

# European Robotics Forum

Workshop “European robotics projects... beyond the  
Robotics Unit at the ERF 2015”

March 11, 2015, Vienna

## RoboSoft CA

“A Coordination Action for  
Soft Robotics” in Fet Open

Cecilia Laschi, RoboSoft Coordinator

The BioRobotics Institute

Scuola Superiore Sant’Anna, Pisa, Italy



Image: Massimo Brega, The Lighthouse



THE BIROBOTICS  
INSTITUTE



Scuola Superiore  
Sant'Anna

A Coordination Action for Soft Robotics

FP7, THEME ICT-2013.9.1 “Challenging current Thinking”, **FET-Open**

# Soft Robotics



Definition of Soft Robotics by the RoboSoft Community:

*“Soft robot/devices that can actively interact with the environment and can undergo ‘large’ deformations relying on inherent or structural compliance”*

Soft robotics is not just a new direction of technological development. The use of soft materials in robotics is going to unhinge its fundamentals.

**Soft Robotics scientific and technological challenges are across many disciplines**

**Soft Robotics is no more robotics only**

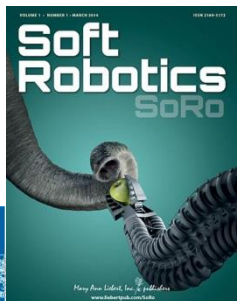
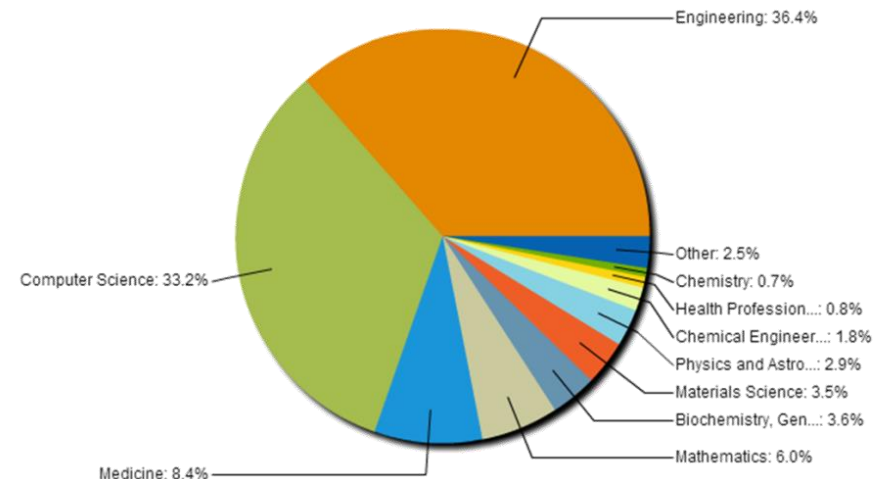
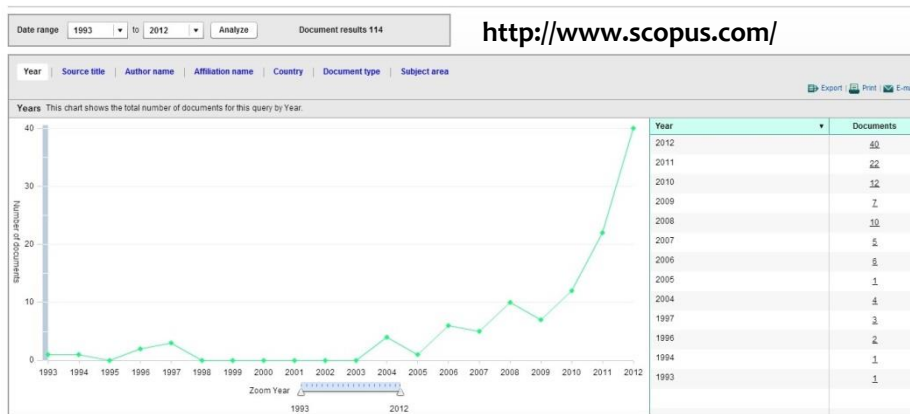
Kim S., Laschi C., and Trimmer B. (2013) Soft robotics: a bioinspired evolution in robotics, *Trends in Biotechnology*, April 2013.  
Laschi C. and Cianchetti M. (2014) “Soft Robotics: new perspectives for robot bodyware and control” *Frontiers in Bioengineering and Biotechnology*, 2(3)

