# Francesco D'Orazio

*Curriculum Vitae*

## Current Position

I just ended the PhD program in Automatic Control at the Robotics Lab, Department of Computer, Control and Management Engineering, Sapienza University of Rome, under the supervision of Prof. Giuseppe Oriolo. During my PhD, I spent a period of six months at the Technical University of Munich under the supervision of prof. Angela Schoellig. My research focuses on the motion generation for mobile manipulators through optimization techniques, such as Model Predictive Control with applications in mobile manipulation while maintaining dynamic equilibrium or navigating in human-centered environments.

## Education

2022 – 2025 **PhD**, *PhD Program in Automatic Control, Bioengineering and Operations Research*, Sapienza, University of Rome.

2020 – 2022 **MSc Degree**, *Control Engineering*, Sapienza, University of Rome, *110/110 cum laude* with honour programme

2017 – 2020 **BSc Degree**, *Control and Computer Science Engineering*, Sapienza, University of Rome, *110/110 cum laude*

## Publications

Submitted in Sept 2025 F. D'Orazio, S. Samavi, X. Du, S. Zhou, G. Oriolo, A.P. Schoellig. SM$^2$ITH: Safe Mobile Manipulation with Interactive human prediction via Task-Hierarchical bilevel model predictive control. At *2026 IEEE Inter. Conf. on Robotics and Automation (ICRA 2026)*

Submitted in July 2025 L. Brunke, S. Zhou, F. D'Orazio, A.P. Schoellig. Addressing Relative Degree Issues in Control Barrier Function Synthesis with Physics-Informed Neural Networks. At *2026 IEEE American Control Conference (ACC/L-CSS)*

Presented in Dec 2024 F. D'Orazio, T. Belvedere, S.G. Tarantos, and G. Oriolo. Maintaining Balance of Mobile Manipulators for Safe Pick-Up Tasks. In *2024 IEEE Inter. Conf. on Control, Automation, Robotics and Vision (ICARCV 2024)*, IEEE, 2024

Presented in Sept 2024 P. Carboni, G. Nardini, E. Santini, G. Gravina, T. Belvedere, M. Cipriano, F. D'Orazio, and G. Oriolo. A Vision-Based Control Scheme for Safe Navigation in a Crowd. In *Intern. Workshop on Human-Friendly Robotics (HFR 2024)*. Springer, 2024. **Won the best Paper award**

Mar 2024 A. Cristofaro, F. D'Orazio, L. Govoni, and M. Mattioni. Multi-consensus Problems in Hybrid Multi-agent Systems. In *Hybrid and Networked Dynamical Systems: Modeling, Analysis and Control*. Cham: Springer Nature Switzerland.

## Computer Skills

| | |
|---|---|
| Programming Languages | Matlab & Simulink, C, C++, Python, LaTeX |
| Libraries and Simulators | Pinocchio, Casadi, Acados, QpSolverCollection, Gazebo, Pybullet, DART |
| Operating Systems | Windows, Ubuntu |
| Other Tools | github, ROS, ROS2, Docker, Anaconda, RoboStack |

## Projects

### Research

**Whole Body Controller for Maintaining Balance of Mobile Manipulators**
Develop of optimization-based controller strategies for mobile manipulators that have to lift heavy objects preventing the loss of dynamic equilibrium. The optimization problem is formulated as a quadratic programming problem and the balance constraint is formulated using Control Barrier Functions.

**Safe Crowd Navigation for a Mobile Robots and Mobile Manipulators**
Develop of model predictive control strategies for mobile robots and mobile manipulators that navigate safely in a human-populated environment eventually manipulating objects, estimating human state (i.e. positions and velocities) through Kalman Filters using sensory information or external motion capture systems with experimental validation.

### Master Thesis

**Rollover Prevention of a Wheel Mobile Manipulator using Control Barrier Functions**
An operational-space controller is used to perform a pick-and-place operation of a heavy object with a mobile manipulator which is filtered by a quadratic programming problem enforcing kinodynamic feasibility and safety. The control barrier functions technique is used to enforce the safety constraints preventing the robot from tippng over. MATLAB has been used to validate the work

### Student Projects

**Hybrid consensus for multi-agent systems with time-driven jumps**
Study of the leaderless formation problem with a group of unicycles in an hybrid setting. Their evolution is governed by information exchanged by two communication graphs, Flow (Continuous Time) and Jump (Discrete Time).

**ESP and ESP+ Control Schemes for a 3R Compliant Robot**
Application of the Elastic Structure Preserving control scheme to a 3R planar robot with elastic transmission. Its aim is to move the robot in an equivalent plane where gravity is not present, with a configuration-depending damping on the link side, but preserving the elastic elements. ESP+ preserves also the scaling of the inertia matrix.

**Enforcing Mobile Robot Safety Under Input Constraints**
Derivation of a control law based on Control Barrier Function that ensures safety in the Adaptive Cruise Control Framework under input limitations. The problem is that the controlled vehicle wants to go as fast as possible (up to the speed limit) without colliding with a vehicle in front

**Optimal Tuning of LQR controller for Quadrotor Helicopters using GA and PSO**
Derivation of a controller based on LQR for controlling a UAV linearized around its hoovering position. The LQR matrices have been tuned using meta-heuristics (Genetic Algorithm and Particle Sworm Optimization)

## Coursework

### PhD

Numerical Methods for Optimal Control (IMT Lucca), Model Predictive Control (IMT Lucca), Numerical Optimization (IMT Lucca), Reinforcement Learning (IMT Lucca), Control of Soft and Articulated Elastic Robots (EECI 2023, Sapienza University of Rome), From vehicle dynamics control to autonomous driving in urban environments (SIDRA 2023, CeUB Bertinoro)

### Master's Degree

Autonomous and Mobile Robotics, Robotics 1, Robotics 2, Nonlinear Systems and Control, System Identification and Optimal Control, Dynamic of Electrical Machines and Drives, Process Automation, Robust Control, Multivariable Feedback Control, Machine Learning, Control of Multi-Robot Systems, Underactuated Robots, Physical Human Robot Interaction

## Teaching

Co-supervision of 4 Undergraduate level theses, BSc in Control and Computer Science Engineering (L-8), Sapienza, University of Rome

Co-supervision of 2 Master theses, MSc in Artificial Intelligence and Robotics (LM-32), Sapienza, University of Rome

Supervision of 10 Final Projects for the course "Autonomous and Mobile Robotics" (Prof. Giuseppe Oriolo)

Tutor of the Linear Systems course (Teoria dei Sistemi). Course in the BSc of Computer and Control Engineering at Sapienza, University of Rome