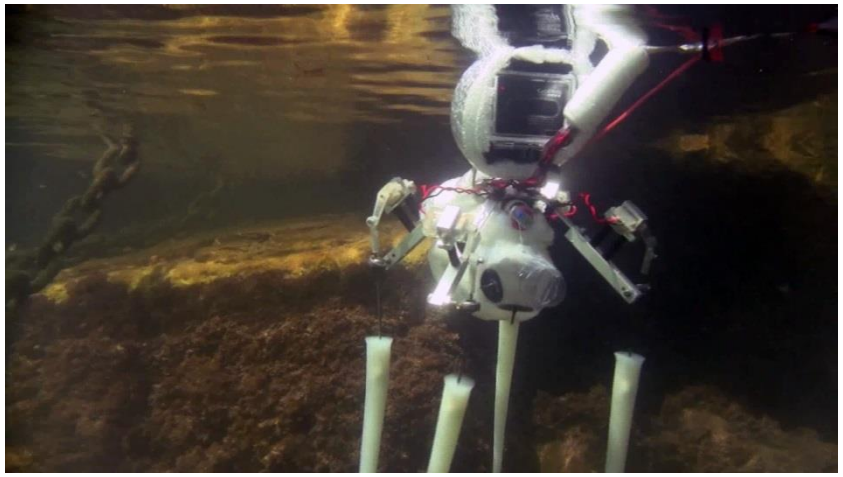
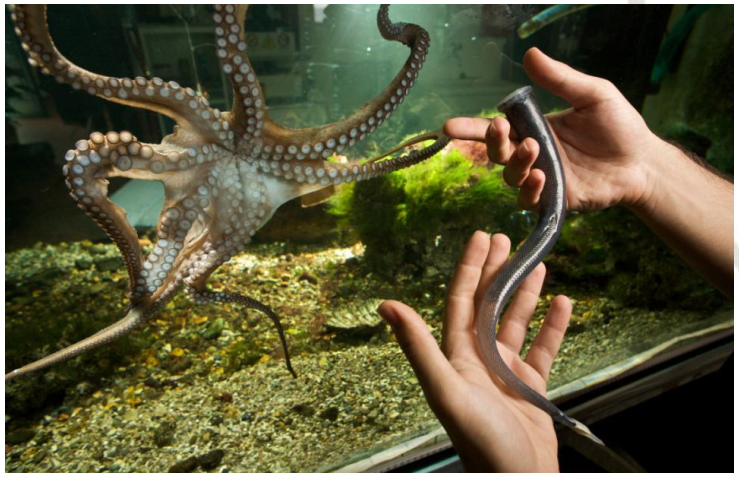
ISTITUTO DI BIOROBOTICA

Scuola Superiore Sant'Anna

Linee di ricerca

- **Robotica Soft**
  - **OCTOPUS** (European Commission, ICT-FET Programme, 2009-2013)
  - **OCTO-PROP** (European Commission, Marie-Curie Action, 2010-2014)
  - **PoseiDRONE** (Fondazione Livorno, 2012-2015)
  - **Smart-e** (European Commission, Marie-Curie ITN, 2013-2017)
  - **I-Support** (European Commission, PHC, 2015-2018)



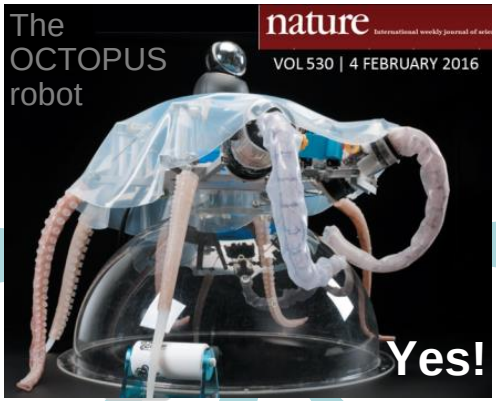


OCTOPUS Robot

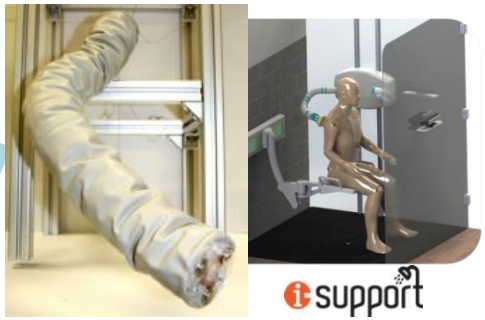
Soft Robotics Area

Can we build robots with soft materials?

Biomedical applications

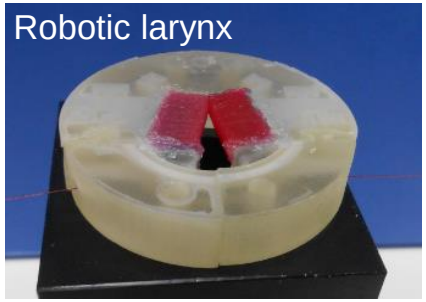


Assistance to elderly people in bathing



What is it for ?

Simulators of body parts



Industrial applications

New sensors and actuators;

New manufacturing;

New products and services;

Marine applications

SOFT ROBOTICS
Soft robotics: Technologies and systems pushing the boundaries of robot abilities
Cecilia Laschi,[1]* Barbara Mazzolai,[2] Matteo Cianchetti[1]
Science Robotics

