



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

PhD Student: Francesco Longobardi

Cycle: XXXIX

Training and Research Activities Report

Year: First

Tutor: prof. Daniel Riccio

Co-Tutor:

Date: November 7, 2024

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Author: Francesco Longobardi

1. Information:

- **PhD student:** Francesco Longobardi
- **DR number:** DR997191
- **Date of birth:** 20/08/1998
- **Master Science degree:** Computer Science **University:** University of Naples Federico II
- **Doctoral Cycle:** XXXIX
- **Scholarship type:** PNRR - DM 118/2023 Mis.: I.4.1 Dottorati generici
- **Tutor:** Daniel Riccio
- **Co-tutor:**
- **Period abroad:**

2. Study and training activities:

Activity	Type ¹	Hours	Credits	Dates	Organizer	Certificate ²
Energy-efficient data science	Seminar	1	0.2	13/12/2023	Prof. Elio Masciari	Y
Robotics meets AI & 5G: il Futuro è adesso!	Seminar	2	0.4	14/12/2023	Prof. Paolo Massarotti	Y
STRATEGIC ORIENTATION FOR STEM RESEARCH & WRITING	Course	24	5	07/12/2023 - 23/02/2024	Dr. Chie Shin Fraser	Y
Hominis	Seminar	5	1	21/02/2024	Prof. Carlo Sansone, Eng. Stefano Marrone	Y
Matrix Analysis for Signal Processing with MATLAB Examples	Course	14	3	30/04/2024 - 28/05/2024	Dr. Massimo Rosamilia	Y
Big Data Architecture and Analytics	Course	20	5	06/05/2024 - 21/05/2024	Dr. Giancarlo Sperli	Y

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Using Deep Learning properly	Course	12	4	23/01/2024 - 08/02/2024	Dr. Andrea Apicella	Y
Introduction to Large Language Models: Evolution and the current state	Seminar	2	0.4	10/06/2024	Dr. Giancarlo Sperli	Y
SUSTAINABLE IT: STRATEGIES AND BEST PRACTICES FOR A GREEN ENGINEERING FUTURE	Seminar	5	1	27/05/2024	Prof. Antonia Maria Tulino	Y
PERCHE' DIGITAL, IN UN MONDO CHE SEMBRA GIA' ESTENSIVAMENTE DIGITALE E PERCHE' TRASFORMARE – TIM	Seminar	4	0.8	10/05/2024	Prof. Antonia Maria Tulino	Y
INTELLIGENZA ARTIFICIALE E REGOLE DEL MERCATO	Seminar	2	0.4	14/05/2024	Prof. Antonia Maria Tulino	Y
REWIRE THE BRAIN: THE POTENTIAL OF NEUROPLASTICITY	Seminar	2	0.4	09/05/2024	Prof. Antonia Maria Tulino	Y
GENERATIVE AI FOR SOFTWARE ENGINEERING: STRATEGIES, IMPACTS AND PRACTICAL APPLICATIONS	Seminar	5	1	29/05/2024	Prof. Antonia Maria Tulino	Y
REGOLAZIONE IN TEMA DI INTELLIGENZA	Seminar	2	0.4	13/05/2024	Prof. Antonia Maria Tulino	Y

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ARTIFICIALE ALLA LUCE DELL'AI ACT – PARTE 2: NUOVE PROSPETTIVE DEL DIRITTO DI INTERNET						
IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors	Seminar	2	0.4	07/05/2024	IEEE Xplore	Y
Scienza moderna e disciplina giuridica dell'Intelligenza Artificiale	Course	20	6	03/06/2024 - 03/07/2024	Prof. Lucio Franzese	Y
Topological Signal Processing and Learning	Seminar	1	0.2	17/07/2024	Prof. Antonia Maria Tulino	Y

- 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	0	0.6	6	0	6.6
Bimonth 2	5	1	6	0	12
Bimonth 3	0	0	6	0	6
Bimonth 4	12	4.8	6	0	22.8
Bimonth 5	6	0.2	3	0	9.2
Bimonth 6	0	0	6	0	6
Total	23	6.6	33	0	62.6
Expected	30 - 70	10 - 30	80 - 140	0 – 4.8	

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3. Research activity:

During the first year of my Ph.D., I focused on two research areas within the realm of surveillance and security: crowd behaviour analysis and biometric recognition, specifically in iris images.

