UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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

Activities and Publications Report

PhD Student: Fabrizio Tavano

Student ID: DR993890

PhD Cycle: XXXV
PhD Cycle Chairman: Prof. Stefano Russo

PhD program student's start date: 1st November 2019
PhD program student's end date: 31st January 2023

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Co-supervisor:

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PhD scholarship funding entity:
No scholarship.

General information

Fabrizio Tavano received in year 2009 the Master Science degree in Electronic Engineering from the University of Campania "Luigi Vanvitelli". He attended a curriculum in Multi-Agent Autonomous Robotic Systems, Automation and Machine Learning within the PhD program in Information Technology and Electrical Engineering. He enrolled into the ITEE PhD program without a grant.

Study activities

Attended Courses

Year	Course Title	Type	Credits	Lecturer	Organization
1st	Module title: Safety critical System for railway traffic management; Lecturer: Dr. Mario Barbareschi, phd of rete ferroviaria italialiana;	Ad hoc course	3,30	Dott.Mario Barbareschi	UNINA
1st	Module: Robotic interaction control, Lecturer Prof. Siciliano: 6 credits	MSc course	6,00	Prof. Siciliano Bruno	UNINA
1st	Module: Robotic lab, Lecturer Prof. Lippiello: 6 credits	MSc course	6,00	Prof. Lippiello Vincenzo	UNINA
1st	Field and service robotics, Lecturer Prof. Ruggiero: 6 credits	MSc course	6,00	Prof. Ruggiero Fabio	UNINA
1st	Module: StartCupCampania 2020, Lecturer Prof. Rippa : 5 credits	Ad hoc course	5,00	Prof. Rippa	UNINA
1st	Module: Intelligenza Artificiale, Lecturer Prof.ssa Amato Flora: 6 credits	MSc course	6,00	Prof.ssa Amato Flora	UNINA
1st	Title: Machine learning	Ad hoc course	3,60	Marco Aiello, Anna Corazza, Diego Gragnaniello, Francesco Isgrò, Roberto Prevete, Francesco Raimondi, Carlo Sansone;	organizer: DIETI, Università di Napoli Federico II, Istituto di ricerca IRCCS SDN, Napoli, Dipartimento di Scienze mediche traslazionali, Università di Napoli Federico II;

1st	ITCH-ITEE PhD module: Strategic Orientation for STEM Research and Writing, lecturer: Prof. Frazer	Ad hoc course	3,60	Prof. C. Fraser	UNINA ITCH-ITEE
1st	Mathematics of the Finite Element Method- PhD Course	Ad hoc course	5,00	Prof. Calabrò	UNINA
2nd	Intelligent robotics	MSc course	6	Prof. Alberto Finzi	Università di Napoli Federico II;
2nd	Image and Video Processing for Autonomus Driving	MSc course	6	Prof. Luisa Verdoliva	Università di Napoli Federico II;
2nd	Image Processing for Computer Vision	MSc course	9	Prof. Giuseppe Scarpa	Università di Napoli Federico II;
2nd	Neural Networks and Deep Learning	MSc course	6	Prof. Giuseppe Prevete	Università di Napoli Federico II
2nd	Text Mining	MSc course	6	Prof. Flora Amato	Università di Napoli Federico II
2nd	Natural language Processing	MSc course	6	Prof. Francesco Cutugno	Università di Napoli Federico II

2nd	Statistical Learning	MSc course	6	Prof. Anna Corazza	Università di Napoli Federico II
2nd	Human-Robot Interaction	MSc course	6	Prof. Silvia Rossi	Università di Napoli Federico II
2nd	Fondamenti di Robotica	MSc course	9	Prof. Bruno Siciliano	Università di Napoli Federico II
2nd	Data Management	MSc course	6	Prof. Flora Amato	Università di Napoli Federico II
2nd	deep learning and computer vision for autonomous systems: focus on drone vision, imaging surveillance and cinematography	Ad hoc course	1.5	Prof. Ioannis Pitas, Aristotle	University of Thessaloniki, CELLL Center for education and lifelong learning

2nd	SIDRA 2021 PhD Summer School (30 hours), titles: "Game Theory and Network Systems", "Modeling and Control of Soft Robotics"	PhD Summer School	3		University of Bologna
3rd	Control System Design	MSc course	3	Prof. Emanuele Garone	Department of Control Engineering and System Analysis (SAAS), Université libre de Bruxelles (ULB),
3rd	Optimization-Based Non linear Control	MSc course	3	Prof. Emanuele Garone	Department of Control Engineering and System Analysis (SAAS), Université libre de Bruxelles (ULB),

Attended PhD Schools

Year	School title	Location	Credits	Dates	Organization
2nd	SIDRA 2021 PhD Summer School (30 hours), titles: "Game Theory and Network Systems", "Modeling and Control of Soft Robotics"	PhD Summer School	3		University of Bologna

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1st	Marked point processes for object detection and tracking in high resolution images: application to remote sensing data; lecturer	0.4	Prof. Josiane Zerubia		Prof. Giuseppe Scarpa

