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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: **Vincenzo Scognamiglio**

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Student DR number: DR995995

**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. Vincenzo Lippiello**

e-mail: [vincenzo.lippiello@unina.it](mailto:vincenzo.lippiello@unina.it)

**Co-supervisor: Dr. Fabrizio Schiano**

e-mail: [fabrizio.schiano@leonardo.com](mailto:fabrizio.schiano@leonardo.com)

**PhD scholarship funding entity: Leonardo s.p.a.**

## General information

Vincenzo Scognamiglio received in year 2021 the Master Science degree in Automation Engineering from the University of Napoli Federico II. He attended a curriculum in Aerial Robotics within the PhD program in Information Technology and Electrical Engineering. He received a grant from Leonardo s.p.a.

## Study activities

### Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1 <sup>st</sup>	Statistical data analysis for science and engineering research	Ad hoc course	4	Prof. Roberto Pietrantuono	ITEE
1 <sup>st</sup>	Academic Entrepreneurship	Ad hoc course	4	Prof. Pierluigi Rippa	ITEE
1 <sup>st</sup>	Neural Networks and Deep Learning	External course	6	Prof. Giorgio Buttazzo, University Sant'Anna of Pisa	University Sant'Anna of Pisa
1 <sup>st</sup>	Operational Research: Mathematical Modelling, Methods and Software Tools for Optimization Problems	Ad hoc course	4	Prof. Adriano Masone	ITEE
2 <sup>nd</sup>	Robotics Lab	MSc course	6	Prof. Jonathan Cacace	University of Napoli "Federico II"
2 <sup>nd</sup>	Field and Service Robotics	MSc course	6	Prof. Fabio Ruggiero	University of Napoli "Federico II"

### Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
1 <sup>st</sup>	IEEE RAS Summer School on Multi-Robot Systems 2022	Prague, Czech Republic	2	01 – 05 /08/22	Czech Technical University, Czech Republic

### Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1 <sup>st</sup>	The learning landscape in deep neural networks and its exploitation by learning algorithm	0.2	Prof. Riccardo Zecchina	Bocconi University	Computational and Quantitative Biology Ph.D. Program
1 <sup>st</sup>	Global and Cluster	0.2	Prof.	University of	Modeling and

## Activities and Publications – Final Report

UNINA PhD in Information Technology and Electrical Engineering – XXXVII Cycle

PhD candidate: Vincenzo Scognamiglio

	Synchronization in Complex Networks and Beyond		Mattia Frasca	Catania, DIEEI	Engineering Risk and Complexity PhD program SSM
1 <sup>st</sup>	The search for Earth-like exoplanets in the Galaxy	0.2	Prof. Giovanni Covone	University of Napoli “Federico II”	SSM – Cosmology, Space Science & Space Technology PhD Program
1 <sup>st</sup>	IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors	0.3	IEEE	IEEE	IEEE
1 <sup>st</sup>	Potential and challenges of next generation railway signaling systems: Moving Block and Virtual Coupling	0.2	Eng. Joelle Aoun	Delft Technical University	Prof. Valeria Vittorini – Consorzio Interuniversitario Nazionale Per L’Informatica (CINI)
1 <sup>st</sup>	On using simple optimization techniques for tuning of UAVs	0.4	Prof. Dariusz Horla	Poznan University Technology	Prof. Fabio Ruggiero - DIETI - University of Napoli “Federico II”
1 <sup>st</sup>	An informal discussion around stochastic control and free boundary problems	0.2	Prof. Tiziano De Angelis	University of Torino	PhD program in “Modeling and Engineering Risk and Complexity” – SSM
1 <sup>st</sup>	Vine robots: design challenges and unique opportunities	0.2	Dr. Nicholas Naclerio	University of California, Santa Barbara	Dr. Mario Selvaggio – DIETI – University of Napoli “Federico II”
1 <sup>st</sup>	Workshop: Shared Autonomy in Physical Human-Robot Interaction: Adaptability and Trust	1.6	X. Jessie Yang, et al.	University of Michigan	Dr. Mario Selvaggio, DIETI, International Conference of Automation and Robotics 2022
2 <sup>nd</sup>	IROS Workshop: Human-Multi-Robot Systems: Challenges for Real World Application	1.5	Julie A. Adams, et al.	Oregon State University	Dr. Gennaro Notomista, University of Waterloo, Ontario, Canada, IROS 2022
2 <sup>nd</sup>	Complex Network Systems: introduction and open challenges	0.2	Prof. Pietro De Lellis	University of Napoli “Federico II”	Scuola Superiore Meridionale - SSM
2 <sup>nd</sup>	Industry 4.0 Fundamentals in Bosch Applications	2	Eng. Martino Bruni	Bosch – Centro Studi Componenti per Veicoli	Prof. Ing. Mariagrazia Dotoli, Coordinator of the National Ph.D. Program in Autonomous Systems, Politecnico di Bari
2 <sup>nd</sup>	Is control a solved problem for aerial robotics research?	0.2	Prof. Antonio	University of Twente	Prof. Fabio Ruggiero, DIETI, University of