Modelling and predicting crowd behaviours can be beneficial to recognise possible dangerous situations and analyse what can be done to prevent them. During the first months of my PhD, I conducted a literature review to learn about recent trends and popular usable benchmarks datasets. Several methods and datasets have been proposed to solve tasks such as anomaly detection, group state estimation and collective motion prediction. In particular, collective motions have been described using a similarity with fluid and gas states, in fact crowd motion resemble laminar or turbulent flows when entities move without causing disturbance to each other and when the flow presents a disturbance respectively. Other classes include gaseous behaviours which can be free or jammed as well as merging, diverging and crossing flows. Finally, static behaviours are taken into account when people don't progress spatially over time [1].

Videos are typically segmented both spatially and temporally to encapsulate a single behaviour.

My work on graph-based representations in crowd behaviour analysis tackles the problem of classifying group motions on unprocessed, raw scenes shot at varying altitudes using drones. It leverages graphs and graph neural networks to represent sub-scenes across a certain time span in order to recognise group motions that are modelled according to the notion of flows and gaseous states. In order to compare our solution proposed in “**Graphic - Graph-Based Representation for Analyzing People's High-Level Interactions in Crowds**” with another popular method based on group descriptors [2], I replicated Shao et al. method using our labeled data, which had to be adapted to the use case – single scenes, segmented to encapsulate a single behaviour. Experiments have shown that our method, albeit under multiple constraints, performs better than Shao's. This work has been accepted and presented at the 2024 IEEE International Conference on Image Processing, Abu Dhabi UAE.

Moreover, I worked on extending an existing work in foreground and background estimation to our use case. This work was intended to extract the background from videos containing big, fast-moving objects by comparing the scene frame by frame and refining foreground masks. In contrast, in the case of UAV behaviour analysis objects of interest are typically small and move slowly. Ideally, extracting a binary foreground mask via isolation of objects of interest that change position in a video, and refining it, it would be possible to use the masks as an attention mechanism for convolutional neural networks trained to extract pedestrians in an accurate way. Following this idea, I extended Longyin Wen et al. [3] method to use estimated masks in their convolutional neural network model. After several training sessions which lasted for weeks, results were unsatisfactory, showing little differences with the original architecture.

My current and future research will focus on iris recognition systems and the application of graph structures and graph neural networks to the problem of accurately matching subjects based on their biometric representations. In particular, I am focusing on extracting relevant embeddings which take into account which part of an iris is the most expressive in order to construct accurate graphs and devise

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features to represent them. This will allow the identification of stable points in an iris image, potentially enhancing the creation of stable embeddings and improving the accuracy of recognition systems.

4. Research products:

Conference paper: F. Longobardi, D. Riccio, “**Graphic - Graph-Based Representation for Analyzing People’s High-Level Interactions in Crowds**”. In: 2024 IEEE International Conference on Image Processing - ICIP 2024, Abu Dhabi UAE. <https://doi.org/10.1109/ICIP51287.2024.10647770> (*Published*).

5. Conferences and seminars attended

Conference: 2024 IEEE International Conference on Image Processing - ICIP 2024, Abu Dhabi, 27-30 October 2024; where I presented the paper “**Graphic - Graph-Based Representation for Analyzing People’s High-Level Interactions in Crowds**” in a scheduled regular session.

Tutorial: “**Visual Data Processing for Drone AI Technology: A Practical Perspective**” organized by Muhammad Haroon Yousaf, Muhammad Saad Saeed, Muhammad Naeem Mumtaz. 27 October 2024 at ICIP 2024

6. Activity abroad:

None.

7. Activity in partner companies:

None.

8. Tutorship

None.

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Riferimenti

- [1] C. Dupont, L. Tobias e B. Luvison, «Crowd-11: A Dataset for Fine Grained Crowd Behaviour Analysis,» in *2017 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, 2017.
- [2] J. Shao, C. C. Loy e X. Wang, «Scene-Independent Group Profiling in Crowd,» in *IEEE Conference on Computer Vision and Pattern Recognition*, 2014.
- [3] L. Wen, D. Du, P. Zhu, Q. Hu, Q. Wang e L. Bo, «Detection, Tracking, and Counting Meets Drones in Crowds: A Benchmark,» in *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 2021.