RoboSoft CA
"A Coordination Action for Soft Robotics"

First Community Plenary Meeting
March 31 – April 1, 2014
Scuola Superiore Sant'Anna, Pisa, Italy

Image: Massimo Brega, The Lighthouse

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Scuola Superiore Sant'Anna

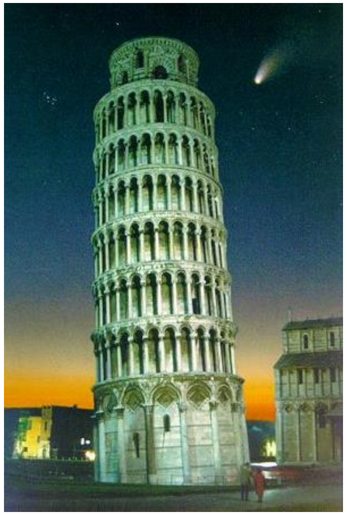
Welcome!

RoboSoft

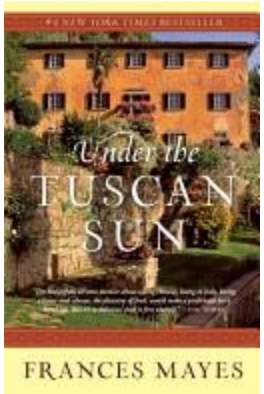
A Coordination Action for Soft Robotics
FP7, THEME ICT-2013.9.1 "Challenging current Thinking", **FET-Open**

Italy, Tuscany and Pisa in Europe

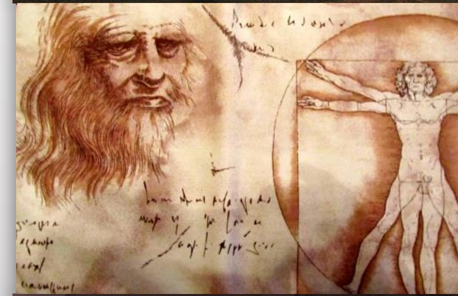
Pisa



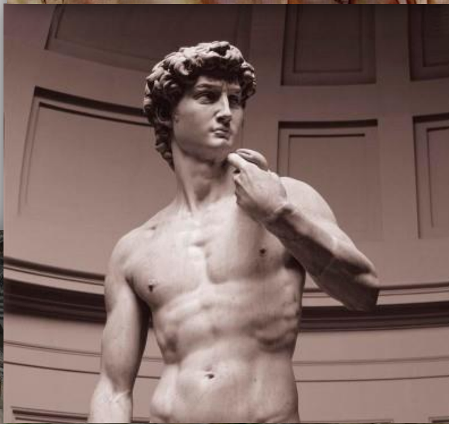
Firenze

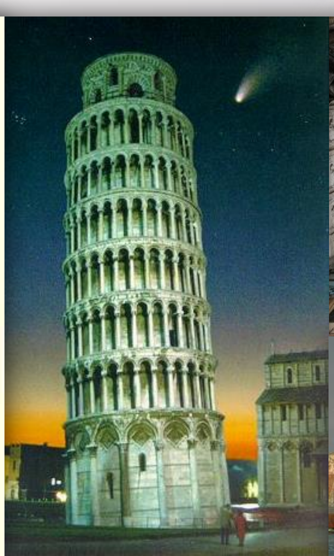


Tuscany, Italy



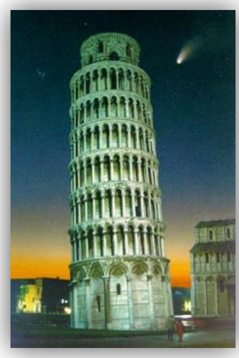
A Country and a region with an **extraordinary wealth of artistic and cultural heritage**, deep attention to preserving the **environment** and **social relations**, excellent climate, **good food** and a relaxed, friendly atmosphere favoring long and active life (**highest life expectancy in the world for males**: **80.4 years**; **second highest for women**: **84.9 years**)