1st	Workshop. title: Intelligenza Artificiale ed Etica;	1.6	Daniele Amoruso.Piero A. Bonatti. José M. Galvan. Riccardo Guidotti. Paola Inverardi. Roberto Prevete. Luciano Serafini. Viola Shiaffonati		Università Federico II
1st	Title: Lo spazio cibernetico come dominio bellico	0.4	Dott. Gian Piero Siroli		Prof. Guglielmo Tamburrini
1st	Title: Numerical methods for modelling. simulation and control for softrobots or robots in interaction with deformable environment;	0.2	Dr. Cristian Duriez-research Director INRIA	INRIA	Prof. Dr. Fanny Ficuciello
1st	Title:Cybersecurity and Fuzzing for robots. blochchain. and more	0.2	Dr.Antonio Ken Iannillo		Dr. Roberta Natella
1st	Title: "How to get published with the IEEE?"	0.4	Dr.ssa Eszter Lukacs	IEEE	DIETI
1st	Title: "Computational Biology: Large scale data analysis to understand the molecular bases of human diseases"	0.2	prof. Michele Ceccarelli		DIETI
1st	Title: "Elettromagnetismo e Salute"	0.2	prof.ssa Rita Massa	UNINA	Università di Napoli "Federico II"
1st	webinar. title: Virtual seminars on sensing with nano-devices;	0.8	Jerome Wenger;Carsten Rockstuhl; Leonetta Baldassare;Monica Fleischer	Plasmonica	Plasmonica
1st	programma dei webinar di Innovation Village 2020. seminar: " La programmazione europea e la ricerca. Nuovi scenari della programmazione europea dopo il 2020. La gestione di un progetto di ricerca "	0.4	Filippo Ammirati	UNINA	Università degli Studi di Napoli Federico II
1st	programma dei webinar di Innovation Village 2020. seminar: " Health 4.0 – La rapidità della medicina e la	0.4	Paolo Netti;	UNINA	Università degli Studi di Napoli Federico II;

	velocità del cambiamento del nostro mondo"				
1st	programma dei webinar di Innovation Village 2020. seminar: "Realtà virtuale e salute reale. Healt 4.0: dal bit alla mente. spazi virtuali e salute"	0.4	Valentino Megale	UNINA	TecUp
1st	webinar: "Large Scale Training of Deep Neural Networks" lecturer:;	0.5	Dott.Giuseppe Fiameni		Prof. Carlo Sansone
1st	seminar: Exploring Autonomy in Robotic Flexible Endoscopy	0.4	Prof. Pietro Valdastri		Prof.ssa Fanny Ficuciello
1st	seminar: Noninvasive Mapping of Electrical Properties using MRI.	0.4	Prof. RICCARDO LATTANZI		Prof. Rita Massa. Prof.Giuseppe Ruello
1st	Title: How do Emerging Technologies like Cobots. RFID. Augmented Reality & Digital Twin drive the Digitalization Paradigm under Industry 4.0;	0.2	Dr. Wasim Raad		The professorship Measurement and Sensor Technology (MST) at TU-Chemnitz (Germany). organized within the activities of the DAAD project PraSEE
1st	Workshop. title: "Wearable Brain-Computer Interface for Augmented Reality-based Robotic Applications in Industry 4.0";	0.2	Prof. Pasquale Arpaia	UNINA	The professorship Measurement and Sensor Technology (MST) at TU-Chemnitz (Germany). organized within the activities of the DAAD project PraSEE

1st	Title: "La Digital Transformation in Sanità per fronteggiare l'emergenza Covid";.La realtà virtuale in riabilitazione;1.Gamification in Sanità e presentazione di IamHero srl. start up innovativa che cura i bambini affetti da ADHD con i giochi digitali;Brain Computer interface come tecnologia per l'autismo e per le disabilità motorie	0.2	Annarita Falanga. Direzione Villa delle Ginestre ;: Lucio Tommaso De Paolis. Direttore dell'AVR Lab del Dipartimento di Ingegneria dell'Innovazione dell'Università del Salento;Pierpaolo Di Bitonto. Head of Research & Development Grifo multimedia ;.Pasquale Arpaia.Direttore ARHeMLab of DIETI Excellence Department. Dipartimento di Ingegneria elettrica e delle Tecnologie dell'Informazione – Università degli Studi di Napoli Federico II	'Università del Salento;ARHeMLab of DIETI Excellence Department. Dipartimento di Ingegneria elettrica e delle Tecnologie dell'Informazione – Università di Napoli Federico II	INNOVATION VILLAGE 2020; Università di Napoli Federico II
1st	seminar: AI Webinar Series on Deep Learning for CINI AIIS Labs	0.4	Gunter Roeth;Niki Loppi;Giuseppe Fiameni		NVIDIA. CINI National Lab. CINECA AIIS Labs
1st	Seminario Web "Algorithmic Accountability - Affidabilità e responsabilità degli algoritmi";	0.4	il professor Joshua Kroll. Fabio Bassan. Giuseppe Francesco Italiano. Stefano Quintarelli. Marco Bianchi		Fondazione Ugo Bordoni
1st	Workshop: La mappatura internazionale delle start-up dei droni	0.6			Osservatorio Droni. Politecnico di Milano. Osservatori.net digital innovation

