Emanuele Cuzzocrea

Curriculum Vitae

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I am a first-year PhD student in Robotics and Intelligent Machines at the Italian Institute of Technology (IIT) in Genoa, within the Humanoid & Human Centered Mechatronics (HHCM) Lab, under the supervision of Dr. Nikolaos Tsagarakis. My research focuses on applying foundation models (i.e., LLM, VLM, VLA) to legged robots, with an emphasis on perception-driven loco-manipulation and navigation tasks. During my Master's studies, I conducted research at the PRISMA Lab in Naples, where I contributed to the hardware construction of the SOLO 12 quadruped robot and carried out my thesis, "*Analysis of Quadruped Robot Gaits in Push-and-Slide Interaction Tasks*", supervised by Prof. Fabio Ruggiero, conducted on the ANYmal-D quadruped robot. My research interests include legged robots, foundation models, and robot perception. Outside of robotics, I enjoy speedcubing, tennis, golf, chess, drawing, and video game development.

Education

2025–Present **Ph.D. Student in Robotics and Intelligent Machines**.
Italian Institute of Technology (IIT), Genoa, Italy
Humanoid & Human Centered Mechatronics (HHCM) Lab
Supervisor: Dr. Nikolaos Tsagarakis

2022–2025 **M.Sc. in Automation and Robotics Engineering**.
University of Naples Federico II, Naples, Italy
Thesis Title: Analysis of Quadruped Robot Gaits in Push-and-Slide Interaction Tasks
Supervisor: Prof. Fabio Ruggiero
Graduation grade: 110/110 cum laude

2019–2022 **B.Sc. in Automation Engineering**.
University of Naples Federico II, Naples, Italy
Thesis Title: Motion Programming of a Robot in the Matlab-Coppeliasim Environment
Supervisor: Prof. Luigi Villani
Graduation grade: 110/110 cum laude

2014–2019 **Secondary School Education**.
Giovanni Da Procida Scientific High School, Salerno, Italy
Graduation grade: 100/100 cum laude

Master's Thesis

Title *Analysis of Quadruped Robot Gaits in Push-and-Slide Interaction Tasks*
Supervisor Prof. Fabio Ruggiero
Co-supervisors Dr. Pierluigi Arpenti, Ing. Michele Avagnale

Description The thesis explores the execution of a push-and-slide task with the ANYmal-D quadruped robot equipped wit a stick rigidly mounted to its base. A hybrid control strategy is employed, combining both model-based and reinforcement learning techniques. The policies were trained using the Isaac Lab framework, and successfully transferred to the real robot. The objective is to determine the best gaits, base orientations, force values and sliding velocities to perform the task. Statistically significant differences between different parameter combinations are assessed through analysis of variance (ANOVA).

Master's Degree Exams

- Nonlinear Dynamics and Control, grade: 30/30
- Robot Interaction Control, grade: 30/30 cum laude
- Field and Service Robotics, grade: 30/30 cum laude
- Intelligent Robotics, grade: 30/30 cum laude
- Virtual Prototyping, grade: 30/30 cum laude
- Machine Learning, grade: 30/30 cum laude
- Robotics Lab, grade: 30/30
- Identification and Optimal Control, grade: 30/30
- Foundations of Robotics, grade: 30/30 cum laude
- Design and Development of Real-Time Systems, grade: 30/30
- Advanced Control, grade: 28/30
- Electric Drives for Automation and Robotics, grade: 30/30
- Advanced Mechanics, grade: 30/30
- Models and Methods of Operations Research, grade: 30/30

Research Experiences

2025–Present **Ph.D. Student at Italian Institute of Technology (IIT)**.
Italian Institute of Technology (IIT), Genoa, Italy
Description: As a PhD student in the Humanoid & Human Centered Mechatronics Lab (HHCM), I am working on control and planning methods for legged robots. My current research focuses on leveraging foundation models (i.e., LLM, VLM and VLA) to address perception-driven loco-manipulation and navigation tasks.