Tuscany: the Land of Robot(ic)s

The University and Research System in Pisa



Sistema Universitario Pisano

SCUOLA NORMALE SUPERIORE PISA

Scuola Normale Superiore
Established 1810
150 professors
283 students

UNIVERSITÀ DI PISA

University of Pisa
Established in 1343
2.100 professors
50.000+ students

SCUOLA SUPERIORE SANT'ANNA PISA

Scuola Superiore Sant'Anna
Established in 1987
100 professors
220 students

CNR
National Research Council
15 Research Institutes
About 1.500 researchers

NEST

National Enterprise for nanoScience and nanoTechnology

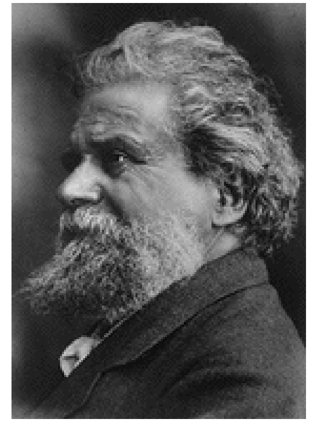
INFN

National Institute of Nuclear Physics
About 300 researchers

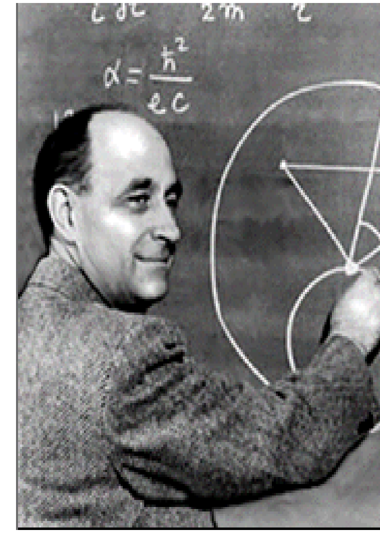
Eminent scientists and statesmen who studied and worked in Pisa

