Dipartimento di Informatica, Università di Torino	Italian Society for Ethics of AI (SIpEIA)

### Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
2 <sup>nd</sup>	ISSSE 2023 - 16th International Summer School on Software	Salerno, Italy	3	12/06/2023 – 15/06/2023	University of Salerno

### Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 <sup>st</sup>	Possible Quantum Machine Learning Approaches in HEP	0.4	Dr. Michele Grossi	CERN	ITEE
1 <sup>st</sup>	Connecting the dots: Investigating an APT campaign using Splunk	0.4	Dr. Antonio Forzieri	EMEA Cyber Security Specialization and Advisory , Splunk Inc.	ITEE
1 <sup>st</sup>	Single cell omics leverage Machine Learning to dissect tumor microenvironment and cancer immuno editing	0.4	Dr. Raoul J. P. Bonnal	IFOM - the FIRC Institute of Molecular Oncology	ITEE
1 <sup>st</sup>	Threat Hunting Use Cases	0.4	Vladimir Kurdin	Group-IB	ITEE
1 <sup>st</sup>	GDPR basics for computer scientists	0.4	Dr. Rigo Wenning	European Research Consortium for Informatics and Mathematics	ITEE
1 <sup>st</sup>	All roads lead to WebRTC: an introduction to Janus	0.4	Dr. Lorenzo Miniero	Meetecho	ITEE
1 <sup>st</sup>	Designing Quantum Algorithms	0.4	Prof. Michele Amoretti	University of Parma	ITEE
1 <sup>st</sup>	Computational analysis of cancer genomes	0.2	Nùria Lòpez-Bigas	University Pompeu Fabra	CQB
1 <sup>st</sup>	Project Văc: Can a Text-to-Speech Engine Generate Human Sentiments?	0.2	Prof. V.K. Gubani	Illinois Institute of Technology	ITEE
1 <sup>st</sup>	Explainable Natural Language Inference	0.3	Dr. Marco Valentino	University of Manchester	ITEE
1 <sup>st</sup>	An Introduction to Deep Learning for Natural Language Processing	0.2	Dr. Marco Valentino	University of Manchester	ITEE
1 <sup>st</sup>	Probing and infusing biomedical knowledge for pre-trained language models	0.3	Dr. Zaiqiao Meng	University of Glasgow	ITEE
3 <sup>rd</sup>	International Webinar	1	-	-	PhD Food Science

	Series 2023-2024, by the PhD School in Food Science				
3 <sup>rd</sup>	IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors	0.4	-	IEEE	IEEE
3 <sup>rd</sup>	Regolazione in tema di intelligenza artificiale alla luce dell'AI act	1	Elvira Raviele	MIMIT	5G Academy
3 <sup>rd</sup>	Intelligenza Artificiale e Regole del Mercato	0.4	Prof. Massimo Rubino De Ritis	Università degli Studi "Luigi Vanvitelli"	5G Academy
3 <sup>rd</sup>	Verso una gestione smart della risorsa idrica con il supporto della digital innovation	0.2	Prof. Enrica Menduni de Rossi	ABC Napoli	5G Academy

### Research activities

Marco De Luca's research activities have focused on two main areas: software testing and software development and documentation in the context of safety-critical industrial systems, where compliance with ISO 26262 requirements is mandatory. In the domain of software testing, his research addressed the fragility of test cases in template-based web applications, particularly those generated by GUI-based Capture and Replay tools. These test cases are prone to failure due to minor layout changes, known as "test breakages". To mitigate this, Marco De Luca developed a technique using hook-based locators, which embed unique attributes in HTML tags within templates, making test cases more resilient to layout changes. This method significantly reduced test failures in a validation study and enabled systematic comparison of locator robustness using a model that classifies layout changes.

In the area of software development and documentation, Marco De Luca contributed to the design of a software architecture documentation metamodel tailored to the requirements of ISO 26262, which aids compliance with this standard. He also introduced a tool-based Software Architecture Recovery (SAR) technique to automatically recover architectural documentation from codebases, simplifying maintenance in industrial environments. Additionally, he developed a framework for assessing architectural metrics such as modularity and maintainability, supporting continuous compliance with safety standards. Finally, his work on community detection helped identify developer community in social networks, aiding in the formation of more cohesive and effective development teams.

