MAICOL LAURENZA

maicol.laurenza@unicusano.it

ABOUT ME

The candidate is currently a RTT Researcher at University Niccolò Cusano, Rome. Co-supervised ten master thesis and published 8 publications in international journals and conference proceedings. The research interests include developing controls in the field of advanced mechatronics for autonomous vehicles, with a focus on autonomous cars and legged locomotion.

EXPERIENCE

2023-current   **RTT Researcher**, *University Niccolò Cusano, Department of Engineering*

2021-2023   **Professor under contract**, *Dep. of Mechanical and Aerospace Engineering, Sapienza University of Rome*

Courses:

Lab of Autonomous Driving Cars and Swarms: Master degree course for mechanical engineers on self-driving vehicles, 6 CFU

2021-2023   **Postdoctoral research fellow**, *Dep. of Mechanical and Aerospace Engineering, Sapienza University of Rome*

· Design of an innovative autonomous marine platform: SUNMARE

· Design and realization of AutoSapiens: the first autonomous car of Sapienza University

· Gaits optimization of quadrupedal robots

· Design of navigation and control systems for autonomous vehicles

· Design of obstacles avoidance algorithms for autonomous vehicles

PROJECT ACTIVITIES

2022-2023   **Industrial project with Nextchem srl of Tecnimont Group**

Design of an Autonomous Mechatronic Waste to Syngas Gasifier

2022-2023   **Recipient of internal Sapienza University public funding award within the scope of the "Piano Nazionale di Ripresa e Resilienza - PNRR"**

National Center for Sustainable Mobility Urban Mobility

Development of an experimental platform for testing autonomous driving systems in urban environments

2021-2023	**POR – FESR with CNR-INM**
	SUNMARE Surface UNmanned multipurpose research MARine vEhicle
	Innovation and digitisation of self-contained multipurpose marine research vehicles
2019-2021	**PON - Programma Operativo Nazionale with CNR et al.**
	Autonomous Robotics for the Extended Ship
	Development of a launch and recovery system for autonomous surface and underwater vehicles

ISTRUZIONE

2018-2021	**Ph.D in Theoretical and Applied Mechanics**, *Dep. of Mechanical and Aerospace Engineering, Sapienza University of Rome*
	Optimization strategy to the design and motion generation of a legged robot, based on energy-efficiency criteria.
	Thesis: *Legged robots: methods of optimal control and design*
2015-2018	**Master degree in mechanical engineering**, *Sapienza University of Rome*
	Thesis: *Sviluppo di un sistema di guida autonoma su vettura di serie*
2010-2015	**Bachelor degree in mechanical engineering**, *Sapienza University of Rome*
	Thesis: *Teoria di Prandtl per l'ala finita*

PERSONAL SKILLS

Language skills

Mother language: Italian

Other languages: **English**

- · Listening: C1
- · Reading: C2
- · Speaking: B2
- · Writing: B2

Digital Skills

Matlab/Simulink, MSC Adams, SolidWorks, Inventor, Rhinoceros, Adobe Ilustrator, Photoshop, Latex, Microsoft Office tools.

Driving licence

A3, B

Other skills

I've always been a good listener and quick learner. I have a great interest in Japanese culture, especially regarding the world of animation and comics. In the free time, I like digital drawing but also do sports such as boxing and hiking.

DESCRIPTION OF INDUSTRIAL AND RESEARCH PROJECT ACTIVITIES

The candidate has been involved in industrial research projects within the domains of applied mechanics, mechatronics, and advanced robotics. Below is a concise overview of the key research project activities to which the candidate has lent his expertise:

Project POR FESR SUNMARE: Surface UNmanned multipurpose research MARine vEhicle

funded by Regione Lazio in collaboration with CNR-INM
Scientific Director: prof. Antonio Carcaterra

The idea behind the project proposal is to study, to assess and draw up the technical and functional requirements of an innovative multipurpose, autonomous, transportable research vessel capable of carrying out most of the data acquisition activities for knowledge, monitoring and control of marine environments with zero environmental impact ("Blue" environmental footprint).

Activities performed by the candidate: Definition of sensors and design of the onboard architecture including communication protocols. Design of the Launch and Recovery System (LARS). Digital twin of the marine platform including dynamic model, multibody model, modeling of external disturbances, virtualization of the sensors, creation of virtual scenarios. Design of the navigation and control system. Implementation of algorithms for the autonomous identification of faults or anomalies without the use of direct sensors via machine learning. Implementation of advanced adaptive control based on reinforcement learning.

Project Nextchem: Gasifier with an Autonomous Mechatronic System GASM

funded by NextChem S.p.A. Tecnimont GROUP
Scientific Director: Gianluca Pepe

The project proposal is situated within the realm of sustainable circular economy, viewing waste as an opportunity for energy recovery and the production of syngas useful for combustion and hydrogen generation. Nextchem, through the European IPCEI Hy2USE project, aims to develop the world's first Waste to Hydrogen plant. The research and development activities are focused on creating an intelligent mechatronic system for automated waste management upstream of the gasification process.

Activities performed by the candidate: Development of digital twin of the waste treatment plant and control.