LEONARDO FIBONACCI
(1170 - 1250)
Mathematician

GALILEO GALILEI
(1564 - 1642)
Scientist, mathematician and philosopher



Giosuè Carducci
(1835 - 1907)
Nobel Prize in Literature 1906

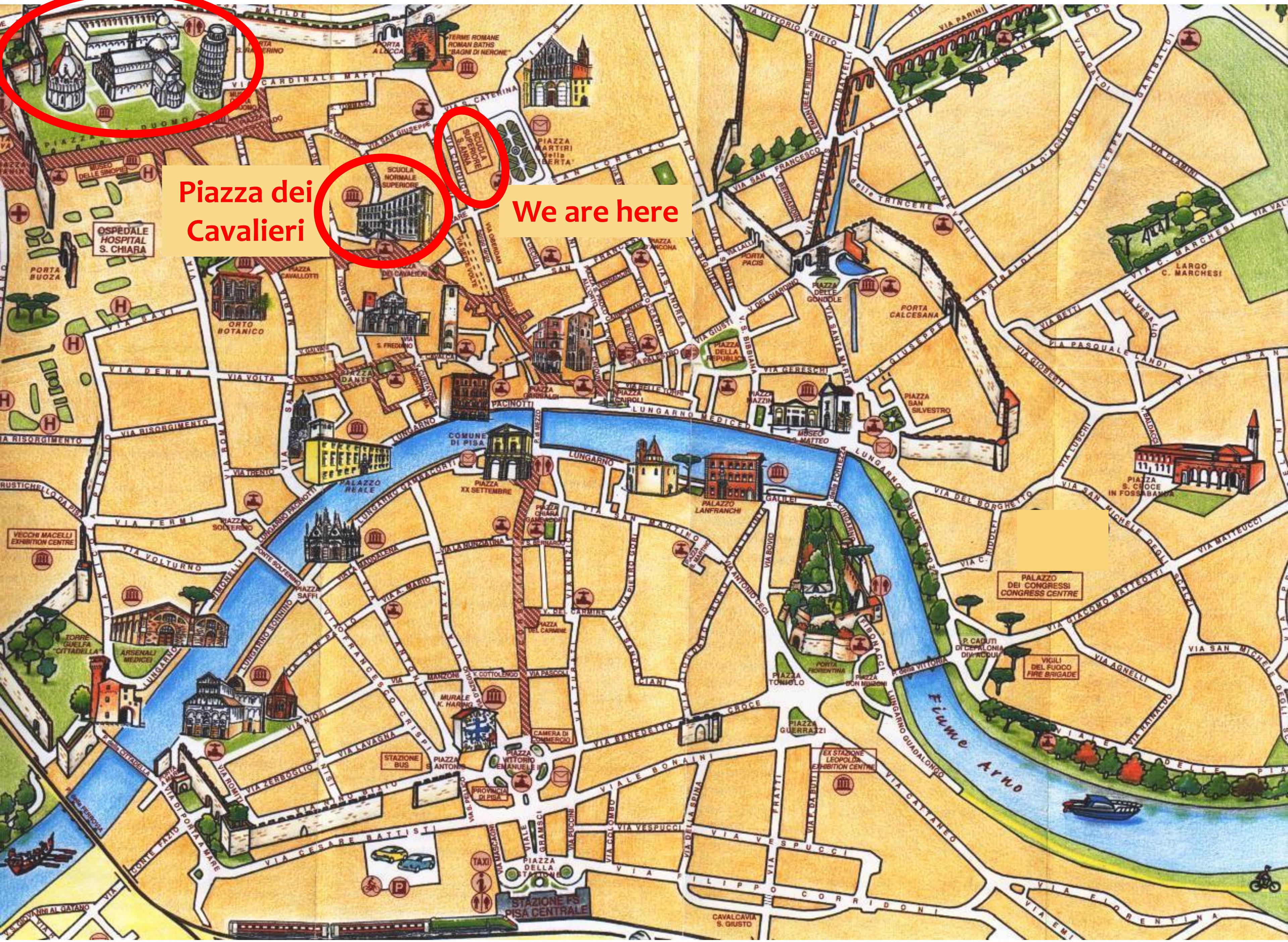


ENRICO FERMI
(1901 - 1954)
Physicist
Nobel Prize in Physics 1938

CARLO RUBBIA
(1934)
Physicist
Nobel Prize in Physics 1984

CARLO AZEGLIO CIAMPI
(1920)
President of the Italian Republic

ENRICO LETTA (1966)
Former Prime Minister of Italy



Piazza dei Cavalieri
We are here
SCUOLA NORMALE SUPERIORE
SCUOLA SUPERIORE S.ANNA
PIAZZA MARTIRI della LIBERTA'
TERME ROMANE ROMAN BATHS "BAGNI DI NERONE"
OSPEDALE HOSPITAL S. CHIARA
ORTO BOTANICO
PORTA BUOZA
MUSEO DELLE SINOPIE
VIA CARDINALE MAFFI
VIA DERNA
VIA VOLTA
VIA RISORGIMENTO
VIA FERMI
VIA VOLTURNO
VECCHI MACELLI EXHIBITION CENTRE
TORRE GUELFA "CITTADELLA"
ARSENALI MEDICEI
PALAZZO REALE
COMUNE DI PISA
PIAZZA XX SETTEMBRE
LUNGARNO
LUNGARNO MEDICEO
PALAZZO LANFRANCHI
MUSEO S. MATTEO
PIAZZA SAN SILVESTRO
PORTA CALCESANA
PIAZZA DELLE GONDOLE
PIAZZA DELLA REPUBBLICA
PIAZZA S. CROCE IN FOSSABANDA
LARGO C. MARCHESI
PALAZZO DEI CONGRESSI CONGRESS CENTRE
VIGILI DEL FUOCO FIRE BRIGADE
VIA SAN MICHELE
VIA MATTEUCCI
VIA GIACOMO MATTEOTTI
EX STAZIONE LEOPOLDA EXHIBITION CENTRE
PIAZZA GUERRAZZI
PIAZZA VITTORIO EMANUELE II
CAMERA DI COMMERCIO
STAZIONE BUS
PIAZZA S. ANTONIO
PROVINCIA DI PISA
PIAZZA DELLA STAZIONE
STAZIONE FS PISA CENTRALE
VIA CESARE BATTISTI
VIA FILIPPO CORRIDONI
VIA VESPUCCI
VIA FIORENTINA
CAVALCAVIA S. GIUSTO
VIA CATTANEO
LUNGARNO GUADALONGO
Fiume Arno
TAXI
VIA BONAINI
VIALE BONAINI
VIA BENEDETTO CROCE