1st	Title DOTTORATO E IMPRESE: TALENTI. RICERCA E INNOVAZIONE	0.4			Università di Bologna
1st	Seminario: "Salute. algoritmi e Intelligenza Artificiale. Tecnologie digitali al servizio di medici e pazienti"	0.4			Fondazione Ugo Bordoni
1st	Valutazione dei livelli di esposizione e del rispetto dei limiti delle antenne e 5G;Misure di segnali complessi nell'ambiente: Sistemi 5G;Estrapolazioni su segnali 4G. 5G	1	Prof. MD Migliore; Dr D. Franci ; Dr.S. Adda		Prof. Rita Massa. Prof. Giuseppe Ruello
2nd	Telemedicina in Italia: casi di successo	0.6		UNINA	prof. ing. Giovanni D'Addio, DIETI, Corso di Dispositivi per la Telemedicina
2nd	GDPR basics for computer scientists	0.3	Dr. Rigo Wenning		Prof. Piero Bonatti,Prof.ssa Anna Corazza
2nd	Exploiting medical imaging in the era of big data	0.4	Dr Marco Aiello		Prof. Piero Bonatti,Prof.ssa Anna Corazza
2nd	#andràtuttobene: Images, Texts, Emojis & Geodata in a Sentiment Analysis Pipeline;	0.3	Prof. Serena Pelosi		Picariello lectures on data science, Prof. Longo, Prof. Amato
2nd	At the Nexus of Big Data, Machine Intelligence, and Human Cognition	0.2			Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	Exploiting Deep Learning and Probabilistic Modeling for Behavior Analytics	0.2	Prof. Giuseppe Manco		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	Data Driven Transformation in WINDTRE through Managers voice	0.4	Marcello Savarese	WINDTRE	Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	From Photometric redshifts to improved weather forecasts: an interdisciplinary view on machine learning	0.2	Prof. Kai Polsterer	Heidelberg Institute for Theoretical Studies HITS	Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato

2ⁿᵈ	The era of Industry 4.0: new frontiers in business model innovation	0.2	Marco Balzano – university Ca' Foscari in Venice	university Ca' Foscari in Venice	Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2ⁿᵈ	Machine Learning;causality lost in translation	0.3	Edwin A. Valentijn – Rijksuniversiteit Groningen;	Rijksuniversiteit Groningen;	Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2ⁿᵈ	Approaches to Graph Machine Learning;	0.3	Miroslav Cepek–Oracle Labs	Oracle Labs	Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2ⁿᵈ	Convegno:"Droni, fare Sistema per un maggiore sviluppo"	0.6	Prof.Alessandro Perego,Prof.Giuseppe Sala, dott.ssa Paola Olivares,dott. Vincenzo Butticè, dott. Stefano Giovannini, dott. Marco Lovera, dott. Giuseppe Gori, dott. Fabio Bosatelli,dott. Matteo Sinopoli, dott. Cristina Rossi Lamastra,dott. Alessandro Renzo, dott. Laura Piantanida, dott. Davide Invernizzi,dott. Paola Castagna,dott. Evila Piva,Marco Lovera, dott. Giovanni Battista Gallus,dott. Valentino Sevino,dott. Marco Pironti, dott. Silvia Pantanella, dott. Carmela Tripaldi, dott. Andrea Mezzetti;		Osservatori.net digital innovation, Politecnico di Milano,dipartimento di scienze e tecnologie aerospaziali. aerospace system and control laboratory
2ⁿᵈ	"Il Risanamento napoletano: cura per la città 'malata", "The History of Pandemics to Support Public Health Preparedness and Epidemiological Modelling for COVID-19";	0.4	Olivares,dott. Vincenzo Butticè, dott. Stefano Giovannini, dott. Marco	dipartimento di Architettura, Dipartimento di Sanità Pubblica UNINA	dipartimento di Architettura, Dipartimento di Sanità Pubblica UNINA
2ⁿᵈ	Visual Interaction and Communication in Data Science	0.4	Lovera, dott. Giuseppe Gori, dott. Fabio Bosatelli,dott. Matteo		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato

2nd	Big data and computational linguistics	0.4	Sinopoli, dott. Cristina Rossi Lamastra,dott. Alessandro Renzo, dott.		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	The coming revolution of Data driven Discovery (a fourth Methodological Paradigm of Science), lecturer: Prof. Longo	0.3	Laura Piantanida, dott. Davide Invernizzi,dott. Paola Castagna,dott.		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	Distributional Semantics Methods: How Linguistic features can improve the semantic representation; lecturer: Alessandro Maisto	0.3	Evila Piva,Marco Lovera, dott. Giovanni Battista Gallus,dott. Valentino		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	Artificial intelligence and 5G combined with holographic technology: a new perspective for remote healt monitoring; lecturer: Dr.Pietro Ferraro, Dr. Pasquale Memmolo	0.4	Sevino,dott. Marco Pironti, dott. Silvia Pantanella, dott. Carmela		Prof. Antonia Maria Tulino;
2nd	Convegno:"Scienza e cultura della pace, in ricordo di Pietro Greco"	0.8		Comitato organizzatore del gruppo RUniPace UNINA: Maria Carmela Agodi, Francesco Giannino, Marco Musella, Stefano Oliverio, Ilenia Picardi, Simon Pietro Romano, Maura Striano, Guglielmo Tamburrini Patrocinio RUniPace; USPID;	Comitato organizzatore del gruppo RUniPace UNINA: Maria Carmela Agodi, Francesco Giannino, Marco Musella, Stefano Oliverio, Ilenia Picardi, Simon Pietro Romano, Maura Striano, Guglielmo Tamburrini Patrocinio RUniPace; USPID;
2nd	Introduzione del 5G nel sistema ferroviario	0.5			Collegio Ingegneri Ferroviari Italiani CIFI
2nd	Dalla manutenzione ciclica alla manutenzione predittiva: la diagnostica mobile della infrastruttura di Rete Ferroviaria Italiana,	0.5			Collegio Ingegneri Ferroviari Italiani CIFI
2nd	Optimized Graph Representations for Right-Wing Reddit Community Using Graph Neural Networks	0.2	Mr Mohammad Diaoulé Diallo	University of Bielefeld	Prof. Silvia Rossi, DIETI, UNINA Priscalab
2nd	Introduction to Legged robots and examples of IIT's Dynamic Legged Systems Lab	0.4	Dr. Claudio Semini, Dr. Michele Focchi,		Organizer:Prof. Fabio Ruggiero
2nd	Introduction to underwater robotics	0.4	Dr. Claudio Semini, Prof. Gianluca Antonelli		Prof. Fabio Ruggiero