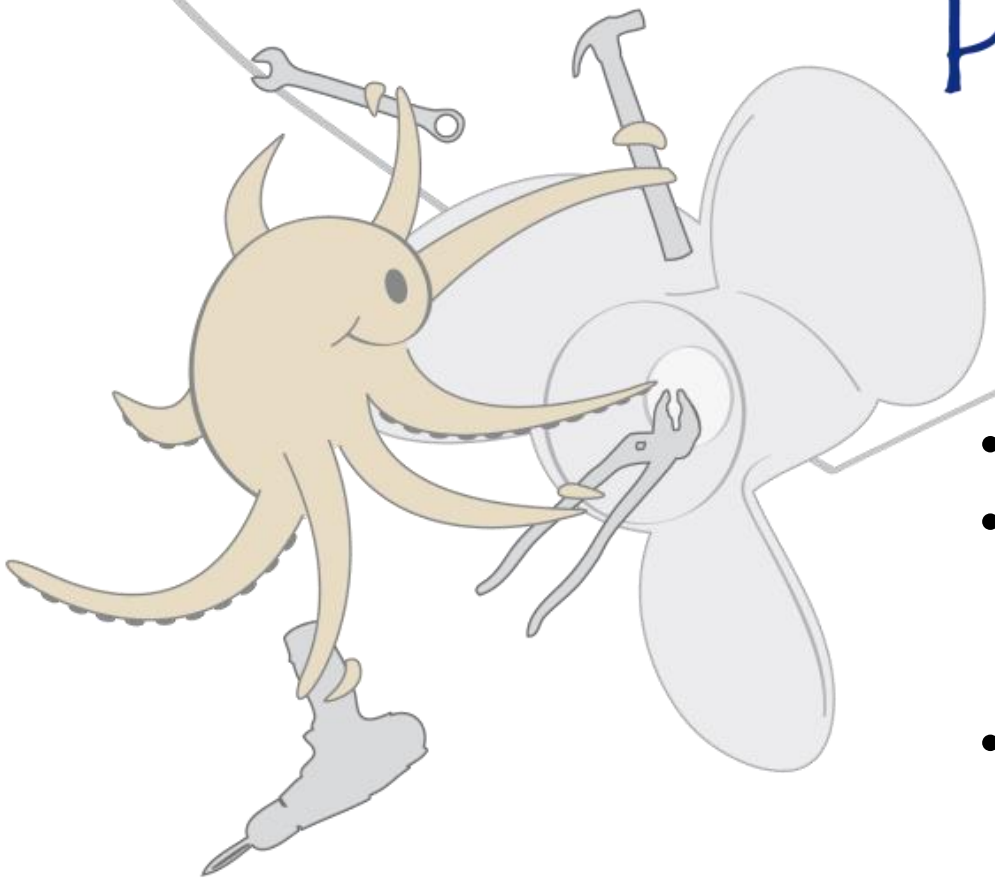
ISTITUTO DI BIOROBOTICA

Scuola Superiore Sant'Anna

Applicazioni marine per il robot polpo

Fondazione Livorno, 2012-2015

PoseiDrone



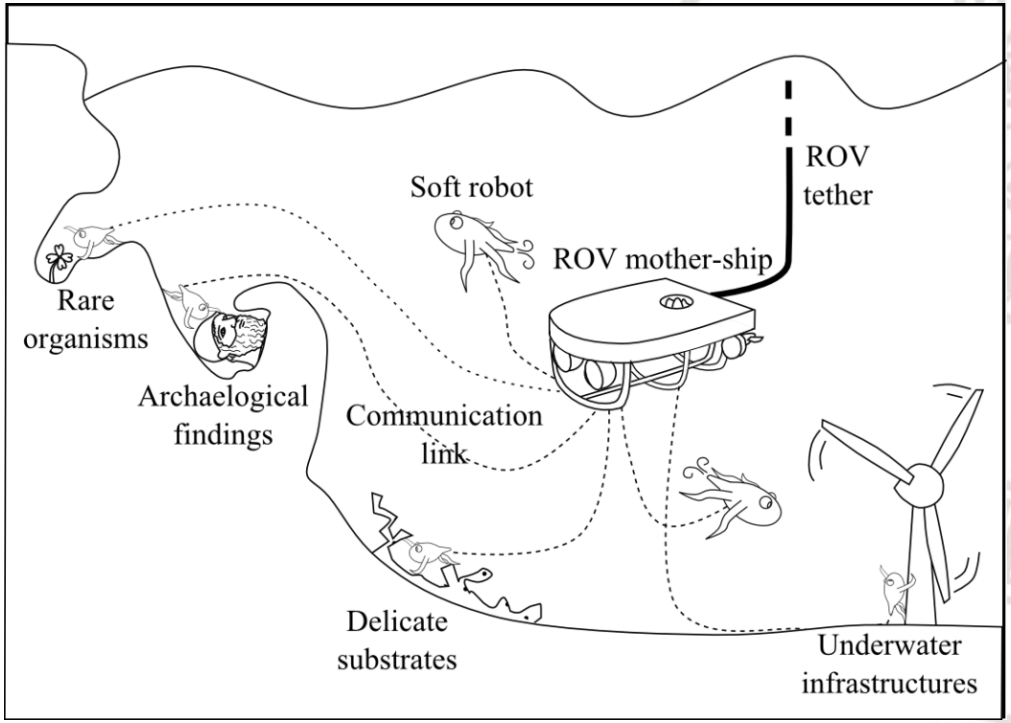
- Robot marino 'soft'
- Può operare a contatto con il fondale o i manufatti da ispezionare
- Capacità di locomozione e di manipolazione

