



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

**PhD Student: Alberto Moriconi**

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**Cycle: XXXVII**

**Training and Research Activities Report**

**Academic year: 2022-2023 - PhD Year: Second**

**Tutor: prof. Nicola Mazzocca**

**Date: October 23, 2023**

# Training and Research Activities Report

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Cycle: XXXVII

Author: Alberto Moriconi

## 1. Information:

- **PhD student:** Alberto Moriconi **PhD Cycle:** XXXVII
- **DR number:** DR995869
- **Date of birth:** 29/05/1989
- **Master Science degree:** Computer Engineering **University:** Naples Federico II
- **Scholarship type:** no scholarship
- **Tutor:** Nicola Mazzocca
- **Co-tutor:**

## 2. Study and training activities:

Activity	Type <sup>1</sup>	Hours	Credits	Dates	Organizer	Certificate <sup>2</sup>
Enhancing qubit readout with Bayesian Learning	Seminar	1	0.2	5/4/2023	Quantum Science and Technologies @Naples	N
Traffic Engineering with Segmented Routing: optimally addressing popular use cases	Seminar	1	0.2	23/6/2023	Prof. V. Persico, DIETI, Unina	N
Exploring Advanced Aerial Robotics: A Journey Into Cutting-Edge Projects and Neural Control	Seminar	1	0.2	29/6/2023	Ing. Eugenio Cuniato, ETH Zurich	N
Models of human motor coordination – a critical assessment and some open problems	Seminar	1	0.2	29/6/2023	John Hogan, University of Bristol, UK	N
BGP & Hot-Potato Routing: graceful and optimal convergence in case of IGP events	Seminar	1	0.2	30/6/2023	Prof. V. Persico, DIETI, Unina	N

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Ricerca e formazione nella società della transizione digitale	Seminar	5	1	22/9/2023	CINI (Consorzio Interuniversitario Nazionale per l'Informatica)	N
Unina Quantum Day – Come può tornarci utile la scienza	Seminar	2	0.4	28/9/2023	Proff. Francesco Tafuri, Giovanni Piero Pepe, Dipartimento di Fisica “Ettore Pancini”, Unina	N

- 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	-	-	9	0.5	9.5
Bimonth 2	-	-	8	-	8
Bimonth 3	-	0.2	8	-	8.2
Bimonth 4	-	0.8	9	-	9.8
Bimonth 5	-	-	11	-	11
Bimonth 6	-	1.4	11	-	12.4
<b>Total</b>	-	2.4	56	0.5	58.9
<b>Expected</b>	30 - 70	10 - 30	80 - 140	0 - 4.8	

## 3. Research activity:

*The main topic of my second year of research has been the application of approximate computing techniques to automatic methodologies for the synthesis of approximate circuits.*

*The methodology, based on exact synthesis and multi-objective combinatorial optimization, has been implemented in an open-source logic synthesis framework and has been tested on extensive benchmarks, showing improvements when confronted with the state of the art.*

*While originally devised and tested for area and/or depth reduction on ASICs, the methodology showed promising results in power reduction on FPGAs; a power model has been devised to model the expected results and extensive test have been conducted to experimentally confirm the hypothesis.*

*Another part of my research activity pertains safety-critical railway systems. In this field, my main focuses have been memory protection for real-time operating systems for resource-constrained devices and proof-of-concept architectures for autonomous train operation.*

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## 4. Research products:

- M. Barbareschi, S. Barone, V. Casola, P. Montone and A. Moriconi, "A Memory Protection Strategy for Resource Constrained Devices in Safety Critical Applications," 2022 6th International Conference on System Reliability and Safety (ICSRS), Venice, Italy, 2022, pp. 533-538, doi: 10.1109/ICSRS56243.2022.10067350.
  - o Awarded "Best presentation" of its session
- Amendola, A., Barbareschi, M., De Simone, S. et al. A real-time vital control module to increase capabilities of railway control systems in highly automated train operations. *Real-Time Syst* (2023). <https://doi.org/10.1007/s11241-023-09401-5>
- G. Mezzina et al., "A Step Toward Safe Unattended Train Operations: A Pioneer Vital Control Module," 2023 Design, Automation & Test in Europe Conference & Exhibition (DATE), Antwerp, Belgium, 2023, pp. 1-4, doi: 10.23919/DATE56975.2023.10137186.
- Mezzina, G. et al. (2023). Model-Based Vital Control Architecture for Highly Automated Train Operations. In: Berta, R., De Gloria, A. (eds) *Applications in Electronics Pervading Industry, Environment and Society. ApplePies 2022. Lecture Notes in Electrical Engineering*, vol 1036. Springer, Cham. [https://doi.org/10.1007/978-3-031-30333-3\\_21](https://doi.org/10.1007/978-3-031-30333-3_21)
- Barbareschi, M., Barone, S., Mazzocca, N., & Moriconi, A. "FPGA Approximate Logic Synthesis through Catalog-Based AIG-Rewriting Technique". (Journal paper, submitted)

## 5. Conferences and seminars attended

- IEEE--ICSRS 2022 : IEEE--2022 the 6th International Conference on System Reliability and Safety (ICSRS 2022); Venice, Italy; Nov 23, 2022 - Nov 25, 2022; presented the paper "A Memory Protection Strategy for Resource Constrained Devices in Safety Critical Applications", awarded "Best presentation" in its panel.

## 6. Periods abroad and/or in international research institutions

None.

## 7. Tutorship

- *Exercitations on datapath and control unit implementation based on the microprogrammed design paradigm for the Digital Systems Design course (Architettura dei Sistemi Digitali) – Prof. Nicola Mazzocca - 12 hours*

## 8. Plan for year three

The activities I expect to work on in the third year are mostly related to my main research topic, the synthesis of approximate logic circuits. My main objectives are:

- Completing the analysis and characterization of the behavior of existing tools on FPGA synthesis.

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- *Based on the results of this step, devising a simplified methodology that is specifically aimed to the optimization of switching activity in LUT-based devices.*
- *Evaluate light-weight methods for metrics evaluation, such as algebraic methods for arithmetic circuits and signal-reliability analysis techniques from the circuit testing literature.*
- *Add other applicative examples to enrich the final thesis.*

*I would also like to explore other emerging technologies, especially those applicable in low-power and constrained-resources devices.*

*Together with the scientific production of the first two years, this constitutes a preliminary draft of my final thesis.*