2nd	3EM Group: attività nell'ambito dei sistemi di progettazione industriale	0.2	3MGroup	3MGroup	Prof. De Tommasi
2nd	End-to-End Optimization of Augmented Experience Services over Cloud-Integrated 5G Networks	0.8	Pr. Jaime Llorca		Prof.ssa Antonia Maria Tulino
2nd	Sadas Engine, an innovative DBMS for the DATA WAREHOUSE, great PERFORMANCE in the VLDB environment	0.4	Eng. Luca De Rosa, technical manager SADAS	SADAS	DIETI,PICARIELLO LECTURES ON DATA SCIENCE, Prof. Longo, Prof. Amato
2nd	SMCV- Sistemi di misura dei Carichi Verticali	0.6	Prof. Malavasi	Università di Roma La Sapienza	Collegio Ingegneri Ferroviari Italiani CIFI
2nd	Il rumore ferroviario dalle cause del fenomeno agli interventi di mitigazione	0.5			Collegio Ingegneri Ferroviari Italiani CIFI
2nd	Sensoria Healt	0.2	Stefano Rossotti		Picariello lectures on data science SCIENCE, Prof. Longo, Prof. Amato
2nd	Recovery Lab: Transizione digitale e sviluppo delle reti di telecomunicazione	0.2	Prof. Michele Polo, Eni Chair in Energy Markets at Università Bocconi di Milano	Università Bocconi di Milano	Il Dipartimento di Scienze Economiche e Statistiche dell'Università di Napoli Federico II, Recovery Lab
2nd	Qiskit: state of the art and tools for Quantum Computers from IBM,	0.4	Dr. Federico Accetta,	IBM Italia,	Prof.ssa A. S. Cacciapuoti (DIETI, UniNA),
2nd	SAR Polarimetry: Theory, Machine Learning & Applications	0.4	Carlos López-Martínez	Associate Professor in the area of remote sensing and microwave technology in the Universitat Politècnica de Catalunya, Barcelona,	organizer: IEEE
2nd	Second Quantum Revolution: innovation trends and expected industrial impacts	0.4	Dr. Antonio Manzalini		Prof.ssa A. S. Cacciapuoti (DIETI, UniNA)
3rd	Impatto economico e sociale della diffusione del 5G	0.4	Giacinto Matarazzo, Ricercatore Fub, Renato Paniccià, Ricercatore Irpet	Fondazione Ugo Bordoni	Fondazione Ugo Bordoni

3rd	Potential and challenges of next generation railway signaling systems: Moving Block and Virtual Coupling	0.2	Eng. Joelle Aoun	Research centre …	Prof. Prof. Valeria Vittorini (DIETI, UNINA)
3rd	Computational single-cell biology-from one to many cells	0.2	Oliver Stegle, German Cancer Research Center (DKFZ)	German Cancer Research Center (DKFZ)	Prof. Michele Ceccarelli, PHD Program in computational and Quantitative biology, Università degli studi di Napoli Federico
3rd	Dissecting glioblastoma by single cell RNA-seq	0.4	Itay Tirosh (Senior Scientist at the Weizmann Institute of Science);	the Weizmann Institute of Science	Prof. Luigi Ferraro, Prof. Michele Ceccarelli, PHD Program in computational and quantitative biology, università degli studi di Napoli Federico II
3rd	Software Product Line Management and Software Versioning in SADAS"	0.4	dr. Roberto Mosca and dr. Aniello Santorelli (SADAS-Naples);	(SADAS-Naples);	: Prof. Sergio Di Martino (DIETI, UniNA)
3rd	Using delays for control	0.2	"; Lecturer: Prof. Emilia Fridmann	school of Electrical Engineering-Tel Aviv University	Prof. Stefania Santini (department DIETI, University of Naples "Federico II"
3rd	Towards a political philosophy of AI	0.4	Prof. Mark Coekelbergh		Prof. Longo, Antonio Picariello Lectures on Data Science-Cicle II
3rd	A day in the life of a Chief Data Officer	0.4	Dott. Roberto Maranca;		Prof. Longo, Antonio Picariello Lectures on Data Science-Cicle II
3rd	Logistica Healthcare: asset strategico per il Paese	0.4	Prof. Alessandro Perego	Politecnico di Milano school of management, osservatori.net digital innovation	Politecnico di Milano school of management, osservatori.net digital innovation
3rd	Droni: tra tradizione e innovazione	0.6	Prof. Alessandro Perego	Politecnico di Milano school of management, osservatori.net digital innovation	Politecnico di Milano school of management, osservatori.net digital innovation
3rd	Transizione ecologica, one size does not fit all	1.3	Prof. Alessandro Perego	Politecnico di Milano school of management, osservatori.net digital innovation	Politecnico di Milano school of management, osservatori.net digital innovation
3rd	Digital innovation for sustainable and inclusive agrifood systems	0.4	Prof. Alessandro Perego	Politecnico di Milano school of management, osservatori.net digital innovation	Politecnico di Milano school of management, osservatori.net digital innovation