PoseiDRONE: un robot marino soft

ISTITUTO DI BIOROBOTICA

Scuola Superiore Sant'Anna

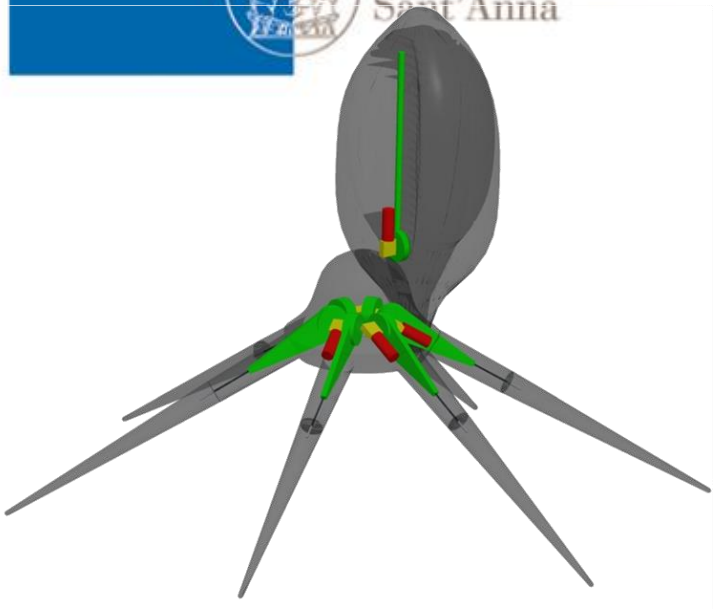
PoseiDrone

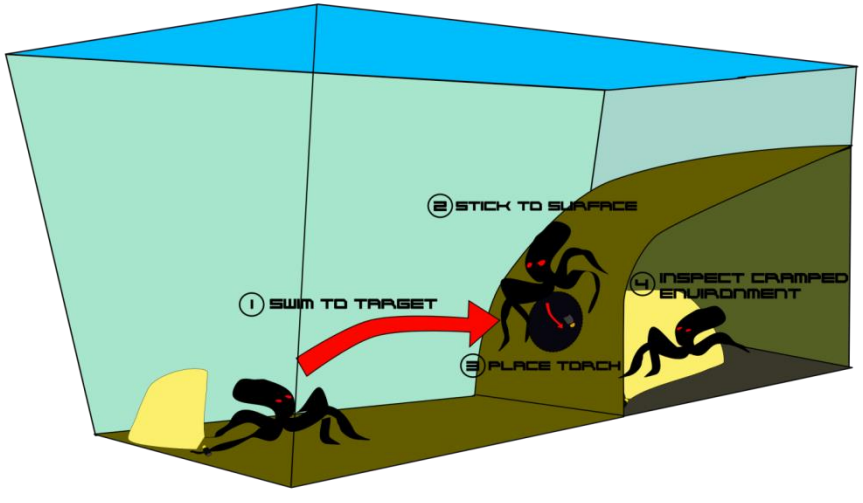


FONDAZIONE LIVORNO

ISTITUTO
DI BIOROBOTICA

Scuola Superiore
Sant'Anna





1992
2012
Fondazione
Cassa di Risparmi di
Livorno

per l'Arte
l'Educazione
la Sanità

la Fondazione e la Ricerca

PoseiDRONE
con l'Istituto di BioRobotica
Scuola Superiore
Sant'Anna
di Studi Universitari e di Perfezionamento

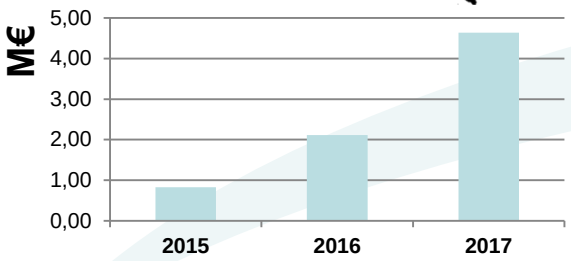
Photo Credits to Roberto Zucchi FotoArte

Photo Credits to Massimo Brega The Lighthouse

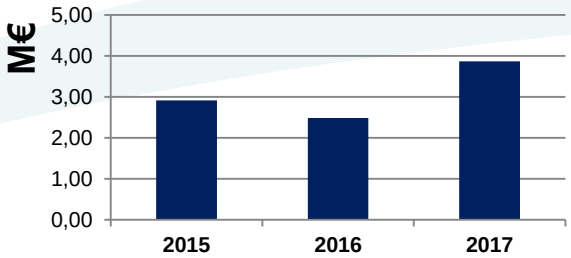
Primo prototipo PoseiDRONE

Annual Funding

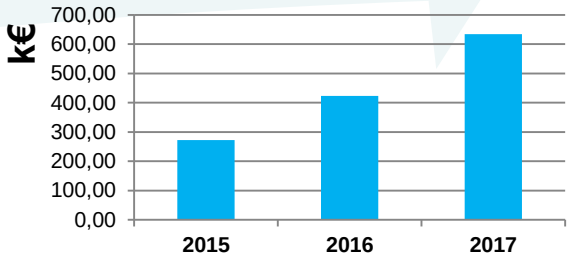
National projects



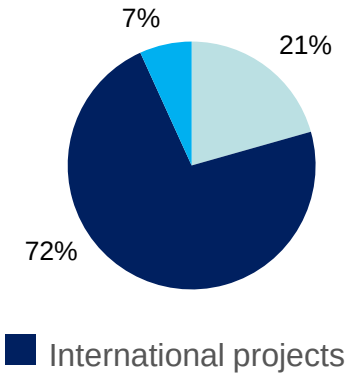
International projects



Research contracts

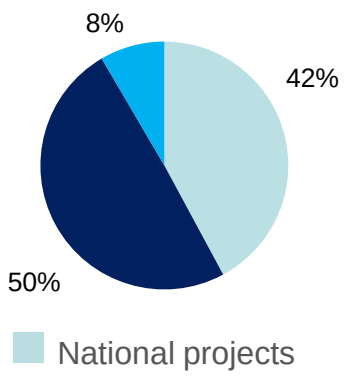


2015 (total 4.6M€)



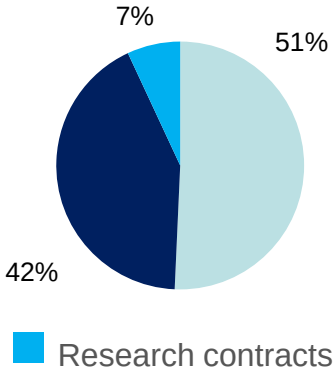
International projects

2016 (total 5.5 M€)



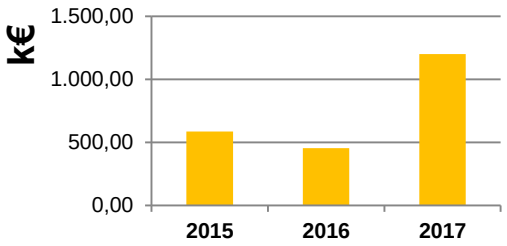
National projects

2017 (est. 10.3 M€)



Research contracts

Reserves used (or available for 2017) for research co-financing



THE BIOROBOTICS INSTITUTE

EUROPEAN COMMISSION

HORIZON 2020

Excellent Science (24.4 B €)

- European Research Council (13.1 B €)
- Future and Emerging Technologies (2.7 B €)
- Marie Skłodowska-Curie Actions (6.1 B €)
- Research Infrastructures (2.5 B €)

Industrial Leadership (17 B €)

- LEIT = Leadership in enabling and industrial technologies
  - ICT
  - Nano, new materials
  - Biotechnology
  - Space