# Why RoboSoft?

(April 2013)



The Soft Robotics community is **growing** and **active**, but still **scattered**, and needs coordination to synergise and consolidate



- \* Special issue on "Soft Robotics" of *Advanced Robotics* 26(7), 2012
- \* Special issue on "Soft Robotics" of *Actuators*
- \* RAS TC on Soft Robotics Co-Chairs: Fumiya Iida, Cecilia Laschi, Akio Ishiguro, Robert Wood



# RoboSoft

## A Coordination Action for Soft Robotics

Type of funding scheme: Coordinating Action (CA)

Work programme topics addressed: ICT-2013.9.1: Challenging current Thinking, **FET-Open**

Duration: **36 months** , Budget: **952 960 €** from EC



## RoboSoft rationale

- \* A Coordination Action in Soft Robotics is extremely necessary and **timely** in the current landscape of robotics and biorobotics to endorse the rapid development of this new area at the merge of engineering and science and its community and **to exploit the challenging potentiality** of the use of soft technologies for the future generation of machines.
- \* A common forum will help soft robotics researchers to **combine their efforts, to maximize the opportunities and to materialize the huge potential impact**.
- \* On the other hand, leaving the soft robotics community **scattered** would waste its potential for scientific progress and technological innovation, as the achievements in this field do not find proper publication, presentation and discussion in existing scientific contexts.
- \* RoboSoft will create the missing framework for the soft robotics scientists, regardless of their background disciplines, and will enable the **accumulation and sharing of crucial knowledge** needed for scientific progress in this field.

# FET Open – Objective ICT-2013.9.1

## Challenging current thinking



This objective also supports Coordination and Support Actions for creating the best conditions within which FET research can flourish and achieve the transformative impacts that it aspires to. These activities may be, for example:

- actions, including networking and dissemination activities, aiming at the emergence of new research communities or collaborations involving a broad diversity of disciplines and actors into FET research;
- actions towards the increased active involvement of high-tech research intensive SMEs in exploratory research directions relevant to future ICT markets;
- actions that stimulate excellence and future leadership of pioneering teams of young researchers along new, exploratory research directions relevant to future ICT;
- actions aiming to strengthen the international dimension of FET.



# Objective ICT-2013.9.1

## Challenging current thinking



### Expected impact

For CSA actions:

- catalyse transformative effects on the communities and practices for high-risk and high-impact research and on the mechanisms to support the global nature of such research;
- new, engaged and risk-taking research communities prepared to develop new and non-conventional approaches for addressing future challenges in science and society.

# RoboSoft in a nutshell



## What?

- \* Create and consolidate the scientific community of soft roboticists
- \* Educate a young scientific community of students
- \* Promote dissemination of soft robotics
- \* Provide means for exploitation

## Who?

- \* Universities, laboratories, research institutions (EU and not) working in the field of Soft Robotics
- \* Industrial stakeholders
- \* Other scientific communities

## How?

- \* Annual plenary meetings with scientific events for soft robotics community and working groups for indications to the EC
- \* Summer Schools for PhD students and young researchers
- \* Events for fertilization of other scientific communities
- \* Dedicated workshops and exhibitions for stakeholders

# RoboSoft first year facts and figures

- \* 22 Community Members
- \* 1 Plenary Meeting for RoboSoft Community
- \* 11 events at international conferences
- \* 4 fertilization events
- \* 1 working papers
- \* 2 Newsletters
- \* Collaborations with IEEE RAS TC on Soft Robotics, IGERT at Tufts and ESNAM network



SEVENTH FRAMEWORK PROGRAMME  
THEME ICT-2013.9.1  
Challenging current Thinking, FET-Open



RoboSoft working paper

Grant Agreement number: 619319

Project acronym: RoboSoft

Project title: A Coordination Action for Soft Robotics

Funding Scheme: Coordination and support action

Start date of the project: October 1, 2013

Duration of the project: 36 months

Project's coordinator: Cecilia Laschi, Scuola Superiore Sant'Anna

Deliverable Number: D3.2.1 RoboSoft working paper

Due date: September 30, 2014

Actual submission date: September 30, 2014

WP3 Leader: SSSA - Scuola Superiore Sant'Anna

Involved Partners in the WP: ETH Zurich, UOB

Project website: [www.robosoftca.eu](http://www.robosoftca.eu)

