



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

PhD Student: Domenico Francesco De Angelis

Cycle: XXXIX

Training and Research Activities Report

Academic year: 2023-24 - PhD Year: Second

Tutor: prof. Anna Rita Fasolino

Co-Tutor:

Date: November 9, 2024

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Author: Domenico Francesco De Angelis

1. Information:

- PhD student: Domenico Francesco De Angelis PhD Cycle: XXXIX
- DR number: 1076
- Date of birth: 19/08/1993
- Master Science degree: Computer Engineering University: University of Federico II Naples
- Scholarship type: No funded
- Tutor: Anna Rita Fasolino
- Co-tutor:
- Period abroad: *list research institutions, public administrations and/or companies and number of months spent/to be spent there*

2. Study and training activities:

Activity	Type ¹	Hours	Credits	Dates	Organizer	Certificate ²
Big Data Architecture and Analytics	Course	16	5	6-7-13-14-16-20-21/05/24	Prof. Giancarlo Sperli	Y
Using Deep Learning Properly	Course	10	4	23-25-30/01/2024 01-06-08/02/2024	Dr. Andrea Apicella	Y
Industrial Embedded Systems Design with the ARM Architecture	Course	17	4	3-7-10-12-13-14-26/06/2024	Prof. Mario Barbareschi	Y
Software Security	Course	48	6		Prof. Roberto Natella	Y
From ACE Technologies to Sustainable	Seminar	2	0,4	16/09/2024		Y
Generative AI for software engineering: strategies, impacts, and practical applications	Seminar	8	1	29/05/2024	Prof. Antonia Maria Tulio	Y
Intelligenza artificiale e regole del mercato	Seminar	2	0,4	14/05/2024	Prof. Antonia Maria Tulio	Y
Verso una gestione intelligente delle risorse idriche con	Seminar	1	0,2	14/05/2024	Prof. Antonia Maria Tulio	Y

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Tips and Best Practice to Get Published from IEEE Editors	Seminar	1,5	0,4	07/06/2024	IEEE	Y
Exploring the Frontiers of Modern Cryptography	Seminar	1,5	0,3	12/04/2024	Prof. Simon Pietro Romano	Y
Research Integrity	Seminar	1	0,2	08/10/2024	Elisa Magistrelli - Spring Nature	Y
Learning in nonstationary environments	Seminar	2	0,4	15/10/2024	Prof. Carlo Sansone	Y
Study state of art cross-version binary code problem, ISO 26262, debug info structure (DWARF)	Research		6			N
Study of ANGR, binary analysis state of art, ISO 26262 Part8	Research		6			N
Study of ISO 26262 Part8, preparation of conference paper ECSA	Research		6			N
Study on social network analysis, Revision of conference paper ECSA	Research		6			N
Study on social network analysis, ANGR, repository-mining	Research		6			N
Study on reverse engineering of equivalence classes, cross-cutting concern	Research		3			

1) Courses, Seminar, Doctoral School, Research, Tutorship

2) Choose: Y or N

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2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1			6	0	
Bimonth 2			6	0	
Bimonth 3	4	0,3	6	0	
Bimonth 4	9	2,2	6	0	
Bimonth 5	6		6	0	
Bimonth 6		0,6	2	0	
Total	19	3,1	32	0	
Expected	30 - 70	10 - 30	80 - 140	0 - 4.8	

3. Research activity:

In my first year of PhD studies, I delved into Software Engineering, particularly focusing on safety-critical domains and static analysis to enhance testing and the reverse engineering of design description. A burgeoning area of research in this field is the integration of artificial intelligence (AI) techniques, which can significantly enhance static analysis and reverse engineering processes, among other things.

Following this, I am part of Micron Technology as Firmware Engineer. Micron Technology is a leading global semiconductor company specializing in memory and storage solutions. In this role, I was part of a team dedicated to improving processes to meet the stringent requirements of ISO 26262.

The ISO 26262 is a standard that deals with the functional safety of the E/E (Electric and Electronic) component of road vehicles. The standard defines a functional safety development V-process model that automotive manufacturing must follow and document to achieve compliance with the standard, otherwise the produced device won't be suitable to run in commercial vehicles. In the industry, the documentation of software architecture for embedded systems is not always aligned with ISO. The lack of compliant documentation could negatively impact the system's maintainability, testability, and safety. Proper documentation is essential to ensure compliance with the standards that translate in improved maintainability, testability, and safe operability.

My research activities, focused on Chapter 6 of ISO 26262, "Product Development at the Software Level." These contributions leveraged my expertise in static analysis to study how software development and verification processes adhered to the highest safety standards mandated by ISO 26262.

One of the key tasks I undertook was using static analysis to reverse engineer state machines described by tasks in legacy firmware code written in C. This process was crucial for understanding and validating the behavior of the existing code, ensuring that it met the necessary safety requirements. By applying these advanced techniques, we were able to enhance the reliability and safety of our embedded systems, aligning with the rigorous standards of the automotive industry.

My solution is based on static analysis of source code, based on source code pattern rule to implement a sort of optimized symbolic analysis then permit to define starting from a state machine defined using switch case

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statement to generate a graph of possible transitions between states of this machine. After some analysis this graph was used to generate UML state chart diagram for the target tool.

4. Research products:

- D. Amalfitano, M. De Luca, D.F. De Angelis, A.R. Fasolino, Automated Architecture Recovery for Embedded Software Systems: An Industrial Case Study, **European Conference on Software Architecture**, pp. 53-68, 2024

5. Conferences and seminars attended

-

6. Periods abroad and/or in international research institutions

-

7. Tutorship

-

8. Plan for year three

- Continue to use the symbolic analysis to define class-partitioning of software under test (SUT).
- Using static analysis to reverse engineering the requirements of SUT.
 - Exploring other solutions such as LLM (generative ai)