  (13.5 B €)
- Access to Risk Finance (2.9 B €)
- Innovation in SMEs (0.6 B €)

Societal Challenges (29.7 B €)

- Health (7.5 B €)
- Food (3.9 B €)
- Energy (6 B €)
- Transport (6.3 B €)
- Climate (3 B €)
- Inclusive Societies (1.3 B €)
- Security (1.7 B €)

Spreading Excellence (0.8 B €)

Science for Society (0.5 B €)

EIT (2.7 B €)

JRC (1.9 B €)

Euratom (1.6 B €)

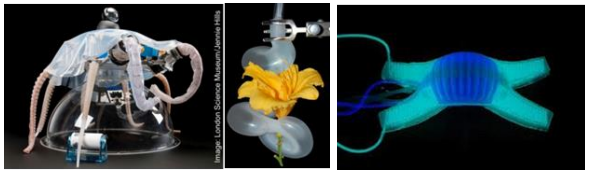
THE BIOROBOTICS INSTITUTE

Scuola Superiore Sant'Anna

The wave of fundamental research

Wave of fundamental research

Science + enabling technologies



Systems

Applications

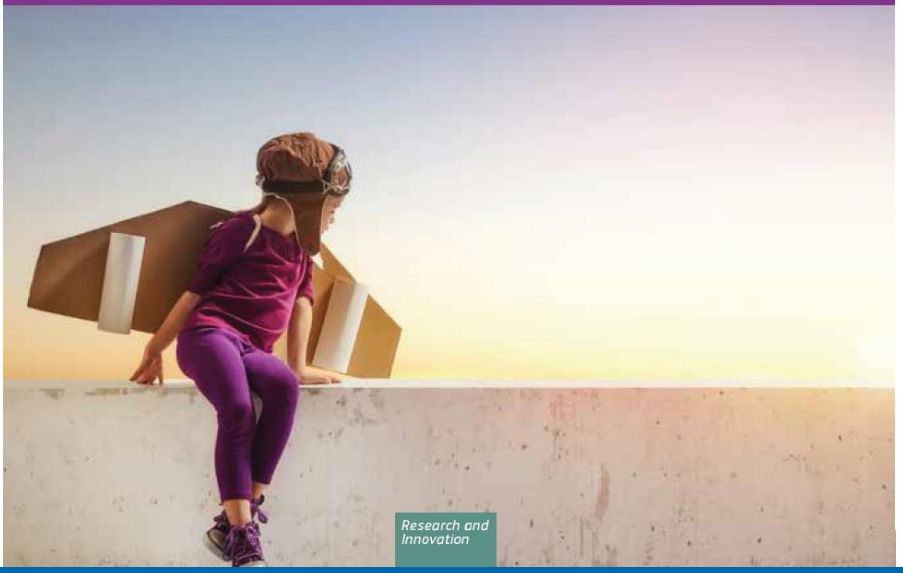
FET ⟷ **GAP** ⟷ **ICT Robotics?** — **Private investments?**

European Commission

LAB – FAB – APP

Investing in the European future we want

Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes



Summary of recommendations

The following recommendations are aimed at maximising the impact of future EU research and innovation programmes. Each of them is exemplified by a key action.

1. **Prioritise research and innovation in EU and national budgets**
   Action: double the budget of the post-2020 EU research and innovation programme.
2. **Build a true EU innovation policy that creates future markets**
   Action: Foster ecosystems for researchers, innovators, industries and governments; promote and invest in innovative ideas with rapid scale-up potential through a European Innovation Council.
3. **Educate for the future and invest in people who will make the change**
   Action: modernise, reward and resource the education and training of people for a creative and innovative Europe.
4. **Design the EU R&I programme for greater impact**
   Action: make the future programme's pillars driven by purpose and impact, fine-tune the proposal evaluation system and increase flexibility.
5. **Adopt a mission-oriented, impact-focused approach to address global challenges**
   Action: set research and innovation missions that address global challenges and mobilise researchers, innovators and other stakeholders to realise them.
6. **Rationalise the EU funding landscape and achieve synergy with structural funds**
   Action: cut the number of R&I funding schemes and instruments, make those remaining reinforce each other and make synergy with other programmes work.
7. **Simplify further**
   Action: become the most attractive R&I funder in the world, privileging impact over process.
8. **Mobilise and involve citizens**
   Action: stimulate co-design and co-creation through citizen involvement.
9. **Better align EU and national R&I investment**
   Action: ensure EU and national alignment where it adds value to the EU's R&I ambitions and missions.
10. **Make international R&I cooperation a trademark of EU research and innovation**
    Action: open up the R&I programme to association by the best and participation by all, based on reciprocal co-funding or access to co-funding in the partner country.
11. **Capture and better communicate impact**
    Action: brand EU research and innovation and ensure wide communication of its results and impacts.