PIAZZA TONIOLO
PORTA FIORENTINA
VIA SAN MARTINO
PIAZZA SOLFERINO
PIAZZA SAFFI
PIAZZA DANTE
S. FREDIANO
PIAZZA CAVALLOTTI
PIAZZA CAIROLI
PIAZZA GARIBALDI
PACINOTTI
PIAZZA DEL CARMINE
MURALE K. HARING
VIA VITTORIO VENETO
VIA PARINI
VIA SAN FRANCESCO
VIA DELLE TRINCERE
VIA SAN LORENZO
PORTA PACIS
VIA GIUSEPPE GARIBALDI
VIA PASQUALE LANDI
PIAZZA MAZZINI

Introduction to Soft Robotics and RoboSoft CA


Image: Massimo Brega, The Lighthouse

Cecilia Laschi

RoboSoft CA Coordinator

The BioRobotics Institute

Scuola Superiore Sant'Anna

First Community Plenary Meeting

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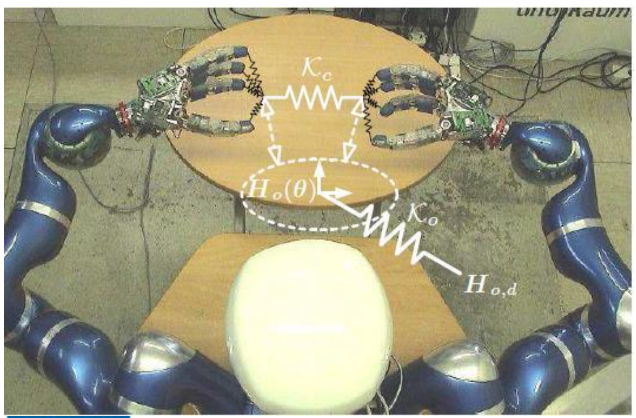
Why RoboSoft?

* Soft Robotics is a young emerging area of research and technological development
* Soft Robotics stems from robotics, from one side, and AI, from another side
* Soft Robotics is at the merge of many disciplines and technologies
* Soft Robotics state of the art is increasingly rich, not only with bioinspired solutions, and applications are coming in many fields
* The Soft Robotics community is growing and active, and needs coordination to synergise and consolidate

Soft Robotics: a working definition

Variable impedance actuators and stiffness control

* Highly flexible (hyper-redundant or continuum) robots
* High number of tigid links, multi-axis joints



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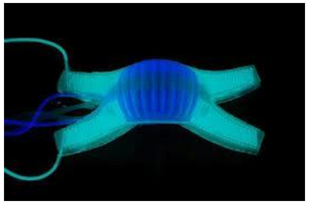
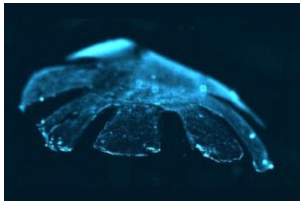
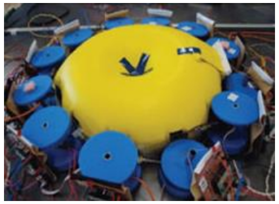
IEEE Robotics and Automation Magazine, Special Issue on Soft Robotics, 2008

