The E. Piaggio Institute – University of Pisa

<table>
<thead>
<tr>
<th>Pisa University: Summary Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute</td>
</tr>
<tr>
<td>Year of foundation</td>
</tr>
<tr>
<td>Reference person</td>
</tr>
<tr>
<td>Website</td>
</tr>
<tr>
<td>Robotic Applications</td>
</tr>
<tr>
<td>Scientific Expertise</td>
</tr>
<tr>
<td>Team size</td>
</tr>
<tr>
<td>Senior Researchers</td>
</tr>
</tbody>
</table>

**Introduction**

The E. Piaggio Institute is a centre for advanced robotics studies directed by Prof. Antonio Bicchi with the original aim to foster studies and research for automation in industry. With this mission it was created in 1965 with the name of “Centre for Automatica” under the direction of Alessandro Faedo, mathematician that also the responsibility of Dean of Pisa University and, later, Italian republic senator.

Currently E. Piaggio research centre become an independent institution inside Pisa University, with some administrative features typical of the University Departments in the Italian university organisation.

Under the scientific point of view Piaggio Institute is now concentrated on several themes of Robotics and BioEngineering, also if still maintains a part of its original focus on mechanical studies, but widening its range of interests to the topics of man-robot relationships, Artificial Intelligence, coordination of robots in teamwork and many others.
**Areas of Interest**

The Piaggio Institute, as before mentioned, shares its interests between bioengineering and classical robotics fields, having in mind that also BioEngineering is also aimed at a different branch of robotics. This is in fact how the researchers of BioEngineering area of Piaggio Institute will define themselves:

“Biomedical Engineering in Pisa has its roots in the Piaggio Center. Multidisciplinary by its very nature, the research on Bioengineering is directed at studying, mimicking, and supporting the human body using dry and wet materials, sensing and actuation and intelligent wetware, software and hardware. The Center is also a hub for Biomedical Engineering students”.

Under the classical robotics point of view Institute Piaggio is one of the first and of the most prominent study centre in the world to develop the idea and the importance of compliance both at the control and at the mechanical level. Compliance includes the concept of soft robotics, currently largely studied in the world, to increase the compatibility of robots with human beings, but doesn’t limit the “softness” to the surface layer of the machines, but goes in depth, transferring this concept to the operation and the control itself of the machines. Robots must be compatible with human beings up to their inner operation.

To realise this goal, several technologies are simultaneously applied, including the technique that allow to control a multi-link and multibody system through a networked control, studying the delay effects, the coordination rules, the software organisation and many other approaches (see as an example Fig. 48 at the side).

![Fig. 48 - Networked Control - A Modular and Layered Cosimulator for Networked Control Systems](image)

Also the studies for the development and the control of multiDOF and efficient hands are part of this philosophy (see for instance Fig. 49 and Fig. 50) and project like “SOFTHANDS, a theory of soft synergies for a new generation of artificial hands”, funded by ERC, are the support to carry out this top level activity.

![Fig. 49 - HE First Hand grasps trials: scissor (left side), syringe (middle) and stapler (right side)](image)

A relatively recent interest area that involved many studies on the cooperation among team of robots was the study of the behaviour of underwater autonomous vehicles (AUV) operating together to shorten and make more accurate explorations, monitoring and control, search and rescue missions. Piaggio institute was charged with this objectives under the push of Regione Toscana putting together with other research centres of Toscana (Firenze, WASS at Livorno) to

![Fig. 50 - The Hand Embodied Project](image)
study the problem of pollution monitoring of the Toscana coasts and, in another project (Thesaurus), the technology to discover and study underwater shipwrecks with their relics of ancient times, important part of Cultural Heritage of the region.

The group developed both new AUVs (in particular the Tifone, shown in Fig. 51), with the task to cooperate in teams of three units, able to exchange information and coordinate their own operations, mechanical actuators (especially for marine propulsion) and local and social intelligence.

Cooperation and collaboration agreements

Piaggio Institute, like in the case of Scuola Superiore S. Anna, has established a large network of national and international relationships that allow him to be considered one the poles of the world robotics research especially in the area of compliant robotics.

His director, Prof. A. Bicchi, postdoc scholar at MIT, is senior scientist at IIT and one of most respected researchers at international level.

Prof. Bicchi is also the elected Chair of the Italian Association

At national level, in the recent years, Piaggio Institute became one of the founders of the Interuniversity Center of Integrated Systems (ISME), mentioned also for the other members of the group. This university association has already proven to be able to successfully compete at international level with a number of approved project. Among them we can mention CO³ AUVs, Trident, UAN, VENUS, EPOCH (a NoE), SITAR.

Educational Activity

Piaggio Institute, despite the activities related to its institutional role of University department, was deeply involved in the exchange of technology, information and cultural initiatives with the surrounding territory. It is one the main generator of high tech SMEs that are hosted, during all the first phases of their startup in infrastructures owned by University and that allow the young enterprises to establish their first core business before being launched on the competitive market.

Among these we can mention high tech industries like QROBOTICS, specialized in soft robotics technologies, ADATEC, a wide spread technology firm, especially involved in informatics and robotics, Kirkstall, more involved in biotechnology applications, Pure Power Control, made by specialists in engineering services, especially with reference to powertrains and their control.

But apart the special support to these firms, launched by students of the University itself, Piaggio Institute opened a fixed consultant office, operating towards all the surrounding industrial district, able to offer technological solutions to support new and innovating industrial initiatives.

With this respect and with the support of Regione Toscana (pianeta Galileo), Piaggio Institute is also organizing regular lessons addressed to young specialist of local industries willing to improve their level of education and increase their industry innovation capability.
Main results (papers and/or realizations of reference people)


Balestrino A, Caiti A, Grammatico S. A new class of Lyapunov functions for the constrained stabilization of linear systems. AUTOMATICA [Internet]. 2012.