			Franchi		Napoli “Federico II”
2 <sup>nd</sup>	Exploring Advanced Aerial Robotics: A Journey into CuttingEdge Projects and Neural Control	0.2	Eng. Eugenio Cuniato	ETH Zurich	Eng. Julien Mellet, DIETI University of Napoli “Federico II”
2 <sup>nd</sup>	AI, Robots and Society: Challenges and Opportunities for Social Innovation	0.2	Dr. Amit Kumar Pandey	Rovial Space, France	Prof. Bruno Siciliano, DIETI, University of Napoli “Federico II”
3 <sup>rd</sup>	Norme ed Etica per l’Applicazione dell’Intelligenza Artificiale	1.6	Prof. Salvatore Venticinque and Prof. Guglielmo Tamburrini	University of Campania “Luigi Vanvitelli”, University of Napoli “Federico II”	Eng. Francesco Castagna, Ordine degli Ingegneri della Provincia di Napoli

### Research activities

Vincenzo Scognamiglio participated in research about developing a framework for autonomous navigation of an Unmanned Aerial Vehicle (UAV) in a GNSS-denied environment. The framework has been employed primarily for operations of visual inspection of industrial facilities. During the PhD, the candidate integrated the aerial navigation framework with a ground robot creating a heterogeneous multi-robot system. The implementation in real-world environments of the multi-robot system raised new challenges related to the communication between the agents and cooperation methods that have been investigated during the second year of the PhD. The system has been extensively validated in national and international challenges: Leonardo Drone Contest and Robotic Drone Challenge at the European Robotic Forum. In this context, Vincenzo Scognamiglio has delved into the study of the odometry estimation problem, the candidate investigated, during one of his periods abroad, the consistency of EKF-based odometry problem analyzing it as an optimization problem. During his period abroad at Toronto Metropolitan University he had the opportunity to investigate the topic of reactive replanning for UAVs in a dynamic environment, the work is still in progress. As side work, to enhance the autonomy and robustness of UAVs, Vincenzo Scognamiglio investigated the problem of rotor fault detection and isolation.

### Tutoring and supplementary teaching activities

Vincenzo Scognamiglio assisted Prof. Fabio Ruggiero and Prof. Jonathan Cacace as Tutor for 10 hours for the course of Mobile Robots of the master’s degree in Autonomous Vehicle.

### Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1 <sup>st</sup>	20	3.5	35	

2 <sup>nd</sup>	12	4.3	42.1	1.6
3 <sup>rd</sup>	0	1.6	48.4	

*0.6 credits for seminars are missing due to the difficulty of attending in presence seminar during the second semester of the third year considering that the candidate was abroad.*

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

PhD Year	Institution / Company	Hosting tutor	Period	Activities
1 <sup>st</sup>	Toronto Metropolitan University (TMU), Toronto, Ontario, Canada	Dr. Reza Faieghi, Assistant Professor	2 months	Research on reactive obstacle avoidance in dynamic environment Joint scientific paper preparation on the research at the previous point, still under work.
1 <sup>st</sup>	Czech Technical University (CTU), Prague, Czech Republic	Prof. Martin Saska, associate professor and lead of the Multi-Robot System Group	4 months	Research on odometry robustification for long-term outdoor navigation.