THE BIOROBOTICS INSTITUTE

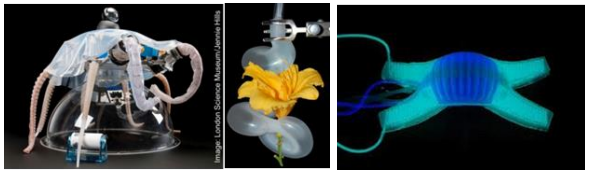
Scuola Superiore Sant'Anna

The wave of fundamental research

New wave of fundamental research needed for the applications of the future

Wave of fundamental research

Science + enabling technologies



Systems

Applications

FET

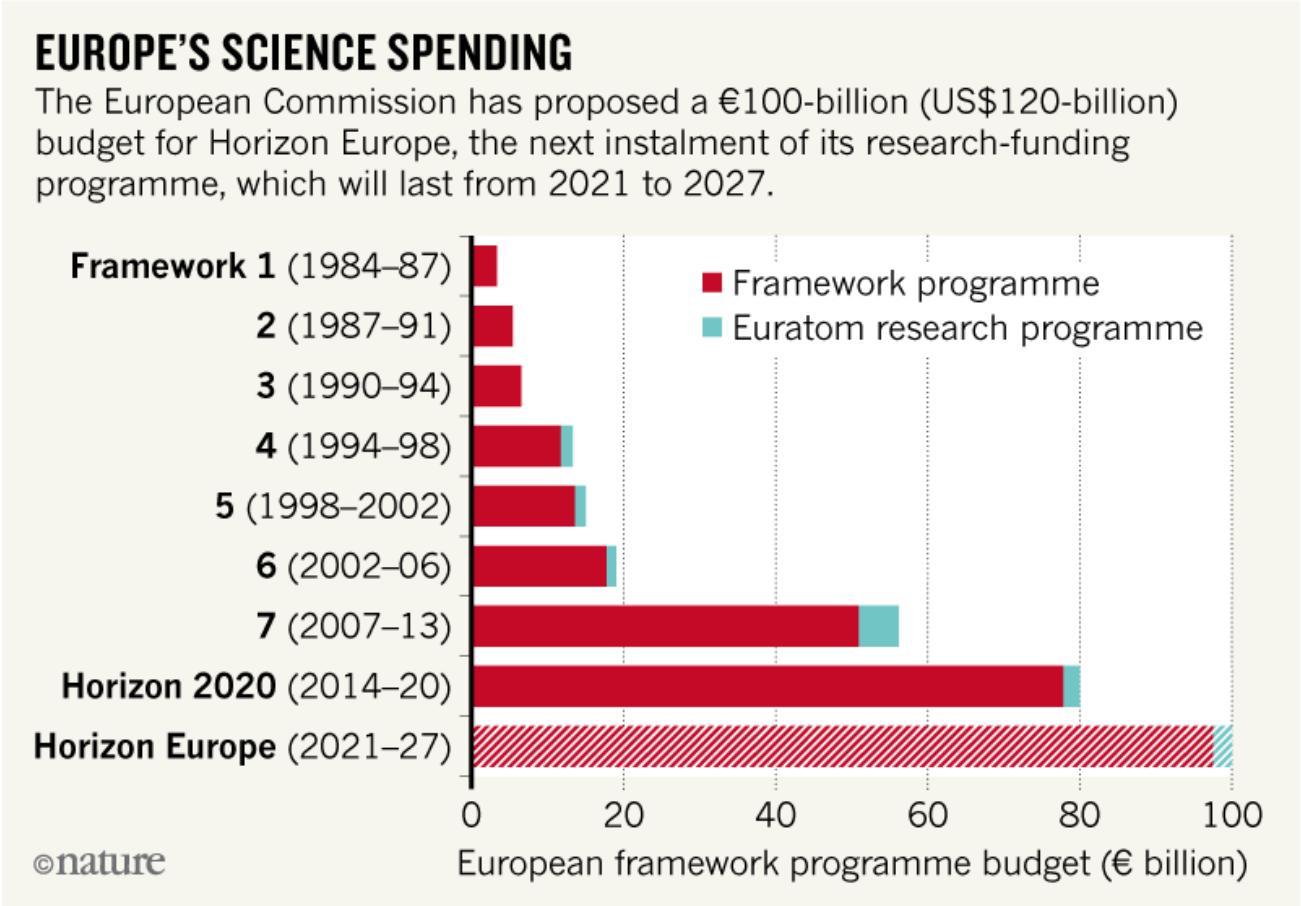
GAP

ICT Robotics?

Private investments?

Towards FP9 - "Horizon Europe"

Pillar 1 "Fundamental Science"
Pillar 2 "Global Challenges"
Pillar 3 "Open Innovation"



TERRINet

The European Robotics Research Infrastructure Network

Objectives

- The **E**uropean **R**obotics **R**esearch **I**nfrastructure **Net**work (**TERRINet**) aims at building a unique **distributed** and world-class **Robotics Research Infrastructure.**
- Harmonised **access**, **use** and **sharing** of **platforms**, **knowledge**, **technologies** and **resources** (both human and technical) to different groups of users, irrespective of location, will **sustain** a **Starting Community leveraging on a common World-Class Networked Infrastructure**.
- The joint infrastructure, with simplified and standardised procedures based on the best practices of the involved institutions, will contribute to steeply accelerate the **advancement** of Robotics Research, by boosting its potential for innovation through the capitalisation of wherewithal and expertise across Europe.

13 partners from 7 EU countries and one Associated Country (Switzerland)

Grant agreement No.	730994-2
Expected starting date	December 1, 2017
Duration of the project	48 Months
EC funding	5.000.000,00€ (4999236,25)

FETFLAG-01-2018: Preparatory Actions for new FET Flagships

This topic aims at launching Coordination and Support Actions (CSA) to prepare new candidate FET Flagships.

Specific Challenge:

FET Flagships are science- and technology-driven, large-scale, multidisciplinary research initiatives built around a visionary unifying goal. **They tackle grand science and technology (S&T) challenges requiring cooperation among a range of disciplines, communities and programmes**. FET Flagships should provide a strong and broad basis for future innovation and economic exploitation, as well as novel benefits for society of a potential high impact. The overarching nature and magnitude implies that they can only be realised through a collaborative long-term and sustained effort.

Scope:

Proposals should contain a description of a potential FET Flagship and how this is to be matured over the course of the preparatory action into a more complete blueprint.

Three main areas:

1. **ICT and Connected Society;**
2. **Health and Life Sciences;**
3. **Energy, Environment and Climate change**

- In each of these areas **at least one and at most two proposals for Flagship preparatory actions will be selected for funding**.
- Proposals must clearly specify which of the three areas they target.

TOPIC : Preparatory Actions for new FET Flagships

Topic identifier: FETFLAG-01-2018
Publication date: 27 October 2017

Types of action: CSA Coordination and support action
DeadlineModel: two-stage
Opening date: 31 October 2017
Deadline: 20 February 2018 17:00:00
2nd stage Deadline: 18 September 2018 17:00:00

Time Zone : (Brussels time)

ICT and Connected Society

- **Smart Materials and Nanoscale Engineering:** Novel nano-engineered materials and systems with properties enabling the design and manufacturing of radically new ICT components and devices creating disruptive technologies and market opportunities.
- **Robotics, Interfaces and Artificial Intelligence:** a new generation of robotics technologies including soft and flexible robotics, bio-inspired robotics, new approaches to human-machine interaction and cooperation, cognition and artificial intelligence, giving rise to much smarter systems performing sophisticated functions opening radically new opportunities to address societal and economic challenges.
- **ICT for Social Interaction and Culture:** new ICT technologies and approaches for empowering deep social interactions across diverse cultures, languages, goals, values, etc.; for understanding large-scale complex socio-technical systems and their interactions, interdependencies and evolutions and avenues for exploiting this understanding.

