



UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Prof. Alessandro Freddi

Dept. of Information Engineering (DII)



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Activities

Prof. Alessandro Freddi, PhD, MS

Associate Professor in Systems and Control Engineering, DII, UNIVPM, Assistant Head of Laboratory of Artificially Intelligent Robotics (LAIR), a laboratory based in the Faculty of Engineering, Università Politecnica delle Marche, Ancona.

His main research activities include **fault diagnosis, fault prognosis, fault-tolerant control,** and **human-robot interaction,** with applications to **unmanned vehicles,** autonomous and **robotic systems.**

More than 130 peer-reviewed research papers, with about 1,500 citations received <https://orcid.org/0000-0002-9880-0238> ([Publication List](#), H-index = 23 according to Google Scholar; H-index = 20 according to Scopus).

Currently Associate Editor for the IEEE Transactions on Automation Science and Engineering (T-ASE) and member of the IEEE Control Systems Society Conference Editorial Board (CEB).

Involved in several national and international projects, together with the research group of the LAIR.

- European projects participated by the LAIR group:
 - 2024: EMOTIVE - Empowering Mobility with affective cOmputing, brain-computer inTerface, Internet of Things, and Vital signs monitoring for Smart WhEelchairs, Pharaon Second Open Call winner, H2020
 - 2022-2025: DANTE EDIH - Digital Solutions for a Healthy, Active and Smart Life European Digital Innovation Hub
 - 2013-2016: AdriHealthMob - Adriatic Model of Sustainable Mobility in the Health and Care Sector, IPA Adriatic Cross-Border Cooperation Programme
 - 2011-2012: JADE - Joining Innovative Approaches for the Development of transnational integration and knowledge clusters of policies related to independent living Elderly, FP7
- National projects participated by the LAIR group:
 - 2022-2025: VITALITY - Ecosistema di Innovazione, Digitalizzazione e Sostenibilità per l'Economia Diffusa nell'Italia Centrale, PNRR – Ecosistema dell'Innovazione.
 - 2022-2024: INTELLIGENCE 5.0 - dai sistemi cyber fisici per la creazione di macchine utensili self aware ad innovativi modelli di servizi industriali evoluti”, MISE - settore applicativo “Fabbrica intelligente”
 - 2021-2023: ChAAEnge, Progetto Nazionale - MISE



HR EXCELLENCE IN RESEARCH



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Staff, equipment and laboratories

Laboratory of Artificially Intelligent Robotics

https://dii.univpm.it/en-gb/lair_en/

STAFF: The group is currently formed by **3 Associate Professors, 1 visiting Associate Professor, 2 Senior Researchers, 2 post-doc Researchers, 2 PhD students.**

RESEARCH ACTIVITY

The Laboratory of Artificially Intelligent Robotics (LAIR) has a solid background in systems, control and automation engineering, and works mainly in these three fields:

- 1) model-based fault diagnosis and (fault-tolerant) control, with application to autonomous systems;
- 2) data-driven fault diagnosis and prognosis, with application to motors and industrial systems;
- 3) human-robot interaction, with main applications to service and assistive robotics.



EQUIPMENT

3x DJI Drones, 1x Elephant Robotics Mercur, 1x Hello Robot Stretch , 1x Softbank Robotics Pepper, 1x Rethink Robotics Baxter, 2x OhmniLabs Robots, 2x Temi Robots, 2x Brain Computer Interface devices, 1x Sunrise Smart Wheelchair, 2x Haptic devices, several sensors and microcontroller kits for automation and mobile robotics.



HR EXCELLENCE IN RESEARCH



Background: Autonomous systems represent a subset of Cyber-physical systems (CPS) which possess the capability to make decisions and operate independently. These systems offer remarkable functionalities; however, they are also vulnerable to threats such as malicious cyberattacks, which negatively impact both security (as in the protection of the digital domain) and safety (as in the protection of the physical domain). CPS security is typically managed using cybersecurity (Information Technology - IT) and network security solutions. While integrating traditional IT security measures, such as encryption, remains essential, this approach alone is insufficient. A fundamental property that makes CPS unique compared to generic IT systems is that the physical evolution of a system's state must comply with immutable laws of nature. For this reason, **research on CPS security now lies at the intersection of control systems and cybersecurity.**

What we OFFER:

- expertise in the domain of model-based algorithms for systems' safety
- expertise in data-driven workflows for diagnosis and prognosis of autonomous systems
- benchmarks and testbeds to deploy and test new ideas



We SEARCH candidates with (one or more):

- knowledge in Cyber-Physical Systems
- experience in ROS and robotic networks
- background in model-based design for dynamical systems

Project OBJECTIVES:

- Analysis of common attack types and their potential consequences
- Attack detection methods
- Secure estimation
- Secure control



Project OUTCOMES:

- Increased safety of CPS
- Increased security of CPS
- Application to Industrial plants
- Application to Autonomous Vehicles