### PhD Thesis

In the PhD Thesis, Vincenzo Scognamiglio investigates the exploitation of an autonomous Multi-Robot System in visual inspection operations of industrial plants. Dealing with the lack of a Global Navigation Satellite System (GNSS) signal, the agents need to localize relying only on onboard capabilities, and then plan movements to accomplish the visual inspection tasks. The thesis will first focus on the design of a complete autonomous navigation framework suited for Unmanned Aerial Systems (UAV) which has been characterized for specific inspection missions. Subsequently, the aerial robot is integrated with a ground robot to constitute a heterogeneous Multi-Robot System. The deployment of an autonomous navigation framework in real-world tests helps to identify the odometry estimation problem as critical for long-term operations. To this end, the second part of the thesis will center on the study of the Extended Kalman Filter (EKF)-based odometry estimation's consistency. This study will define a policy to detect when an EKF-based odometry source is degrading helping an adaptive filtering system to fuse gradually different sources of odometry.

### Research products

Research results appear in 1 papers published in international journals, 0 papers published in national journals, 4 contributions to international conferences, 0 contributions to national conferences, 0 patents.

### List of scientific publications

#### International journal papers

J. Cacace, **V. Scognamiglio**, F. Ruggiero, V. Lippiello

Motor Fault Detection and Isolation for Multi-Rotor UAVs Based on External Wrench Estimation and Recurrent Deep Neural Network,

*Journal of Intelligent & Robotic Systems*,

vol. 110 (148), pp. 1-13, 2024, DOI: 10.1007/s10846-024-02176-2

#### International conference papers

S. Roos-Hoefgeest, J. Cacace, **V. Scognamiglio**, I. Alvarez, R. C. González, F. Ruggiero, V. Lippiello

A Vision-based Approach for Unmanned Aerial Vehicles to Track Industrial Pipes for Inspection Tasks, *International Conference on Unmanned Aircraft Systems (ICUAS)*

Warsaw, Poland, June 2023, pp. 1183-1190, IEEE, DOI: 10.1109/ICUAS57906.2023.10156565

**V. Scognamiglio**, R. Caccavale, P. Merone, A. de Crescenzo, F. Ruggiero, V. Lippiello

Autonomous Visual Inspection of Industrial Plants Using Unmanned Aerial Vehicles, *International Conference on Unmanned Aircraft Systems (ICUAS)*

Chania-Crete, Greece, June 2024, pp. 1148-1154, IEEE, DOI: 10.1109/ICUAS60882.2024.10556996

**V. Scognamiglio**, R. Caccavale, A. Finzi, V. Lippiello

A Scalable Multi-Robot System for Cooperative Exploration,

*Springer Proceedings in Advanced Robotics (SPAR) – European Robotic Forum (ERF)*

Rimini, Italy, March 2024, Springer, Accepted and presented, proceedings still not available

**V. Scognamiglio**, J. Cacace, F. Ruggiero, V. Lippiello

Fault Detection and Isolation for a Standard Quadrotor Using a Deep Neural Network Trained on a Momentum-based Estimator,

*IEEE 20<sup>th</sup> International Conference on Automation Science and Engineering (CASE)*

Bari, Italy, August-September 2024, IEEE, Accepted and presented, proceedings still not available

### Patents and/or spin offs

### Awards and Prizes

## Activities and Publications – Final Report

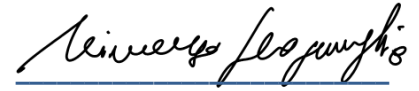
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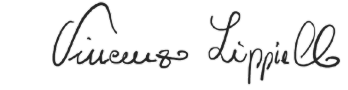
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**Date 15/10/24**

**PhD student signature**

  
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**Supervisor signature**

  
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