Project Urban Mobility PNRR: Integrated Technologies for Automated Mobility

funded by European Union "Piano Nazionale di Ripresa e Resilienza PNRR"

Co-Principal Investigator: Gianluca Pepe

Recipient of €502,800 in funding for the fourth thematic area of the "Smart, Safe, Green and Clean Vehicles and Transport Systems," which seeks to enhance the knowledge and technologies necessary to ensure sustainable urban mobility. The project's objective is to develop, test, and showcase an integrated system of unmanned ground and aerial vehicles designed for patrol services, medical assistance, emergency response, cargo transportation, and monitoring. Ground vehicles are being designed to work in coordination with aerial vehicles to share and manage information within a cloud-based platform. This platform will provide real-time updates on traffic conditions and emergency alerts. Services are also being created to improve urban environments for autonomous driving platforms, including mission planning, optimized route generation, and fleet coordination. These autonomous platforms share information and collectively manage the entire system, with each vehicle acting as a distributed sensor.

Activities carried out by the candidate: Design of a testing platform for intelligent vehicles in urban environments.

Auto Sapiens Project

funded by Sapienza and in collaboration with SPINITALIA srl

The project "Auto Sapiens" aims to create the first autonomous vehicle of Sapienza on a production vehicle. The Smart for Two has been completely modified by introducing a series of mechatronic systems. In a first phase of the project a dynamic model of the vehicle was created to simulate and interface the on-board electronics through a hardware system in the loop. The vehicle is equipped with steering and acceleration and brake actuators. The sensors installed on board are of the following types: (i) proprioceptive as inertial platform, GPS and odometry and (ii) exteroceptive, that is, measuring quantities external to the vehicle, through ultrasonic sensors, radar and lidar. At the same time, a control system has been developed based on an optimal variational control principle for obstacle avoidance and the setting of optimal manoeuvres such as maintaining the curve attitude, entering and leaving the curve, maximum acceleration, etc. The vehicle is being tested and analyzed on different virtual scenarios and a methodology is defined for assessing the effectiveness of the control in statistical terms.
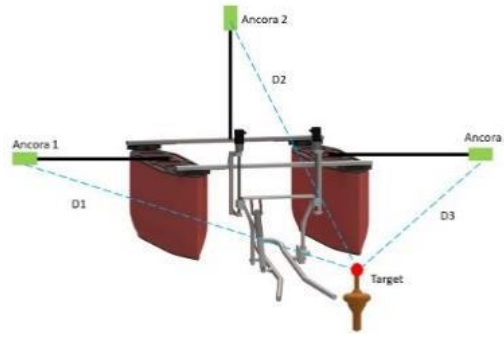

Activities performed by the candidate: Development of control logic and decision-making systems for autonomous control of Auto Sapiens. Development of the digital twin of the entire vehicle and virtual scenarios to test the model. Virtualization of the sensors and implementation of localization algorithms via data fusion. Implementation of obstacle avoidance control logic. Multiple experimental tests on vehicle.

Project PON ARES: Autonomous Robotics for the Extended Ship

The national operating plan ARES is face to the creation of an «extended ship», based on the integration between the system ship and marine robotic technologies, with the involvement of universities, national research centers and companies. This project concerns the development, prototyping of a mechatronic launch and recovery system (LARS) capable of interconnecting two autonomous marine vehicles: a surface vehicle and an underwater exploration vehicle.

Activities performed by the candidate: Design of the LARS system. Digital twin of the marine platform. Implementation of cooperative navigation and control algorithms.

PUBLICATIONS

International journals and conference proceedings 2019-2023

[1] Pepe, G.; Laurenza, M.; Belfiore, N.P.; Carcaterra, A. Quadrupedal Robots' Gaits Identification via Contact Forces Optimization. Appl. Sci. 2021, 11, 2102.

[2] Zanotti, A.; Laurenza, M.; Pepe, G.; Carcaterra, A. The role of spine elasticity on legged locomotion. EURODYN 2023, Delft, The Netherlands, 2023.

[3] Laurenza, M.; Pepe, G.; Mezzani, F.; Malito, A.; De Lauro, M.; Mauro, S.; Culla, A.; Carcaterra, A. Surface Unmanned Multipurpose Research Marine Vehicle: SUNMARE Project. 20th International conference on ship and maritime research, NAV 2022, La Spezia , Italia, 6, 2022.

[4] Laurenza, M.; Pepe, G.; Carcaterra, A. Gait Optimization Method for Quadruped Locomotion. In Advances in Nonlinear Dynamics: Proceedings of the Second International Nonlinear Dynamics Conference (NODYCON 2021), Volume 2 (pp. 439-449).

[5] Laurenza, M.; Pepe, G.; Carcaterra, A. Auto-Sapiens Autonomous Driving Vehicle. In VEHITS 2020 (pp. 361-369).

[6] Laurenza, M.; Pepe, G.; Carcaterra, A. Auto-Sapiens, an experimental autonomous driving system. In EURODYN 2020, Athens, Greece, 2020.

[7] Pepe, G.; Laurenza, M.; Antonelli, D.; Carcaterra, A. A new optimal control of obstacle avoidance for safer autonomous driving. In 2019 AEIT International Conference of Electrical and Electronic Technologies for Automotive (AEIT AUTOMOTIVE) (pp. 1-6).

[8] Laurenza, M.; Pepe, G.; Antonelli, D.; Carcaterra, A. Car collision avoidance with velocity obstacle approach: Evaluation of the reliability and performace of the collision avoidance maneuver. In 2019 IEEE 5th International forum on Research and Technology for Society and Industry (RTSI) (pp. 465-470).