3rd	The quest of quantum advantage with a photonics platform	0.4	Fabio Sciarrino-(Dipartimento di Fisica- UniNA)	Dipartimento di Fisica- UniNA	Dr. Giacomo Ascione, Dr. Micol Benetti, Dr. Marco Coraggio, Dipartimento di Fisica-UniNA
3rd	La Robotica per l'assistenza agli umani	0.5	Prof. Bruno Siciliano (UNINA)	UNINA	Scuola di Robotica, Ente Formatore MIUR
3rd	Vivi la nostra Digital Innovation	0.4	ENEL		ENEL, Unina Federico II, scuola politecnica, Prof. Domenico Cotroneo
3rd	The Spatial structure of Bi-photon States	0.4	Dr.Alessio D'Errico (University of Ottawa,Canada)	University of Ottawa,Canada	Prof. P. Lucignano, Prof. D. Montemurro, Prof. D. Massarotti, Prof. V. D'Ambrosio, Prof. F. Cardano and Prof. M. Esposito,-(UniNA)
3rd	Can a Text-to-Speech Engine Generate Human Sentiments?	0.2	Prof. Vijay K. Gurbani (Illinois Institute of Technology)	Illinois Institute of Technology	Prof. Longo, Prof. Amato, Picariello Lectures, department of Physics Ettore Pacini and DIETI- (UniNA)
3rd	"Design, Learning, and Control for Safe Human-Robot Collaboration"	1.1	Bram Vanderborght Vrije; Abhinav Valada; Sylvain Calinon; Luka Peternel; Andrea Maria Zanchettin; Federica Ferraguti; Alessandro Roncone;	Universiteit Brussel; University of Freiburg, Idiap Research Institute and EPFL, Delft University of Technology; Politecnico di Milano; Università degli studi di Modena e Reggio Emilia; University of Colorado Boulder	20th International Conference on Advanced Robotics
3rd	The Era of Human-Robot Collaboration: Deep Sea Exploration	0.2	Prof. Oussama Khatib	Department of Computer Science,Director of Stanford University	Prof. Bruno Siciliano (UNINA DIETI)
3rd	SocialRobotics@UWaterloo	0.4	Dr. Alexander Mois Aroyo	university of Waterloo, Waterloo, Canada, Social and Intellingent Research Robotics Laboratory (SIRRL)	Prof. Silvia Rossi, Dipartimento di Ingegneria elettrica e delle Tecnologie dell'Informazione
3rd	20th International Conference of the Italian Association for Artificial Intelligence (AI*IA 2021),online, 29th November-3rd December, 2021	8			20th International Conference of the Italian Association for Artificial Intelligence (AI*IA 2021),online, 29th November-3rd December, 2021
3rd	Possible Quantum Machine Learning Approaches in HEP	0.4	Dr. Michele Grossi	CERN, Geneve, Switzerland, Openlab QTI	Prof.ssa Angela Sara Cacciapuoti - (DIETI, UniNA)

3rd	Il Progetto DINoS5G - Diagnostic Integrated Networks of Satellite and 5G	0.4	Eugenio Fedeli	Rete Ferroviaria Italiana	Collegio Ingegneri Ferroviari Italiani CIFI
3rd	Seminar Title: "Gas and Particle Sensing in Air: Challenges, Achievements, and Lessons"	0.6	Doct. Alcheo Martinoli	Swiss Federal Institute of Technology	The 16th International Symposium on Distributed Autonomous Robotic Systems 2022;November 30, 2022, Montbéliard, France

Research activities

Fabrizio Tavano participated in the following researches:

1- Combining Hierarchical MILP-MPC and Artificial Potential Fields for Multi-Robot Priority-based Sanitization of Railway Stations

In this work we presented a new technique based of Hierarchical MILP-MPC (Mixed Integer Linear Programming – Model Predictive Control) method with APF (artificial potential fields metod) for the on-line cleaning of very large and dynamic enviromnents as a railway station. We verified the possibility to use historical data about the positions of people recorded by the WiFi infrastructure Network Meraki and the knowledge about the transportation service in the considered railway station, to predict the movement of clusters of passengers with an horizon time of 1 hour. We have compared our solution with the MARL (Multi-Agent Deep Reinforcement Learning) technique, highlighting the advantages deriving by the use of a graph and the MILP: the on-line control of the sanitization strategy from a remote human staff. We have also tested the quality in a real case simulation, with real data from the Roma Termini Station, the largest and most populated station of Italy.

2- Toward a Heterogeneous Multi-Robot Framework for Priority-Based Sanitization of Railway Stations

We present a new framework for the prioritized multi-robot sanitization of railway stations based on Deep Reinforcement Learning. The proposed framework allows us to define teams of robots having different sanitizing strategies/capabilities, e.g., faster robots rapidly sanitizing small areas in cooperation with slower but long-range ones. Here, robot-specific policies are defined in order to accommodate the different capabilities of the single agents, while two global metrics are defined to assess the performance of the overall team. This capability of managing heterogeneous teams is an important requirement for the infrastructure manager Rete Ferroviaria Italiana S.p.A., which plans to verify to what extent different technologies or different strategies can be combined to reduce costs or increase cleaning efficiency. We tested our framework considering real data collected by the WiFi network of the main Italian railway station, Roma Termini, comparing its results with a similar Deep Reinforcement Learning system where homogeneous robots are employed. To evaluate the framework we proposed a comparison between heterogeneous and homogeneous teams of robots in a realistic domain obtained from a dataset that collects 1 day of data recording of the WiFi network of the Roma Termini railway station. The empirical results show that, despite the additional complexity given by heterogeneity, the heterogeneous system behaves similarly to the homogeneous version of the approach in terms of training convergence. On the other hand,

the heterogeneous system works better than the homogeneous one in restricted and populated environments, while the cleaning performance on the overall map is slightly reduced when compared to the homogeneous case.