Health and the Life Sciences

- **Disruptive technologies to Revolutionise Healthcare:** New technologies and approaches aiming at a paradigm shift in the field of individualised prevention, prediction and treatment of diseases.
- **Understanding Life by Exploring the Genome and the Cell:** Novel technologies and approaches that enable a paradigm shift in studying and understanding the foundational building blocks of life, for example the functioning of the cell, and of cells within organisms, including structure and dynamics, and the full multi-omics(genome/ epigenome/ /proteome/metabolome/connectome etc.) and their interactions.

Energy, Environment and Climate change

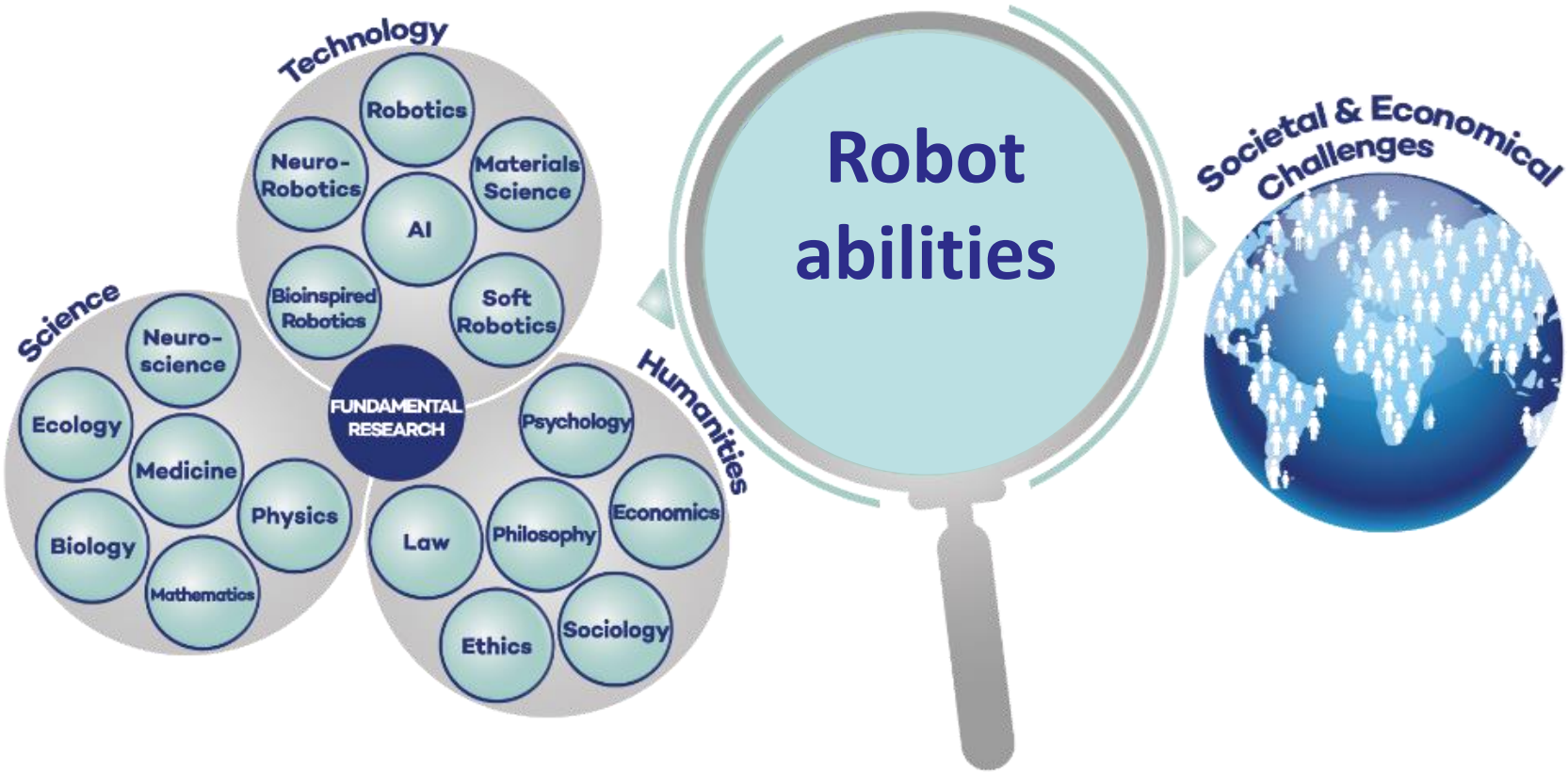
- **Earth, Climate Change and Natural Resources**: New technologies and approaches for high-precision modelling and simulation, including the necessary data integration, that enable an in-depth understanding of the earth, natural hazards and climate change. Their exploitation and use should open up new opportunities for helping to manage/mitigate their effects and impacts on human activity and natural resources in a sustainable way in specific areas such as: agriculture (ensuring food security and sustainable farming), forestry, fisheries, protecting/restoring natural ecosystems, energy supply and demand, etc.
- **Radically new Energy Production, Conversion and Storage devices and systems:** Disruptive technologies aiming at a paradigm shift in renewable energy by exploring and exploiting radically new principles and novel materials that can substantially reduce