Version 3.0, September 2014

People:

Jamie Paik

Jamie Paik received her B.A.Sc. from UBC in 2002, majoring in both Mechanical and Electro-Mechanical Design Engineering. She obtained her Ph.D. from Seoul National University in South Korea before completing a post-doc at the Université Pierre et Marie Curie in Paris, where she designed and built a surgical instrument (the JAMITY) which is used for suturing in laparoscopic surgery, and subsequently at Harvard University. In the Microrobotics Laboratory in Harvard she collaborated with Erik Dussan, Daniela Rus and Robert Wood on the design of Programmable Matter, highly reconfigurable compliant and active materials and structures. She currently lives in Lausanne, Switzerland, where she is a tenure-track Assistant Professor at École Polytechnique Fédérale de Lausanne (EPFL) and founding director of the Reconfigurable Robotics Lab (RRL) lab. She is also a member of the Swiss National Centre of Competence in Research (NCCR) robotics group.

In 2013, robosoft.org named Jamie one of "25 women in robotics you need to know about."

Jamie on soft robotics:

Q: What does soft robotics mean to you?

"To me, soft robotics is a culmination of the need for novel robotic solutions toward more intuitive and intelligent systems."

Q: What can soft robotics deliver now and in the future?

"The community has presented various efforts and results in soft electronics, soft power source, soft/active-DoF mechanism, multi-material fabrication methods, impedance/multi-body control. Most of current solutions are not ready for a straightforward integration with conventional systems nor with other soft components. In the future not too far,

I foresee advanced soft components not only superior in their functional performance, but also characterized with a unified standard."

Q: What needs to be done to advance soft robotics?

"I believe we already are on a good track. It is already exciting that not only classically trained mechanical, electrical engineers and roboticists associate their research with soft robotics, but also material, chemical engineers, and physicists also find their research interests coinciding with soft robotics' booming community. Therefore, while keeping this an open community (and striving that it is), it is crucial to keep the research focus also on its applicability to address criticism that soft robotics is "too soft" robotics. One way of addressing application oriented research would be standardization of materials, connections or fabrication processes. It may be too early to discuss this but as mentioned above, this would allow faster, and effective collaboration with different fields within soft robotics and adaptation to conventional robotic systems: proving that in fact, soft robotics is a solid research field."



Jamie's Reconfigurable matter (left) and origami soft robots

Issue 2

[www.robosoftca.eu](http://www.robosoftca.eu)

September 2014



# Soft Robotics (October 2014)

The image shows a screenshot of the IEEE Xplore Digital Library search interface. The top navigation bar includes links for IEEE.org, IEEE Xplore Digital Library, IEEE Standards, IEEE Spectrum, and More Sites, along with a Cart(0) icon. The IEEE Xplore Digital Library logo is prominently displayed. A user access box indicates that access is provided by Scuola Superio Sant'Anna di Pisa, with a Sign Out link. The main search area features a search bar with the placeholder text 'Enter Search Term' and four search buttons: Basic Search, Author Search, Publication Search, and Advanced Search. A filter sidebar on the left allows users to filter results by 'All Results' (selected) or 'My Subscribed Content'. The search results section shows the query: 'You searched for: (((("soft robot") OR "soft robots") OR "soft robotics"))' and the refinement: 'You Refined by Publication Year: 2008 - 2012 (x)', resulting in 286 results. A red circle highlights the search query and the refinement. A blue arrow points from this circle to a second, zoomed-in view of the search results. In this zoomed view, the search query is the same, but the refinement is 'Publication Year: 2013 - 2015 (x)', resulting in 206 results. A red circle highlights the refined search results in this view. A 'RoboSoft' logo is visible in the top right corner of the main interface.

IEEE.org | IEEE Xplore Digital Library | IEEE Standards | IEEE Spectrum | More Sites | Cart(0)

IEEE Xplore®  
Digital Library

Access provided by:  
Scuola Superio Sant'Anna di Pisa  
» Sign Out

BROWSE ▼ MY SETTINGS ▼ GET HELP ▼ WHAT CAN I ACCESS?