2024–2025 **Internship at PRISMA Lab**.
PRISMA Lab, University of Naples Federico II, Naples, Italy
Description: Between September 2024 and March 2025, I carried out my Master's thesis at PRISMA Lab. From March to August 2025, I continued collaborating with the lab to conduct experimental validation on the real ANYmal-D quadruped robot, with the goal of publishing the results in IEEE RA-L.

2024 **Construction of the SOLO 12 Quadruped Robot**.
PRISMA Lab, University of Naples Federico II, Naples, Italy
Description: Between February 2024 and July 2024, I had the opportunity to actively participate in the hardware construction of the open-source SOLO 12 quadruped robot by PAL Robotics at the PRISMA Lab. My contributions included 3D printing all hardware components, assembly, and working on the electronics.

Publications

- E. Cuzzocrea, M. Avagnale, P. Arpenti, F. Ruggiero, "Analysis of Quadruped Robot Gaits in Push-and-Slide Interaction Tasks". Submitted to *IEEE Robotics and Automation Letters (RA-L)*, January 2026.
  Paper: (link), Video: (link)

Certifications

2025 **ANYmal Master Operator**.
ANYbotics Academy, Zurich, Svizzera

2025 **ANYmal Operator**.
ANYbotics Academy, Zurich, Svizzera

2024 **ANYmal Satefy Training**.
ANYbotics Academy, Zurich, Svizzera

2023 **Advanced Proficiency in KNIME Analytics Platform**.
KNIME Analytics Platform, Zurich, Svizzera

2022 **TOEFL iBT level C1**.
Educational Testing Service

2021 **Course on Workplace Health and Safety**.
University of Naples Federico II, Naples, Italy

2020 **EASA ENAC Category A1/A3 (Drones)**.
European Aviation Safety Agency - National Agency for Civil Aviation

2017 **Cambridge English level B2**.
Cambridge Assessment English, Cambridge, United Kingdom

Awards

2018 & 2019 **Top 15 in the national phase of the Neuroscience Olympiad**.
Italian Society of Neurosciences (SINS), Italy

2018 & 2019 **1st place in the regional phase of the Neuroscience Olympiad**.
Italian Society of Neurosciences (SINS), Italy

2018 & 2019 **Honorable Mention at the Caianiello Award event**.
"E. R. Caianiello" Department of Physics of the University of Salerno, Salerno, Italy

2019 **Top 10 in the regional phase of the Mathematics Olympiad**.
Italian Mathematical Union (UMI), Italy

2019 **Top 10 in the regional phase of the Physics Olympiad**.
Association for Physics Teaching (AIF), Italy

2018 **1st place in the RI-SCATTI photography contest**.
Mediterranean Colors, Salerno, Italy

2017 **Honorable Mention at the Gennaro Capuozzo drawing contest**.
Gennaro Capuozzo Artistic and Literary Award, Naples, Italy

Course Projects

2024 **MPC vs Deep RL for Autonomous Quadruped Locomotion**.
Comparison of model-based and data-driven control strategies for quadruped robots, including MPC and Deep Reinforcement Learning with Reward Machines. Evaluation of multiple gaits and planning-aware locomotion with RRT global planning for obstacle avoidance. Simulations performed in ROS (Gazebo, RViz) and RaiSim using Unitree A1 and Aliengo platforms (link).

2024 **Learning-Based Gait Transitions for Quadruped Robots**.
Development of an autonomous framework for dynamic gait transitions in quadruped robots, using Deep RL with Reward Machines and high-level decision-making for autonomous gait switching. Trained and validated in RaiSim on the ANYmal-B platform (link).

2024 **Modeling and Nonlinear Control of the HKB Oscillator**.
Nonlinear control of the Haken–Kelso–Bunz oscillator, including system modeling and controller design using Feedback Linearization, Sliding Mode Control, and Gain Scheduling techniques, with simulation and performance analysis in MATLAB.