3- An innovative approach in interfacing Diagnostic Application protocols for the RFI Network with legacy communication stacks

The Railway Smart Maintenance Application relies on a Diagnostic Network consisting of data collection entities (LDU, Local Data Units) in charge of gathering railway diagnostic data from sensors deployed in their vicinity, and data processing entities (CDU, Central Data Units), communicating by means of application standards through a telco subnetwork. An innovative approach to efficient predictive maintenance is to consider with reference to the subnetwork serving the diagnostic network, 5G telecommunication integrated with satellite technologies. In such environment, any LDU can choose, based on priority parameters and the state of connectivity, whether to use either 5G RAN access or the satellite access. To this purpose, a new component in the railway diagnostic network, named the "Edge Node", has been introduced. The definition of a new interface layer between the railway communication protocol and the other well-established communication layers of the protocol stacks will permit to combine the advantages of both terrestrial and satellite networks in order to propose an innovative concept of the railway maintenance approach. In this way, it will be possible to obtain a reliable predictive maintenance thanks to the capacity to provide real-time railway monitoring with specific communication requirements related to the specific maintenance service to be implemented.

4- Supervision of railway areas by satellite images

This research aims at designing and implementing an innovative system for the monitoring of hydrogeological and anthropogenic hazards, identification and, therefore, prevention of these, with the aim of ensuring efficiency and safety for traffic on the railway network. The designed system uses SAR and optical images in order to achieve these goals. With the same input data, this system is able to monitor and detect also other possible hazards like vegetation encroachment and the edification of new buildings as well as the structural extension of old ones along the lines and the infrastructure. The system will allow to plan different types of analysis not only to obtain periodic results but also to carry out "on-demand" analyses. This on-demand feature allows the operator is able to provide higher resolution data and set specific parameters for artificial vision algorithms, in order to obtain more precise and accurate results.

5- SEMOR: Safety Enhancement of Maintenance Operators in Railway worksite

Safety at railway construction sites is crucial in ensuring that workers are safe during the construction and maintenance of railway infrastructure. The SEMOR system improves the safety equipment of the personnel working on construction sites and of the vehicles used by them, providing their real-time positioning, and supporting the role of the warning agent. The objective of the project is to centralize the localization of all operators and all means of a railway yard in a portable Central Supervision System (CSS). This system, which can be a PC or a tablet that, is made available to the warning officer and shows the positions with respect to a virtual border that separates the safe area from the unsafe area. In order to do this, each operator and each vehicle is equipped with an individual portable location and signaling device (PID). To detect the real-time, accurate, and robust position, a strategy based on a multi-constellation GNSS receiver and an INS device was developed.

6- Assessing self-organization algorithms for railway traffic: the selection of three case studies for the SORTEDMOBILITY research project

SORTEDMOBILITY stands for Self-Organized Rail Traffic for the Evolution of Decentralized MOBILITY. It proposes a holistic approach for self-organizing management of public transport operations in urban and interurban areas, specifically focusing on rail transport as a mobility backbone.

In this approach, intelligent trains will operate in a self-organized manner to guarantee high levels of service in the multi-modal public transport context. The rail transport system will be more resilient, capable of self-adapting to an evolving environment with respect to the demand and in case of disruptions.

7- A Multi-robot Deep Q-Learning Framework for Priority-based Sanitization of Railway Stations

Sanitizing railway stations is a relevant issue, primarily due to the recent evolution of the Covid-19 pandemic. In this work, we propose a multi-robot approach to sanitize railway stations based on a distributed Deep Q-Learning technique. The proposed framework relies on anonymous data from existing WiFi networks to dynamically estimate crowded areas within the station and to develop a heatmap of prioritized areas to be sanitized. Such heatmap is then provided to a team of cleaning robots - each endowed with a robot-specific convolutional neural network - that learn how to effectively cooperate and sanitize the station's areas according to the associated priorities. The proposed approach is evaluated in a realistic simulation scenario provided by the Italian largest railways station: Roma Termini. In this setting, we consider different case studies to assess how the approach scales with the number of robots and how the trained system performs with a real dataset retrieved from a one-day data recording of the station's WiFi network. We assessed the performance of the proposed framework in different case studies, firstly by considering a worst-case scenario where random clusters of people are scattered along the station, then by considering a more realistic setting in which the distribution of people is retrieved from a one-day data recording provided by the Meraki Cisco System WiFi Network of Roma Termini.

8- Bioinspired Artificial Cockroach Colony Strategy combined with 2-type Fuzzy Logic for the Priority-Based Sanitization of Railway Stations

Recent studies show that in railway stations, there is a high probability of being infected during periods of pandemics: passengers gathered in the corridors and platforms of stations, eating at restaurants, and getting on trains facilitate the transmission of diseases. The pandemic caused by the SARS-CoV-2 has spawned an important crisis that has affected the railway sector in a significant way, for example, by inducing people to prefer cars instead of trains. RFI S.p.A., in collaboration with the University of Naples "Federico II", is studying methods to reduce the risks of contagion in railway stations, and robotics is demonstrated to be very helpful in attacking this issue. In this study, we propose a multi-robot online sanitization system that exploits the information about the position of people. The new method combines the Bioinspired Artificial Cockroach Colony Strategy with the 2-type Fuzzy Logic to coordinate together a team of robot sanitizers. In particular, we were inspired by the social behavior of Cochroacks Colony during their infestation phase, where the insects explore the environment attracted by food deposits, and decide their paths considering the shadowed zones, the presence of pheromones, and the distances by the other members of the colony. Moreover, we have considered a central server that acts like a Daemon. The Server is responsible for segmenting the heatmap in several subareas and assigning a different subarea to each robot, using the taboo search mechanism and 2-type Fuzzy Logic. The Server selects a subarea considering the density of priority inside it, the distance of it from the robots, and the number of robots just present inside the considered subarea. The objective of the server is to assign each robot to a different subarea, preferring one not chosen before, with a higher possible concentration of priority, and maximizing the spreading of the colony in the heatmap. The selected subarea will be an attractive destination for the assigned robot, which considers it as input in its autonomous building of its own cleaning path in the environment. Robots, thanks to the 2-type Fuzzy Logic and the implemented pheromones communication, select their steps at every instant of time,