Enter Search Term

Basic Search Author Search Publication Search Advanced Search

**FILTER THESE RESULTS** ⓘ

Search within results:  
 Search

☒ All Results  
☐ My Subscribed Content

**SEARCH RESULTS**

You searched for: (((("soft robot") OR "soft robots") OR "soft robotics"))

You Refined by  
Publication Year: 2008 - 2012 (x)

286 Results returned

IEEE Spectrum | More Sites | Cart(0)

Access provided by:  
Scuola Superio Sant'Anna di Pisa  
» Sign Out

GET HELP ▼ WHAT CAN I ACCESS?

Enter Search Term

Basic Search Author Search Publication Search Advanced Search

**FILTER THESE RESULTS** ⓘ

Search within results:  
 Search

☒ All Results  
☐ My Subscribed Content

**SEARCH RESULTS**

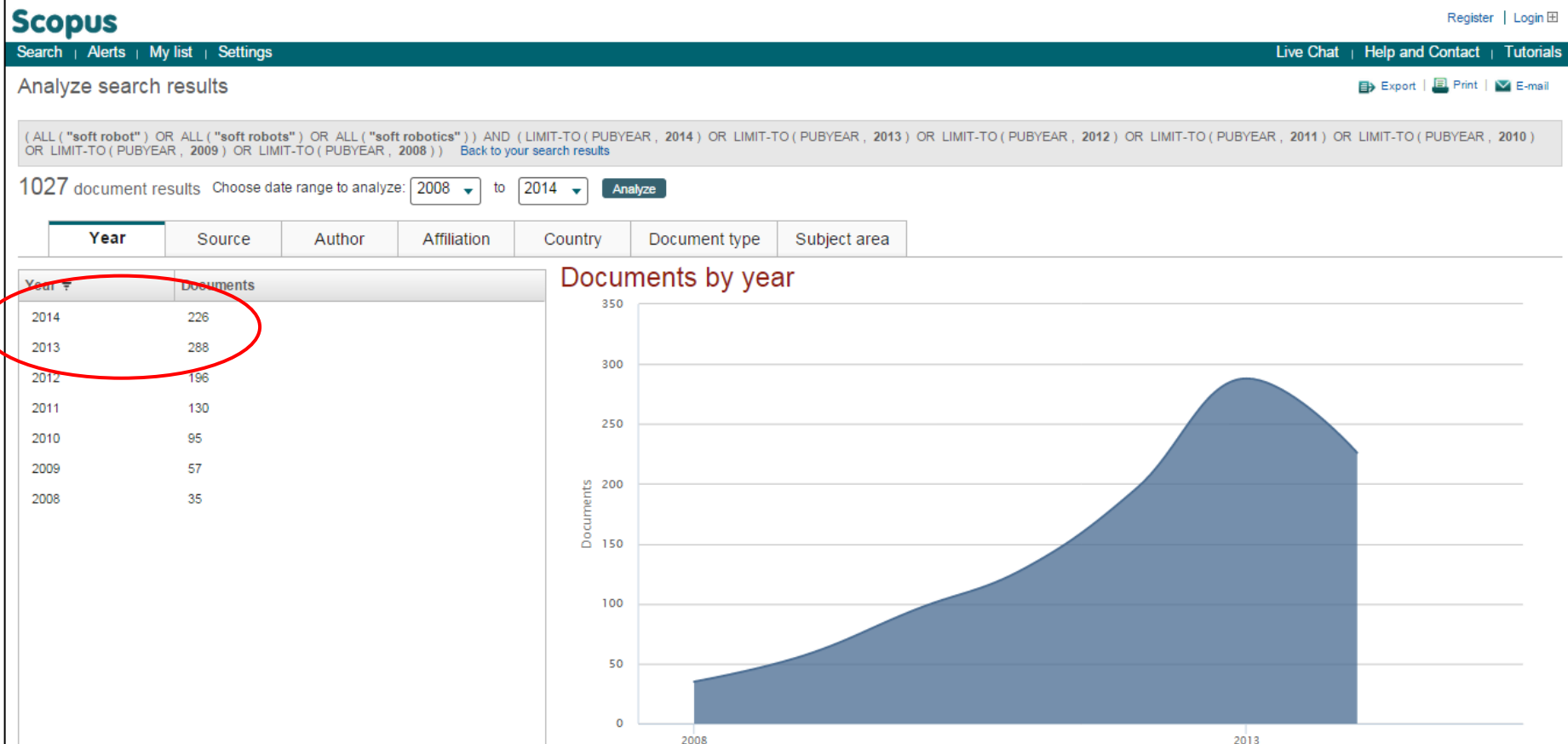
You searched for: (((("soft robot") OR "soft robots") OR "soft robotics"))

