UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

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

Activities and Publications Report

PhD Student: Giovanni Giacco

Student DR number: DR995137

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

PhD program student's start date: 01/11/2020
PhD program student's end date: 31/01/2024

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PhD scholarship funding entity:
No scholarship

General information

Giovanni Giacco received in year 2019 the Master Science degree in Electronic Engineering from the University of Napoli Federico II. He attended a curriculum in "Artificial Intelligence in Earth Observation applications" 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	Statistical data analysis for science and engineering research	Ad hoc course	4	Prof. Roberto Pietrantuono	ITEE
1st	Scientific Programming and Visualization with Python	Ad hoc course	2	Prof. Alessio Botta	ITEE
1st	Big Data Analytics and Business Intelligence	MSc course	6	Prof. Giancarlo Sperlì	ITEE
2nd	Corso di Imprenditorialità accademica	Ad hoc course	4	Prof. Pierluigi Rippa	ITEE
2nd	How to Boost your PhD	Ad hoc course	3	Prof. Antigone Marino	Department of Physics
2nd	Big Data Architecture and Analytics	Ad hoc course	5	Prof. Giancarlo Sperlì	ITEE
3rd	Using Deep Learning properly	Ad hoc course	4	Dr. Andrea Apicella	ITEE
3rd	Satellite and aerial images: automatic processing and analysis in GIS	Ad hoc course	2	Prof. Bianca Federici	University of Genova

Attended Seminars

Year	Seminar Title	Credits	Lecturer	Lecturer affiliation	Organization
1st	GDPR basics for computer scientists	0.3	Dr. Rigo Wenning	European Research Consortium for Informatics and Mathematics (GEIE ERCIM)	Unina DIETI
1st	Digital Project Management: practices, processes, techniques, tools and scientific approach	0.4	Prof. Dario Carotenuto	Research centre CERM, Florence	ITEE
1st	Analisi dei dati multispettrali e iperspettrali	2	Ing. Giorgio Licciardi	Fondazione Amaldi	Fondazione Amaldi, ESA Ambassador
1st	The rise of Artificial	0.2	Dr. Nicolò	Planetek	EO4GEO, Planetek

	Intelligence for Earth Observation		Taggio		Italia
1st	Visual Interaction and Communication in Data Science	0.4	Dr. Marco Quartulli	Vicomtech	ITEE
1st	Dai mainframe all'IoT: una retrospettiva sull'evoluzione delle architetture di calcolo	0.4	Prof. Mazzeo	University of Naples Federico II	ITEE
1st	Big Data and Computational Linguistics	0.4	Prof. Francesco Cutugno	University of Naples Federico II	ITEE
1st	Emotions in Reinforcement Learning Agents	0.2	Prof. Joost Broekens	University of Leiden	ITEE
1st	Sensoria Health	0.2	Dr. Stefano Rossotti	Sensoria Health	ITEE
1st	The coming revolution of Data driven Discovery, Giuseppe Longo	0.3	Prof. Giuseppe Longo	University of Naples Federico II	ITEE
1st	Why Do We Cooperate? Understanding and Modelling Societies using Reinforcement Learning	0.2	Prof. Mirco Musolesi	University College, London, United Kingdon	Scuola Superiore Meridionale
1st	Distributional Semantic Methods: How linguistic features can improve the semantic representation	0.3	Dr. Alessandro Maisto	University of Salerno	ITEE
1st	Optimized Graph Representations for Right-Wing Reddit Community Detection Using Graph Neural Network	0.2	Dr. Mohamed Diaoulé Diallo	German Aerospace Center	ITEE
1st	Ethics of quantification	0.4	Prof. Andrea Saltelli	University of Bergen	ITEE
1st	Sadas, Static Data Analysis System for decision making	0.4	Dr. Vincenzo Minei	Sadas	ITEE
1st	Geospatial Machine Learning for Earth Observation and Climate Modeling	0.2	Dr. Konstantin Klemmer	Microsoft Research	ITEE
1st	L'esposizione ai campi elettromagnetici generati dal sistema 5G - Metodologie scalari e vettoriali di misura dell'esposizione e tecniche	0.8	Prof. Nicola Pasquino	University of Naples Federico II	ITEE