preferring the zones where there are higher values of priorities and higher distances from the other members of the colony and their pheromones. These characteristics of the algorithm facilitate the spreading of the robots' team inside the environment, increasing the quality of the cleaning action. The solution's performances are compared with those of four different methods deployed in the same scenario, using real data shared by RFI S.p.A., showing better results. In particular we compar the presented technique with the MARL technique, the MILP-MPC technique, and two cases of Coverage Path Planning techniques proposed in literature for sanitization task.

Tutoring and supplementary teaching activities

In the period between 1.03.2021- 30.06.2021, I have actively participated to the correction of on-line exercitations and and home-works for the training of the students for the following MSc courses:

- Robotic Labs: 20 hours
- Theory of Systems : 20 hours

In the period between 1.03.2022- 30.06.2022, I have actively participated to the correction of exercitations and home-works for the training of the students for the following MSc courses:

- Period: 01.05.2022 – 30.06.2022 ; 20 hours for the course "Teoria dei sistemi" (Theory of Systems) of Prof. Vincenzo Lippiello
- Period : 01.03.2022 – 30.04.2022; 20 hours, course "Teoria dei Sistemi" (Theory of Systems) of Prof. Vincenzo Lippiello

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching	total
1st	44.5	10.6	57	0	112.1
2nd	70.5	13.1	55	1.6	140.2
3rd	6	18.3	62	1.6	87.9
total	121	42	174	3.2	340.2

The standard expectation of the University relative to the credits is as shown in the table below:

PhD Year	Courses	Seminars	Research	tutorship
1	min 20 - max 40	min 5 - max 10	min 10 - max 35	min 0 – max 1.6
2	min 10 - max 20	min 5 - max 10	min 30 - max 45	min 0 – max 1.6
3	min 0 - max 10	min 0 - max 10	min 40 - max 60	min 0 – max 1.6
TOTAL	min 30 – max 70	min 10 – max 30	min 80 – max 140	min 0 – max 4.8

My curriculum before the Ph.D. courses is focused in electronic engineering and railway systems. In the period of my Ph.D. studies I followed courses and seminars in order to increment my competences in different sectors, in particular in artificial intelligence, machine learning, robotics and automation that are the topics of my research.

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
2st	Université Libre de Bruxelles, Bruxelles, Belgium	Prof. Emanuele Garone, responsible of Département : Service d'Automatique et d'Analyses des Systèmes, Université Libre de Bruxelles,	From 15.09.2021 to 31.12.2021	1. Research on Optimization-Based Non linear Control; Mixed Linear Programming Technique, Model Predictive Control Strategy 2. Joint scientific paper preparation: Riccardo Caccavale, Mirko Ermini, Alberto Finzi, Emanuele Garone, Vincenzo Lippiello, Fabrizio Tavano: Combining Hierarchical MILP-MPC and Artificial Potential Fields for Multi-Robot Priority-based Sanitization of Railway Stations. The 16th International Symposium on Distributed Autonomous Robotic Systems 2022; November 28-30, 2022 Montbéliard, France
3rd	Université Libre de Bruxelles, Bruxelles, Belgium	Prof. Emanuele Garone, responsible of Département : Service d'Automatique et d'Analyses des Systèmes, Université Libre de Bruxelles,	From 15.09.2021 to 31.12.2021	1. Research on Optimization-Based Non linear Control; Mixed Linear Programming Technique, Model Predictive Control Strategy 2. Joint scientific paper preparation: Riccardo Caccavale, Mirko Ermini, Alberto Finzi, Emanuele Garone, Vincenzo Lippiello, Fabrizio Tavano: Combining Hierarchical MILP-MPC and Artificial Potential Fields for Multi-Robot Priority-based Sanitization of Railway Stations. The 16th International Symposium on Distributed Autonomous Robotic Systems 2022; November 28-30, 2022 Montbéliard, France

PhD Thesis

In the PhD Thesis, Fabrizio Tavano has investigated on a strategies of sanitization applying a team of sanitizer robots in a dynamic environment as a railway station during the execution of the transportation services and the commercial activities, with the presence of passengers.

Recent studies have highlighted that shared areas of the railway stations may be locations where there is contagion by viruses and bacteria during the periods of a pandemic like in the case caused by SARS-CoV-2 diffusion. The propagation of SARS-CoV-2 disease particularly damaged the railway sector because the transportation demand had registered a drastic reduction. People prefer to travel only if strictly necessary, using private cars in alternative to public services such as railway transportation. Studies demonstrate the importance of the use of robotics to contrast the diffusion of the pandemic in several applications. In this work, answering