You Refined by  
Publication Year: 2013 - 2015 (x)

206 Results returned

RoboSoft

# Soft Robotics (October 2014)



Source: Scopus  
search for «soft robot» or «soft robots» or «soft robotics»

# Soft Robotics is trendy...

## Fictional Baymax in the Movie "Big Hero 6" Embodies New Research on Soft Robotics



- \* “The origin of *Big Hero 6* reflects my passion for Marvel’s comics – says Don Hall (*movie director*) - ... I am interested in human-robot interaction, in soft robotics research and in japanese culture. As I heard about an inflatable vinyl robotic arm that was able to perform simple actions, such as cleaning teeth of a human and infinite other applications, I realized the idea of a healthcare assistant robot”



# Soft Robotics applications

Robot



Biomedical applications:  
endoscopy, assistance to  
elderly and disabled people

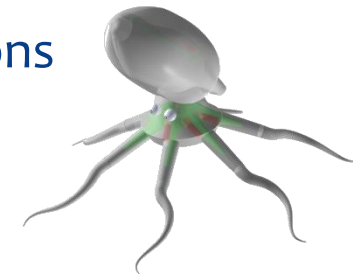
Realistic  
simulators of  
body parts

Industrial project  
on soft actuators

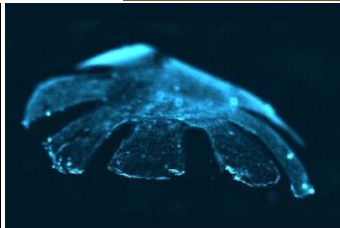
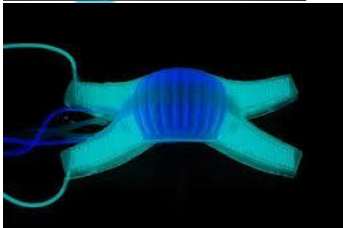
More to  
come!

Manufacturing,  
Agriculture

Marine  
applications



The initial challenge:  
can we build robots  
with soft materials?

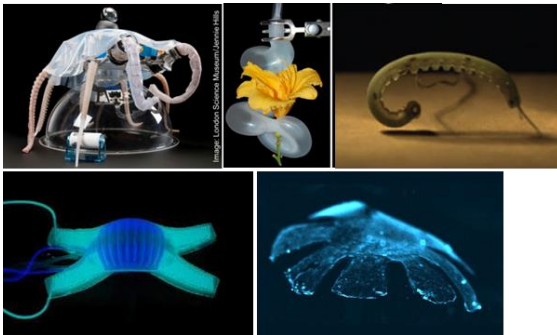


# RoboSoft impact



## Evolution of Soft Robotics

Enabling  
technologies



Systems



Applications

Wave of fundamental  
research

Year 1

Gathering the community

Year 2

Favouring collaborations

Year 3

Favouring applications



# Soft Robotics in Robotics 2020 Multi-Annual RoadMap



- \* 2.3 HealthCare
  - \* 2.3.7.3 Mechatronics
    - \* Mechanical systems -> Surgery  
*"Soft and stiffness controllable robots"*
- \* 2.8 Consumer Robots
  - \* 2.8.7.3 Mechatronics
    - \* Mechanical systems  
*"soft and deformable surfaces"*
    - \* Materials  
*"Integration of soft, deformable and durable surfaces with sensing capabilities"*
- \* 3.2 Aerial Robotics
  - \* 3.2.11.2 Human Robot Interaction
    - \* Safety  
*"New aerial robots with soft materials and dependability"*  
*"New aerial robots with soft materials and dependability for minimization of damages in case of failures"*
- \* 5.3 Human-Robot Interaction
  - \* 5.3.1 Technology Description  
*"Fundamental breakthroughs include the human-centred design of robot mechanics and control (soft-robotics),..."*
  - \* 5.3.4 Benchmarks and Metrics
    - \* *"VIA actuation technology/Soft-robotics"*
- \* 5.4 Mechatronics
  - \* 5.4.3. Expected Step Changes  
Soft robotics approach  
*"State of the art: The majority of robots consists of rigid structures connected to actuators as well as sensors. Expected step change: The boundaries between structure, sensors and actuator are dissolved and allow for integrated compliance and/or damping on one hand and intrinsic sensors on the other. "*

## Robotics 2020 Multi-Annual Roadmap

For Robotics in Europe

Call 2 ICT24 (2015) – Horizon 2020

Release B 06/02/2015



Rev A: Initial release for Comment.