### Tutoring and supplementary teaching activities

Teaching activities related to practical lectures/seminars during the courses of “*Ingegneria del Software*”, SSD: ING-INF/05, CdL Ingegneria informatica, Prof. Anna Rita Fasolino

#### Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1 <sup>st</sup>	30	4	34	0.48
2 <sup>nd</sup>	4	3	52.6	0.48
3 <sup>rd</sup>	2.4	3	60	0

### Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
1 <sup>st</sup>	-	-	-	-
2 <sup>nd</sup>	-	-	-	-
3	-	-	-	-

### PhD Thesis

In the PhD Thesis, Marco De Luca focused on the challenges that have emerged due to the increasing amount of software in vehicles. The automotive industry is transforming as software becomes more integrated into vehicles, now containing millions of lines of code and multiple Electronic Control Units (ECUs). Software is now central to vehicle function and innovation, but it also brings challenges in development, quality assurance, and compliance with safety standards.

This thesis addresses these challenges by improving the software development process in the automotive domain, focusing on software documentation and adherence to industry regulations. It presents several contributions, including a community detection methodology within developer networks to improve team formation by identifying experts with the right skills. In addition, the thesis introduces a new software architecture documentation model for safety-critical domains, compliant with ISO 26262, to improve traceability and maintainability. This template has been validated through industrial case studies, enhancing long-term software reliability. To bridge the gap between design and implementation, the thesis also proposes a software architecture recovery (SAR) tool to automate the generation of architectural documentation from code bases, improving system understanding and ensuring accurate documentation. Finally, a framework for software architecture metrics is introduced to support continuous compliance processes. By identifying suitable metrics, this framework helps integrate compliance into industrial practices, ensuring adherence to safety standards and internal policies.

In conclusion, this research improves software development tackling key challenges in team collaboration, documentation and compliance, enabling innovation and maintaining high standards of safety and reliability.

### Research products

Research results appear in 2 papers published in international journals, 0 papers published in national journals, 5 contributions to international conferences, 0 contributions to national conferences, 0 patents.

### List of scientific publications

#### International journal papers

**M. De Luca**, A. R. Fasolino, A. Ferraro, V. Moscato, G. Sperlí, P. Tramontana,  
A community detection approach based on network representation learning for repository mining,  
*International Journal of Expert Systems with Applications*,  
vol. 231, 2023, DOI: 10.1016/J.ESWA.2023.120597

**M. De Luca**, A. R. Fasolino, P. Tramontana,  
Investigating the robustness of locators in template-based Web application testing using a GUI change classification model,  
*International Journal of Systems and Software*,  
vol. 210, 2024, DOI: 10.1016/J.JSS.2023.111932

#### International conference papers

P. Tramontana, **M. De Luca**, A. R. Fasolino,  
An Approach for Model Based Testing of Augmented Reality Applications,  
*RCIS Workshops*,  
Barcelona, Spain, 2022, Publisher, DOI: <https://ceur-ws.org/Vol-3144/QUAMES-paper2.pdf>

D. Amalfitano, **M. De Luca**, A. R. Fasolino  
Documenting Software Architecture Design in Compliance with the ISO 26262: a Practical Experience in Industry  
*IEEE 20th International Conference on Software Architecture Companion (ICSA-C)*,  
L'Aquila, Italy, 2023, pp. i-xi, IEEE, DOI: 10.1109/ICSA-C57050.2023.00022

D. Amalfitano, **M. De Luca**, A. R. Fasolino, P. Pelliccione, T. Santilli,  
Characterizing Software Architectural Metrics for Continuous Compliance in the Automotive Domain,  
*IEEE 21st International Conference on Software Architecture (ICSA)*  
Hyderabad, India, 2024 pp. 182-193, IEEE Computer Society, DOI: 10.1109/ICSA59870.2024.00025

**M. De Luca**, S. Di Meglio, A. R. Fasolino, L. L. L. Starace, P. Tramontana  
Automatic Assessment of Architectural Anti-patterns and Code Smells in Student Software Projects  
28th International Conference on Evaluation and Assessment in Software Engineering (EASE '24),  
Salerno, Italy, 2023, pp. 565-569, ACM, DOI: 10.1145/3661167.3661290

D. Amalfitano, **M. De Luca**, D.F. De Angelis, A. R. Fasolino  
Automated Architecture Recovery for Embedded Software Systems: An Industrial Case Study  
18th European Conference on Software Architecture (ECSA)  
Luxembourg, Luxembourg, 2024, pp. 55-68, ACM, DOI: 10.1007/978-3-031-70797-1\_4

## Patents and/or spin offs

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## Awards and Prizes

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Date 15/10/24

PhD student signature

  

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Supervisor signature

  

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