the Infrastructure Manager Rete Ferroviaria Italiana's request, we propose a sanitization strategy that coordinates a team of robots in a dynamic railway station without interrupting the preexisting human activities such as transportation services, catering services, shopping, and ticketing. Since every important Italian station is equipped with a WiFi Meraki Cisco System Network, our aim is to exploit such infrastructure to monitor the positions of mobile devices (tablets and phones) and to evaluate the most crowded areas of the station to be sanitized. Specifically, our approach is to define a heatmap whose colored zones indicate the presence of contamination (prioritized zones) caused by the aggregation of visitors, which can be used by robots as guidance during sanitization activities. In Chapter 3, we propose a multi-robot approach to sanitize railway stations based on a distributed Deep Q-Learning technique. A team of cleaning robots - each endowed with a robot-specific convolutional neural network, learns how to effectively cooperate and sanitize the station's areas according to the associated priorities. In Chapter 4 we extended the previous framework allowing to define teams of robots having different sanitizing strategies/capabilities, e.g., faster robots rapidly sanitizing small areas in cooperation with slower but long-range ones. Here, robot-specific policies are defined to accommodate the different capabilities of the single agents. This capability of managing heterogeneous teams is an essential requirement for the infrastructure manager Rete Ferroviaria Italiana S.p.A., which plans to verify to what extent different technologies or strategies can be combined to reduce costs or increase cleaning efficiency. In Chapter 5, a distributed framework, where A centralized server uses the Hierarchical Mixed Integer Linear Programming to coordinate the robots assigning different zones where the cleaning has higher priority; thanks to the MPC-MILP approach, we use historical data about the distribution of people and the knowledge about the transportation service of the station, to predict the future dynamic evolution of the position of people in the environment and the spreading of the contaminants. Each robot navigates the large environment represented as a gridmap, exploiting the Artificial Potential Fields technique to reach and clean the assigned areas. In Chapter 6, we propose a multi-robot online sanitization strategy that combines the bioinspired artificial cockroach colony strategy with the 2-type Fuzzy Logic to coordinate together a team of robot sanitizers. We tested our solution considering real data collected by the WiFi network of the main Italian railway station, Roma Termini shared by Rete Ferroviaria Italiana S.p.A. We compared our results together with other methods conventionally proposed for sanitization, applied to the same scenario.

Publications

Research results appear in *1* paper published in international journals, *1* paper published in national journal, *5* contributions to international conferences, 1 International workshop.

List of scientific publications

International journal papers

1- Riccardo Caccavale , Mirko Ermini, Eugenio Fedeli, Alberto Finzi, Vincenzo Lippiello and Fabrizio Tavano: "A Multi-Robot Deep Q-Learning Framework for Priority-based Sanitization of Railway Stations"; Applied Intelligence- Springer Journal; currently in Major revision

International conference and workshop papers

2- Riccardo Caccavale,Vincenzo Calà, Mirko Ermini, Alberto Finzi, Vincenzo Lippiello and Fabrizio Tavano: "Multi-robot Sanitization of Railway Stations Based on Deep Q-Learning"; AIRO 2021: 8th Italian Workshop on Artificial Intelligence and Robotics of the 20th International Conference of the Italian Association for Artificial Intelligence (AI*IA 2021),online, December 1st-3rd, 2021

3- Riccardo Caccavale, Mirko Ermini, Eugenio Fedeli, Alberto Finzi, Vincenzo Lippiello, and Fabrizio Tavano. Toward a heterogeneous multi-robot framework for priority-based sanitization of railway stations. In Agostino Dovier, Angelo Montanari, and Andrea Orlandini, editors, AIxIA 2022 – Advances in Artificial Intelligence, pages 387–401, Cham, 2023. Springer International Publishing

4- Fabrizio Tavano, Riccardo Caccavale, Mirko Ermini, Eugenio Fedeli, Luca Ricciardi, Alberto Finzi, and Vincenzo Lippiello. Bioinspired artificial cockroach colony strategy combined with 2-type fuzzy logic for the priority-based sanitization of railway stations. In International Conference on Practical Applications of Agents and Multi-Agent Systems, pages 359–374. Springer, 2023

5- R Caccavale, M Ermini, E Fedeli, A Finzi, E Garone, V Lippiello, and F Tavano. Combining hierarchical milp-mpc and artificial potential fields for multi-robot priority-based sanitization of railway stations. In The 16th International Symposium on Distributed Autonomous Robotic Systems 2022. Springer Proceedings in Advanced Robotics, 2023

6- Mirko Ermini, Giuseppe Cadavero, Fabrizio Tavano, Sebastiano Trigila, Luca Rea, Samuela Persia, Francesco G. Lavacca, Francesco D'Alterio; An innovative approach in interfacing Diagnostic Application protocols for the RFI Network with legacy communication stacks; 13th World Congress on Railway Research (WCRR), International Convention Centre Birmingham, United Kingdom, 6-10 JUNE 2022;

7- Fabrizio Cerreto, Paola Pellegrini, Nathalie Botticchio, Rémy Chevrier , Fabrizio Tavano; Assessing self-organization algorithms for railway traffic: the selection of three case studies for the SORTEDMOBILITY research project; RailBelgrade 2023, 10th International Conference on Railway Operations Modelling and Analysis (ICROMA), Belgrade, Serbia, 25th – 28th 2023

8- Eugenio Fedeli, Franco Iacobini, Innocenzo Mungiello, Giuseppe Cadavero, Dario D'Avino, Fabrizio Tavano, Ivan Agostino and Stefano Meuti; Supervision of railway areas by satellite images, IRSC 2022 Congress, the International Railway Safety Council, October 16-21, 2022, Seville, Spain

National journal papers

9- Paolo Cesario, Ivan Colla, Matteo Sciutto, Filippo Sugliano,David Gomez Casco, Fabrizio Tavano, Tiziano Cosso, Michal Falta, SEMOR: Safety Enhancement of Maintenance Operators in Railway worksite, Ingegneria Ferroviaria, Collegio Ingegneri Ferroviari Italiani (CIFI), accepted in date: December 2022

Date 23 January 2023

PhD student signature _____

Supervisor signature   _____