

## Short bio

Marcello Calisti got a B.Sc in Mechanical Engineering from University of Perugia in 2005, and a M.Sc in BioMedical Engineering from University of Florence in 2008. In 2007 he was a Master thesis intern at the European Centre for Soft Computing in Mieres, Spain.

From 2008 and 2009 he was Research Assistant at the University of Florence, where he worked on biomedical signals analysis.

From 2009 to 2012 he was a PhD Student at the BioRobotics Institute of the Scuola Superiore Sant'Anna.

From 2013 to 2017 he was a Research Fellow at the BioRobotics Institute, within the laboratory of Prof. Cecilia Laschi.

From January 2018, he is Assistant Professor of Bioengineering. His main responsibilities cover:

- Independent research activities
- Collaborations within European and National research projects
- Tutoring and supervision of PhD and undergraduates students
- Teaching assistant activities
- Dissemination to the general audience of scientific results and of STEM disciplines
- Scientific editorial activities
- Fund raising and management activities

## Awards

He was finalist, with the project *Kraken*, at the **2012 ASME Student Mechanism and Robot Design Competition**, Chicago, USA.

He was awarded, with the project *TOW*, in the **Gear of Innovation Challenge 2014**, sponsor: GoEngineer, 3D PrinterWorld and GrabCAD.

He was nominated for the best paper award with the paper, F. Corucci, M. Calisti, H. Hauser and C. Laschi; *Novelty-based evolutionary design of morphing underwater robots*; within the category **Artificial Life, Robotics, and Evolvable Hardware - ALIFE + Generative and Developmental Systems - GDS**, at GECCO 2015,

## Personal grants

He got in 2017, as Principal Investigator, an **Early Career Grant** from the National Geographic Society, with the project *SILVER (Seabed-interaction Legged Vehicle for Exploration and Research)*

He got in 2018, as Principal Investigator, a **Grant** from the Arbi Dario spa, with the project *Blue Resolution* for the development of an underwater system for the monitoring and cleaning of the Ocean.

## Ricerca

### Research interests

My research interests lie in the intersection among mechanical engineering and computer science. Nature is a huge reservoir of smart and reliable solutions, and by using bioinspired approaches I am contributing to the development of reliable machines which exploit their body dynamics to simplify control algorithms. This paradigm is often called Embodied Intelligence. This approach was vastly employed to the locomotion of

soft robots, which I contributed to develop with an octopus-inspired robot able to crawl and manipulate objects. Pushing forward this concept, my personal research line is investigating the role of underwater environment to the locomotion of benthic (i.e. that live and move close to the seabed) animals, and to the relationships among deformable body, compliant legs and control. Altogether with the studies on robots locomotion, I am investigating the role of biological vision both for underwater features extraction and for machine controls, exploiting the relationships between the physical environment and biological processing.

### **Current Research Projects**

**Blue Resolution**, In this project the advantages of bioinspired approaches to the design of underwater vehicle will be challenged in real demanding scenarios. A six-leg underwater robot will be developed to monitor and clean the ocean seabed from plastic and microplastics. Traditional underwater design principles will be integrated with bio-inspired conceptual design and control algorithms, to achieve stable locomotion, precise station keeping and accurate sampling by means of an underwater manipulator. In this project (funded by Arbi Dario Spa) I serve as Principal Investigator coordinating three PhD students and one Research Assistant.

**SILVER**, *Seabed-Interaction Legged Vehicle for Exploration and Research*, ambition is to create a new generation of underwater legged robots that will enhance the exploration of the benthonic environment, by providing an underwater robot that safely, precisely, repeatedly, and with a simple user-interface could take high resolution images, move inside underwater structures, collect samples, stand disturbances and monitor continuously a target site. For this project I was awarded of an Early Career Grant by the National Geographic Society, and I am the Principal Investigator within a team made of two PhD students, Giacomo Picardi and Saverio Iacononi.

**SWARMS**, *Smart and Networking Underwater Robots in Cooperation Meshes*. In this European Project, I am contributing with dissemination, management, and research activities. With respect to research, I am working on underwater vision of remotely operated vehicles and autonomous underwater vehicles by means of bioinspired vision algorithms based on polarized vision.

### **Past Research Projects**

**Octopus IP**. In this European Project, I contributed with dissemination, logistic, and research activities. I studied octopus' crawling to extract the fundamental principles of this locomotion, and then I used the biological observations to build a novel underwater robot with soft limbs. This work was carried out in tight collaboration with biologists from the BioRobotics Institute and from the University of Jerusalem.

**RoboSoft CA**. In this coordination action I contributed both with dissemination, management, and mechanical design activities. I was responsible for the implementation of the RoboSoft Grand Challenge, I conceived the rules, defined the scenarios and tasks at conceptual level. I designed and assembled the competition fields, and coordinated the logistic of the challenge, including the collection and elaboration of the data.

**PoseiDRONE**. In this National Project, I contributed with dissemination, management, and research activities. I was involved in the implementation of the benthic locomotion of an underwater robot, by taking as inspiration particular gaits such as bipedal walking of octopuses and underwater hopping. The work regarded both the design and control of the legged system.

### **Other Research Activities**

**Flagellum-inspired robot**. This project explores the application of soft slender soft propellers (inspired by the motile capabilities of flagella) to develop a novel kind of underwater robots. This project is coordinated by Dr. Federico Renda, from Khalifa University.

**MBZIRC, Mohamed Bin Zayed International Robotics Challenge.** Tau-theory describes how animals approach fixed or moving targets for tasks such as landing, following a target, stopping to a point, prey catching, and others. I was responsible of implementing tau-theory on UAVs to perform autonomous landing on moving vehicles, and object approaching for manipulation purposes.

**Vision-based tracking system.** I developed a tridimensional reconstruction algorithm (from images of two cameras in stereo configuration) to estimate the pose and to provide a quantitative comparison among robots and models. My algorithm was used to obtain position and orientation of soft arms, end-effectors and mobile robots.

**Biomedical signal processing.** The research role regarded the analysis of Videokimographic images and of acoustic signals, for the diagnosis of vocal cord disorders and obstructive sleep apnoea syndrome. I worked in collaboration with clinicians and international experts.