	di estrapolazione				
1st	Which one is more important: more parameters or more computation?	0.2	Dr. Jason Weston	Meta	Institute of Advanced Research in Artificial Intelligence (IARAI)
1st	How to Publish Open Access with IEEE to Increase the Exposure and Impact of Your Research	0.2	Dr. Eszter Lukacs	IEEE	ITEE
1st	Localized least-squares radial basis function methods for PDEs	0.2	Dr. Elisabeth Larsson	Uppsala University, Sweden	University of Naples Federico II, Department of Mathematics and Applications
1st	Qiskit: state of the art and tools for Quantum Computers from IBM	0.4	Dr. Federico Accetta	IBM	ITEE
1st	SAR Polarimetry: Theory, Machine Learning & Applications	0.4	Prof. Carlos Lopez-Martinez	Universitat Politècnica de Catalunya	ITEE
2nd	Designing Quantum Algorithms	0.4	Prof. Michele Amoretti	University of Parma	ITEE
2nd	Neural Implicit Representations for 3D Vision	0.2	Prof. Andreas Geiger	University of Tübingen	Institute of Advanced Research in Artificial Intelligence (IARAI)
2nd	Learned optimizers: why they're the future, why they're hard, and what they can do now	0.2	Dr. Jascha Sohl-Dickstein	Google DeepMind	Institute of Advanced Research in Artificial Intelligence (IARAI)
2nd	Intelligenza artificiale e sistemi d'arma autonomi	0.2	Dr. Fosca Giannotti, Dr. Guglielmo Tamburrini	Scuola Normale Superiore, Pisa University of Naples Federico II	GI-STS, CNR
2nd	The learning landscape in deep neural networks and its exploitation by learning algorithms	0.2	Dr. Riccardo Zecchina	Bocconi University	ITEE
2nd	RAILS Mid-term Project Workshop	1	Workshop of 5 hours with several lecturers	Shift2Rail	ITEE
2nd	Sustainable land management and Earth Critical Zone (ECZ): a	7	Prof. Giuliano Langella	University of Naples Federico II	University of Naples Federico II

	journey from ECZ characterization, modelling and Geospatial Decision Support Systems				
2nd	Earth Observation in support of SDG11: Mapping urban deprivation using remote sensing	0.2	Dr. Monika Kuffer, Julio Pedrassoli, Dennis Mwaniki	University of Twente, Federal University of Bahia, UN-Habitat	GRSS - IEEE
2nd	Scaling Geospatial Artificial Intelligence for Disaster Response	0.2	Dr. Lexie Yang	Oak Ridge National Laboratory, USA	GRSS - IEEE
3rd	From Cyber Situational Awareness to Adaptive Cyber Defense: Leveling the Cyber Playing Field	0.4	Prof. Massimiliano Albanese	George Mason University, Virginia, USA	ITEE
3rd	Deep Learning in HPC environment	1.6	Dr. Giorgio Pedrazzi	Cineca	Euhubs4data

Research activities

Giovanni Giacco participated in the research field of Earth Observation (EO) applications powered by Artificial Intelligence (AI).

During the first year of his Ph.D., he explored AI methodologies, focusing on their application to remote sensing imagery. His work spanned a broad spectrum of data sources, including open-access satellite imagery such as Sentinel-2 and Landsat-8 and commercially available data from platforms like Pleiades and Worldview-3. Furthermore, Giovanni extended his research to incorporate Unmanned Aerial Vehicle (UAV) imagery, broadening the scope of his investigations. Specifically, he addressed critical challenges such as Land Cover Land Use mapping from satellite imagery, a pivotal task for environmental monitoring and land management. In addition, his work ventured into disaster response by developing an Automated Crack Detection system using drone imagery, contributing to post-earthquake building damage assessment.

In the subsequent year, he witnessed the continuation of the aforementioned research topics. Concurrently, he expanded his research horizons, delving into novel areas of study.

One research involved the estimation of Carbon Storage using Sentinel-2 satellite imagery with a Deep-Learning approach. Furthermore, to apply what-if analysis in an urban environment, he explored an approach to simulate future scenarios by generating synthetic satellite imagery with Generative AI.

Credits summary

PhD Year	Courses	Seminars	Research	Tutoring / Supplementary Teaching
1st	21	8.6	32	0

2nd	12	9.9	38	0
3rd	6	2	50	0

Research periods in institutions abroad and/or in companies

PhD Year	Institution / Company	Hosting tutor	Period	Activities
3rd	Universidad Politécnica de Madrid (UPM)	Prof. Oscar Corcho	12/09/2023 – 22/12/2023	Research on joint scientific preparation

PhD Thesis

In the PhD thesis, Giovanni Giacco explores using Earth observation data and artificial intelligence (AI) technologies effectively for informed decision-making and sustainable practices. This doctoral thesis explores the concept of User-Centric Earth Observation with Artificial Intelligence, emphasizing the crucial role of aligning Earth Observation efforts with the specific needs and priorities of users and stakeholders.

Central to this research is the synergy between Earth Observation and AI. AI technologies enhance data analysis, feature extraction, classification, and scenario simulation, thus enriching the insights drawn from Earth Observation data. The thesis highlights the power of historical Earth Observation data analysis, shedding light on long-term environmental trends, the impact of human activities, and the lessons that can inform sustainable practices.

Moving to the present, near real-time Earth Observation with AI-driven data analytics is explored. This approach enables the continuous monitoring of environmental conditions, the rapid detection of threats, and the immediate provision of information for decision-makers.

