

Brief description of the BIOIC project

BIOIC (Bioinspired soft robotic systems for cognitive production) is a research project based on scientific excellence between University of Naples Federico II (UNINA) and Fraunhofer Institute for Machine Tools and Forming Technology (IWU).

The objective of the BIOIC project is to setup a framework for a long-lasting strategic research collaboration between UNINA and IWU in the field of bioinspired soft robotic technologies, with a focus on biological transformation and cognitive and sustainable production systems

The project will develop multiple core technology platforms to be used in different scenarios and different application areas. The development of new technologies that take inspiration from the materials, structures and principles of nature and biology will have a significant impact towards a more sustainable industrial production. The research results to be achieved within BIOIC will have primary impact in manufacturing; however, impact on different domains as healthcare, agrifood and service will arise naturally during the course of the project.

Nature uses a design approach based on soft materials: “*nature uses soft material frequently and hard materials sparingly*” (Vogel 1995, Better bent than broken). Evolutionism has generated flexible structures capable of interacting naturally with the environment and adapting to unplanned situations. An octopus’ tentacle or an elephant’s trunk represent biological structures that are able to perform highly complex movements and manipulations tasks thanks to the interaction between their body, compliant and with variable morphology, and the environment. The ability of an elephant's trunk to grasp objects by wrapping them and exploiting environmental constraints is a clear example of what is referred to as *embodied intelligence*: a concept of distributed intelligence stating that the behavior of a biological structure is not controlled only by the brain, but it is the result of the interaction between brain, body and environment. This is strongly different from the design approach used up to now in robotics, which has clearly separated the body (the structure), from the actuators (electric motors) and from the brain (controller). *Soft robotics*, an emerging robotics discipline, has introduced a paradigm shift in the construction of robots, by introducing flexible and bioinspired elements into the mechanical structure of robotic systems. The result is to generate skilled and flexible structures, capable of adapting their shape to the environment and to tasks for which the robot was not programmed. In soft robotics there is no clear difference between body, actuator and controller. All compete equally for the execution of the task. This means that the responsibility for carrying out a task is not left only to control and programming, but also to the robot's ability to deform and adapt to the new tasks and scenarios. A soft robot represents an example of a cognitive system capable of tortuous movements, fine and robust manipulation, as well as safe interaction with humans and the environment.

The team member of the project belong three departments and one center at UNINA: Department of Industrial Engineering, Department of Electrical Engineering and Information Technology, Department of Chemical Engineering, Materials and Production, Center for Advanced Metrological and Technological Services. For IWU, two departments are involved: IIOT Controls and Technical Cybernetics, Adaptronics. The responsible for the overall strategy and coordinators of the collaboration activities will be Prof. Antonio Lanzotti (UNINA) and Prof. Steffen Ihlenfeld (IWU). The scientific and technical responsible for the project will be Dr. Stanislaw Grazioso (UNINA) and Dr. Arvid Hellmich, Dr. Linda Weisheit (IWU). The other team members are: Dr. Mario Selvaggio and Dr. Raffaele Vecchione (UNINA), Dr. Christian Friedrich, Dr. Wilhelm Richard Wockenfuss and Dr. Malte Heinrich (IWU). There is a steering committee formed by multiple members: Prof. Bruno Siciliano, Prof. Paolo Netti, Prof. Leopoldo Angrisani, Prof. Giuseppe Di Gironimo (UNINA), Prof. Welf-Guntram Drossel e Dr. Holger Kunze (IWU). Industrial companies from Germany and Italy have also been involved as part of an advisor group that accompanies the project from an industrial perspective.

The BIOIC project is the first of 3 projects of an Italian-German institutional collaboration signed on the 8th September 2020, by the Italian Minister of Education, Prof. Gaetano Manfredi and the President of Fraunhofer-Gesellschaft, Prof. Reimund Neugebauer. According to the words of Prof. Gaetano Manfredi, *“The aim of the collaboration is to strengthen the partnership between Italian and German universities and their respective research projects, trying to import a model (the Fraunhofer model) that has proved to be capable of valorizing European funds allocated for research and development. A step towards the economic revival of our country and the Italy's position at the international level: research must be a pillar where building the society of the future, with particular attention to the social impact that it should have in the life of all citizens”* [Translated from the post of Prof. Gaetano Manfredi, 8 september 2020]

For further information on the BIOIC project, visit the website: <<https://www.bioic.unina.it/>>