2024 **Virtual Prototyping of Nuclear Remote Handling Tools**.
Virtual prototyping of an auxiliary handling system for a nuclear fusion reactor, developed in CATIA. Design of a modular solution integrating a KUKA industrial manipulator, scissor lift, and omnidirectional cart, with FEM, kinematic, and ergonomic (Jack) analyses to validate structural integrity, reachability, and operator accessibility (link).

2024 **Deep Learning for Visual Perception Tasks**.
Development of classification and regression algorithms using Machine Learning and Deep Learning techniques in KNIME and Python, including training of a Convolutional Neural Network for image-based weather recognition.

2023 **Perception-Aware Navigation and SLAM for Mobile Robots**.
Design and implementation of a mobile robot navigation pipeline in ROS, including trajectory tracking, goal-based navigation, mapping and SLAM, and vision-based tasks. Development and validation performed in custom Gazebo environments (link).

2023 **Vision-Based Manipulation with a KUKA iiwa Robot**.
Design and implementation of vision-based robotic control in ROS for the KUKA iiwa 14, including OpenCV-based object detection, ArUco marker alignment, and camera tracking of moving objects, validated in Gazebo (link).

2023 **MPC-Based Control for Wheeled Soccer Robots**.
Design and implementation of a nonlinear Model Predictive Control framework for trajectory tracking and obstacle avoidance in wheeled soccer robots. Real-time constrained optimization and performance evaluation conducted in MATLAB simulation environment.

2023 **Trajectory Planning and Control of a SCARA Robot**.
Development of trajectory planning and control algorithms for a SCARA robot in joint and operational space, including kinematic modeling, trajectory generation, and closed-loop control implementation in MATLAB.

2023 **Roll-Axis Control of an Aircraft**.
Modeling and control of an aircraft roll dynamics using linear control techniques, including system linearization, controller design, and performance analysis in MATLAB.

Skills

Frameworks	ROS 1/2, Gazebo/RViz, Isaac Sim, Isaac Lab, RaiSim, CoppeliaSim, MATLAB/Simulink, CATIA, CoDeSys, Factory IO
Perception	OpenCV, ArUco, Visual Odometry, SLAM
Learning	PyTorch, Deep Reinforcement Learning, Foundation Models (LLM, VLM, VLA)
Control	Eigen, OCS2, Pinocchio, KDL, YALMIP
Programming	C/C++, Python, MATLAB, Arduino, LaTeX
Tools	Git, GitHub, GitLab, Docker
OS	Windows, Linux, RT-POSIX, FreeRTOS

Languages

Italian	Native Speaker
English	C1 level
French	A2 level

Interests and Hobbies

Rubik's Cube	Since I was young, I have been passionate about Speedcubing, participating in a lot of international competitions and posting videos on my YouTube channel (link).
Arduino	My interest in Arduino dates back to elementary school and is closely tied to my passion for LEGO and Meccano. Among the projects I created during high school are humanoids (link, link), robotic hands (link, link) and Rubik's cubes solvers (link).
Sport	Playing sports has always been very important to me. I am currently registered with the Italian Golf Federation (FIG) playing golf at a competitive level, and I play tennis at an amateur level. In the past, I competed in tennis, athletics, and fencing in the epee discipline.
Chess	I have always found playing chess very stimulating. I have participated in numerous local and online tournaments.
Video Game Developing	Through the Construct 3 software, I often enjoy creating simple mobile games. One of them I published on the Play Store under the name JusTen (link).
Photography & Drawing	I have always loved photography and drawing, considering them powerful means of creative expression. I have participated in various contests, mainly related to social issues such as racism and femicide.
Juggling & Magic Tricks	During my free time, I often enjoy learning new skills, especially related to the world of juggling and magic, and then showing them when I am with my friends.

Personal Links

Portfolio	`https://emanuelecuzzocrea.github.io/website.html`
LinkedIn	`https://www.linkedin.com/in/emanuele-cuzzocrea-351b5124b`
GitHub	`https://github.com/EmanueleCuzzocrea`
YouTube	`https://www.youtube.com/@emanuelecuzzocrea`