The core of this thesis lies in the endeavor to build a resilient future. By combining historical insights, real-time monitoring, and scenario simulation, stakeholders are equipped with the tools to shape sustainable futures. Simulating future scenarios through synthetic data generated by AI enables the simulation of several what-if scenarios in order to analyze various conditions that could occur in the future. It allows stakeholders to explore various possibilities and make informed risk management, policy development, and strategic planning decisions.

Practicality and applicability are demonstrated through a series of case studies encompassing diverse geographical regions and environmental contexts. A near real-time process to extract impervious maps at urban scale was implemented by applying a Deep-Learning (DL) approach to Sentinel-2 satellite imagery. In addition, the task of estimating the Carbon Storage capacity of green infrastructures, a critical metric for environmental assessment, was addressed. It concludes with an exploration of Planning Nature-Based Solutions in urban environments. In this domain, AI supports the integration of diverse datasets to enable sustainable urban planning.

The use of data spaces was analyzed as facilitators of integrating diverse datasets and fostering collaborative data sharing and exploration among stakeholders. This approach ensures Earth Observation data are conducive to cooperative decision-making and knowledge dissemination.

Research products

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

List of scientific publications

International journal papers

Giacco, G., S. Marrone, G Langella, and C. Sansone,
ReFuse: Generating Imperviousness Maps from Multi-Spectral Sentinel-2 Satellite Imagery,
Future Internet 14,
no. 10 (2022): 278., DOI: https://doi.org/10.3390/fi14100278

Pascarella, A. E., G. Giacco, M. Rigiroli, S. Marrone, and C. Sansone,
ReUse: REgressive Unet for Carbon Storage and Above-Ground Biomass Estimation,
Journal of Imaging 9,
no. 3 (2023): 61, DOI: https://doi.org/10.3390/jimaging9030061

Battisti, L., F Aimar, G. Giacco, and M. Devecchi,
Urban Green Development and Resilient Cities: A First Insight into Urban Forest Planning in Italy,
Sustainability,
15(15), 12085., DOI: https://doi.org/10.3390/su151512085

D. Amitrano, G, Giacco, S. Marrone, A. E. Pascarella, M. Rigiroli, C. Sansone,
Forest Aboveground Biomass Estimation Using Machine Learning Ensembles: Active Learning Strategies for Model Transfer and Field Sampling Reduction,
Remote Sensing 15,
no. 21 (2023): 5138., DOI: https://doi.org/10.3390/rs15215138

L. Battisti, G. Giacco, M. Moraca, G. Pettenati, E. Dansero, F. Larcher,
Spatializing Urban Forests as Nature-based Solutions: a methodological proposal
Cities,
144 (2024): 104629., DOI: https://doi.org/10.1016/j.cities.2023.104629

International conference papers

G. Giacco, G. Mariniello, S. Marrone, D. Asprone, C. Sansone
Toward a system for post-earthquake safety evaluation of masonry buildings
International Conference on Image Analysis and Processing,
Lecce, Italy, May 17 (pp. 312-323), Springer International Publishing, DOI: https://doi.org/10.1007/978-3-031-06430-2_26

A. Filograna, G. Giacco; G. Di Caprio

Leveraging cloud-based geospatial data to enhance public services. A case study of the SPOTTED project

2023 3rd International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)

Tenerife, Spain, July 19, IEEE, DOI: https://doi.org/10.1109/ICECCME57830.2023.10252358

National conference papers

Pascarella, A. E, G. Giacco, M. Rigiroli, B. Vento, S. Marrone, G. Langella, A. Coppola, R. Chirone, P. Salatino, and C. Sansone,

AI and Sustainability: Territorial Monitoring and Waste Valorization,

Proc. of the Ital-IA 2023 Thematic Workshops co-located with the 3rd CINI National Lab AIIS Conference on Artificial Intelligence (Ital IA 2023),

Pisa, Italy, May 29-30, 2023, CEUR-WS.org, online https://ceur-ws.org/Vol-3486/143.pdf

L. Battisti, G. Giacco, M. Moraca, F. Cuomo, G. Pettenati, E. Dansero

Servizi Ecosistemici, Aree verdi urbane e dati spaziali: una formula vincente per città resilienti ed ecologicamente attente,
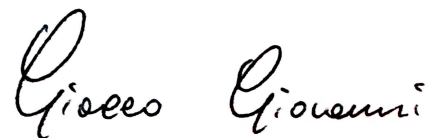
Memorie Geografiche Vol. XXII "Geografia e Tecnologia", 2023, Firenze, Società di studi geografici, 2023, pp. 779 – 784

Awards and Prizes

Winner of the "Follow-up Hackaton Pioneers.io Space4Mobility: Automatic Activities Detection for Green Spaces maintenance"

Date 20/01/2024

PhD student signature

Supervisor signature _____