Rev B: Final Release for Call

# Next FET calls



Opening date(s)<sup>3</sup>: 11/12/2013 for 2014 topics  
01/10/2014 for 2015 topics

Deadline(s)<sup>4 5</sup>:

H2020-FETOPEN-2014-2015-RIA	30/09/2014 at 17.00.00 Brussels time	31/03/2015 at 17.00.00 Brussels time	29/09/2015 at 17.00.00 Brussels time
H2020-FETOPEN-2014-CSA	30/09/2014 at 17.00.00 Brussels time		
H2020-FETOPEN-2015-CSA		31/03/2015 at 17.00.00 Brussels time	29/09/2015 at 17.00.00 Brussels time

Overall indicative budget: EUR 80 million from the 2014 budget, EUR 58 million from the 2015 budget<sup>6</sup> and EUR 22 million from the 2016 budget<sup>7</sup>.

	2014 EUR million	2015 [1] EUR million	2015 [2] EUR million
H2020-FETOPEN-2014-2015-RIA	77	38.5	38.5 <sup>8</sup>
H2020-FETOPEN-2014-CSA	3		
H2020-FETOPEN-2015-CSA		1.5	1.5

# RoboSoft Coordination Action

<http://www.robosoftca.eu/>



**A Coordination Action on Soft Robotics in  
FP7 FET Open Objective ICT-2013.9.1  
"Challenging current thinking"**

**Mailing list  
(newsletter, call for  
events/opportunities,  
other news...)**

## Plenary Meeting

The first RoboSoft plenary meeting has been organized in Pisa, Italy, on March 31-April 1, 2014.

Proceedings, pictures and presentations are available here:

[More Details and Downloads](#)

## RoboSoft Workshop at RSS 2014

The one day Workshop on "Advances on Soft Robotics" at RSS 2014 will gather experts across multiple fields in the scientific community of soft robotics.

### Important Dates:

- Abstract Submission: May 1
- Notification: May 10



## Welcome to RoboSoft

RoboSoft is a Coordination Action for Soft Robotics funded by the European Commission under the Future and Emerging Technologies - FET-Open Scheme (FP7-ICT-2013-C project # 619319).

## RoboSoft rationale

Soft robotics, intended as the use of soft materials in robotics, is a young research field, going to overcome the basic assumptions of conventional rigid robotics and its solid theories and techniques, developed over the last 50 years. Using soft materials to apply forces on the environment, as expected in a soft robot able to locomote, grasp, and perform other tasks, poses new problems at the level of the different components as well as at the whole system level. The technologies for actuating the soft materials have not yet been demonstrated to exist in a general form, although

## Mailing List

To share and receive information related to soft robotics and the RoboSoft project, we created a public mailing list. You can [sign up here](#).

## Share!



## Like!



You and 43 others like Robosoft Coordination Action.



**Facebook page  
(posts, discussions,  
events, news...)**

**Join us!**

**CA Coordinator**

**Cecilia Laschi, [cecilia.laschi@sssup.it](mailto:cecilia.laschi@sssup.it)**

**Scientific Secretariat and Management**

**Laura Margheri, [laura.margheri@sssup.it](mailto:laura.margheri@sssup.it)**



# Thanks

Research Centre on Marine Robotics,  
Livorno, Italy

## Soft Robotics Team:

- Paolo Dario
- Matteo Cianchetti
- Laura Margheri
- Marcello Calisti
- Francesco Giorgio-Serchi
- Maurizio Follador
- Michele Giorelli
- Federico Renda
- Andrea Arienti
- Serena Tricarico
- Mariangela Manti
- Vito Cacucciolo
- Francesco Corucci
- Yasmin Ansari
- Taimoor Shah

RoboSoft CA, ICT FET-Open