Robotics Flagship Proposal Main Concept

Abilities that robots haven't reached yet

Lessons from Nature: simplifying principles for a complex world

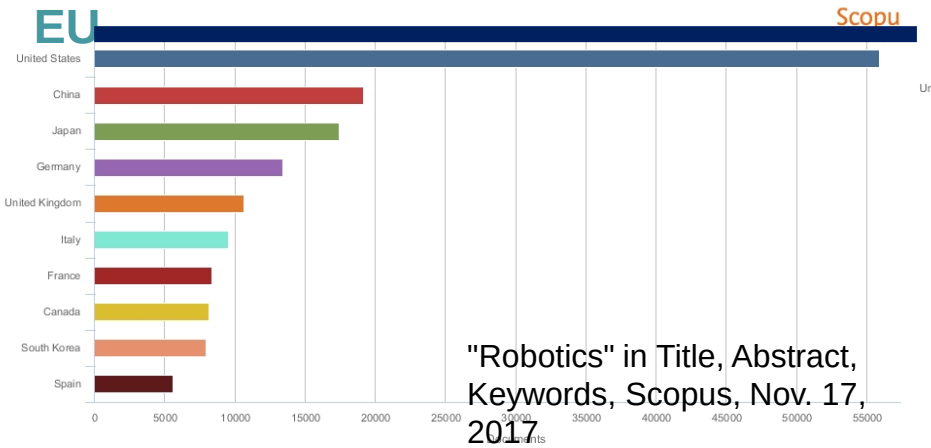
Robotics Flagship focus



Developing further robot **abilities** would enable robot **application** in our environments, on the humans' side, to address societal and economical challenges and to promote industry growth. On the other hand, reaching further abilities presents new scientific and technological challenges for **fundamental research**, requiring interdisciplinary knowledge and research for proving new principles and for developing new solutions, and for ultimately transforming new science into new technology.

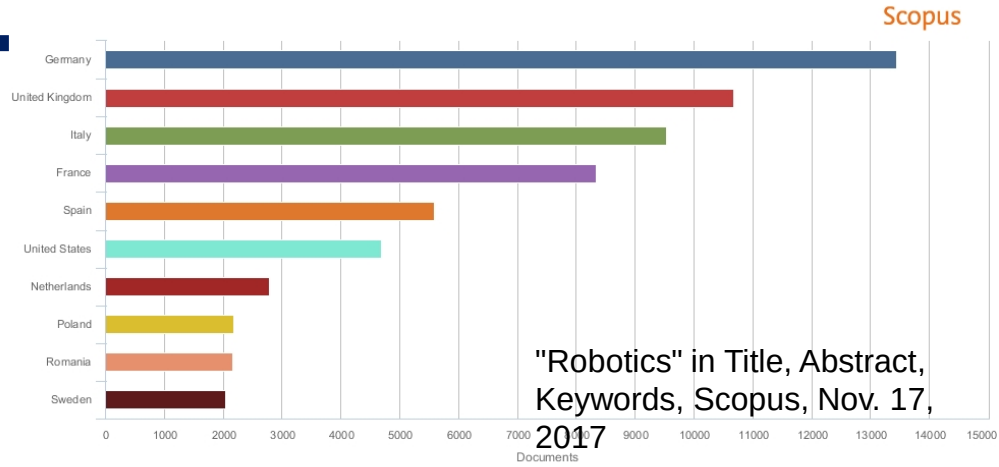
Our starting points:
EU at the forefront with other regions of the world

Publications in robotics – top countries



"Robotics" in Title, Abstract, Keywords, Scopus, Nov. 17, 2017

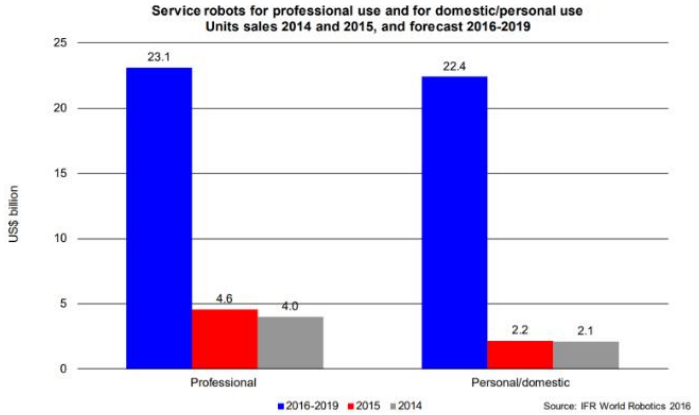
Publications in robotics – top EU countries



"Robotics" in Title, Abstract, Keywords, Scopus, Nov. 17, 2017

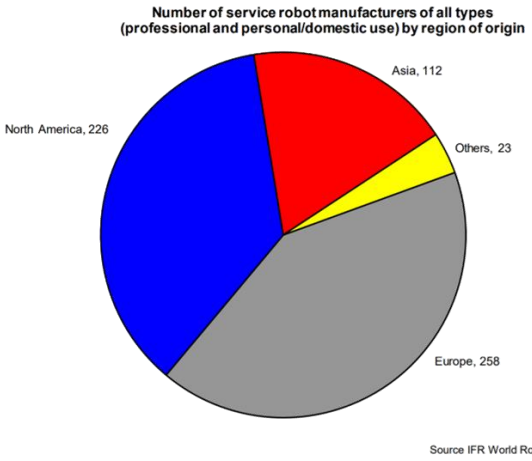
Our starting points: EU Industry and innovation potential

2016-2019: US$ 45 billion sales value



1.4 million industrial robots will be installed in the factories to increase productivity
333,000 service robots for professional use will be sold to non-manufacturing and to manufacturing sectors
42 million service robots for personal and domestic use (consumer robots) will be used in our private life

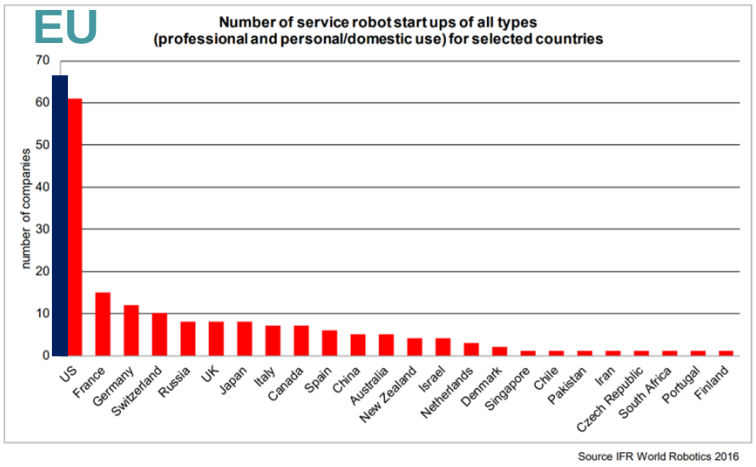
More than 600 service robot suppliers identified



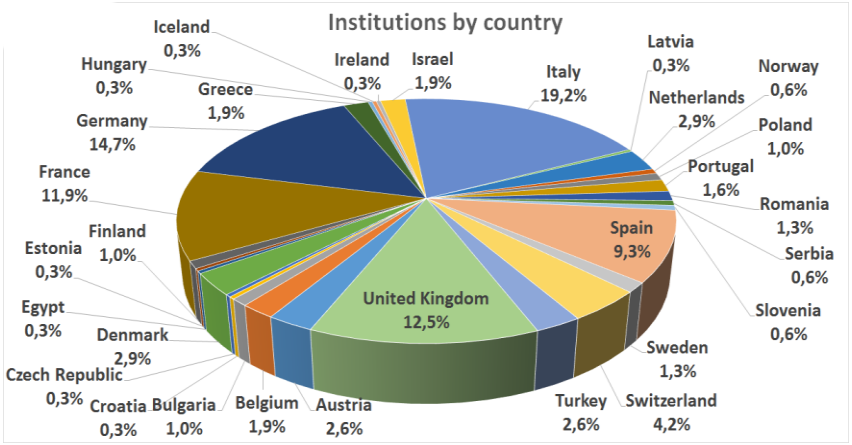
IFR International Federation of Robotics

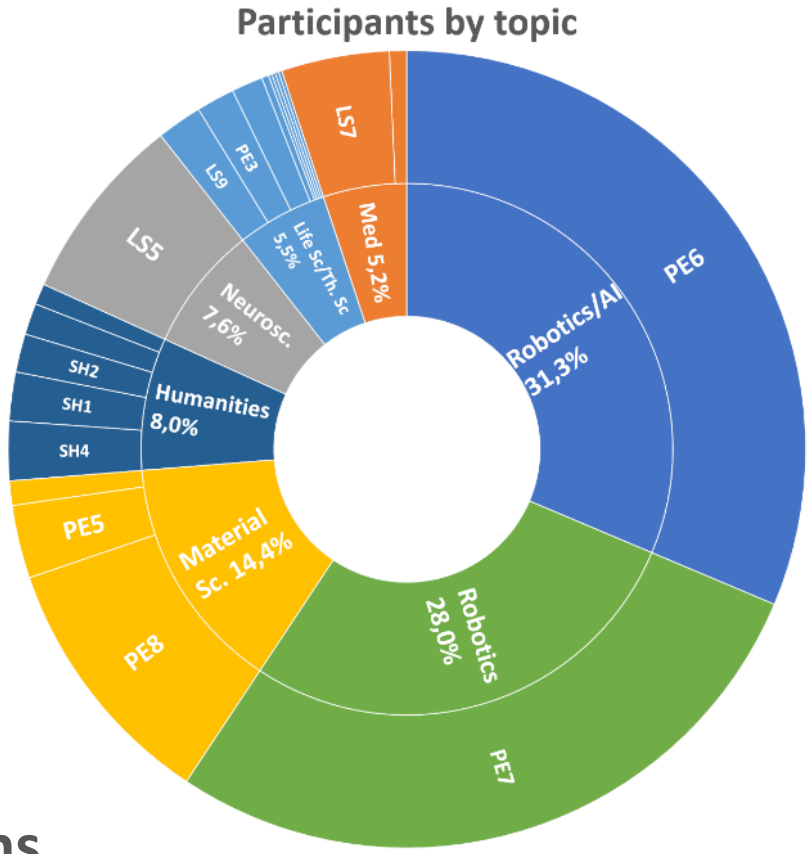
Hosted by VDMA

Most start-up companies in the USA



Robotics Flagship participants

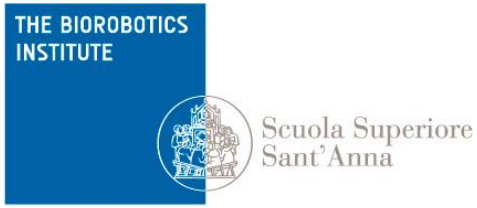




700+ participants, 300+ institutions

In the proposed multidisciplinary approach, **biology** is the inspiration for simplifying principles to deal with a complex world, **materials science** is the foundation for giving the body its proper role in shaping behaviour, **AI** is how to develop new forms of cognitive functions, **ICT** keeps all this in a connected world, and **humanities** are the way to advance knowledge on the relation between humans and robots and to steer the impact of new machines on the society. The aim is *scientific integration*, beyond multidisciplinarity.

Robotics Flagship Coordinating team



- **Cecilia Laschi** (SSSA, Italy) - Coordinator
- **Barbara Mazzolai** (IIT, Italy)
- **Stefano Stramigioli** (University of Twente, Netherlands)
- **Tamim Asfour** (KIT, Germany)
- **Dario Floreano** (EPFL, Switzerland)
- **Jean-Paul Laumond** (LAAS-CNRS, France)
- **Sabine Hauert** (University of Bristol, United Kingdom)

Web site: https://www.roboticsflagship.eu/

email: coordinator@roboticsflagship.eu

Conclusioni

- I finanziamenti europei sono un eccellente strumento per la ricerca universitaria
- L'Unione Europea offre anche strumenti per l'innovazione
- Un punto di forza dei progetti europei è la collaborazione tra partner di paesi diversi e di discipline diverse
- Un punto di debolezza è la difficoltà per l'UE di dare seguito a finanziamenti di base, rischiosi, verso lo sviluppo ulteriore e l'applicazione dei risultati

Grazie

Research Centre on Marine Robotics, Livorno, Italy

RoboSoft

FONDAZIONE LIVORNO

OCTOPUS

i-support

- I-Support, EU PHC
- PoseiDRONE, Fondazione Livorno
- RoboSoft CA, EU ICT FET-Open
- Smart-e, EU Marie Curie ITN
- OCTOPUS, EU ICT FET
- OCTO-Prop, EU Marie Curie Grant

Soft Robotics Team:

- Cecilia Laschi
- Matteo Cianchetti
- Marcello Calisti
- Mariangela Manti
- Giacomo Picardi
- Saverio Iacoponi
- Mrudul Chellapurat
- George Thomas Thuruthel
- Yasmin Ansari
- Taimoor Shah