Use of soft materials in robotics

* Robots made of soft materials that undergo high deformations in interaction
* Soft actuators and soft components
* Control partially embedded in the robot morphology and mechanical properties







Soft Robotics stems from robotics, from one side…

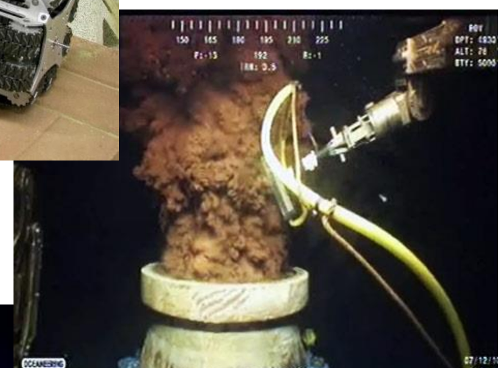
Robotics

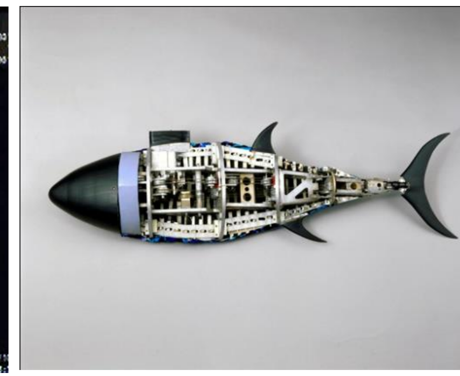
From industrial to service robotics

Robots outside factories…
…having to operate in the real world, they need to manage uncertainties and to react to changes in the environment

Rescue

Biological systems represent an excellent source of inspiration





Underwater

Space

- **Unstructured environment**
- Perception
- Reactive behaviour
- Shared workspace with human beings

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Soft Robotics stems from robotics, from one side…

Robotics

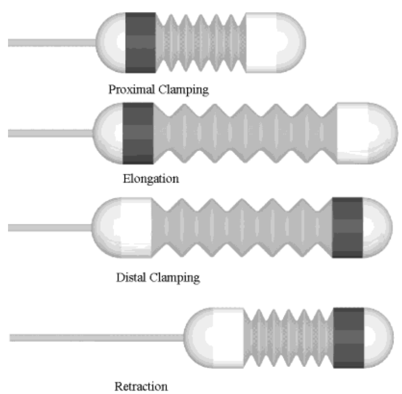
From industrial to service robotics

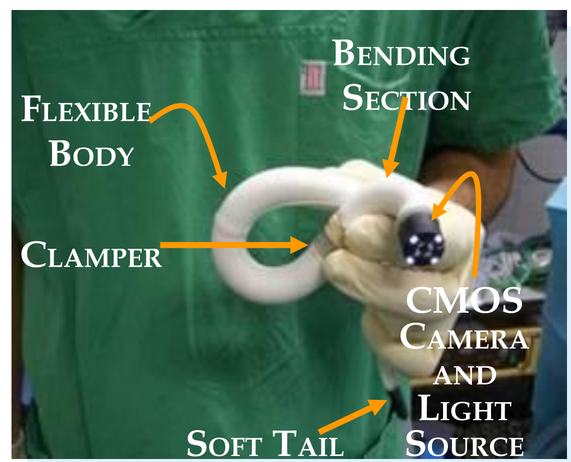
Soft robotics

Bioinspired soft robots

Soft robot inspired to the biomechanics of *Manduca sexta*

Saunders, F., Trimmer, B.A. and Rife, R. (2011) Modeling Locomotion of a Soft Bodied Arthropod Using Inverse-Dynamics. Bioinspiration & Biomimetics 6 (1)





Inchworm-like locomotion, for a flexible endoscope

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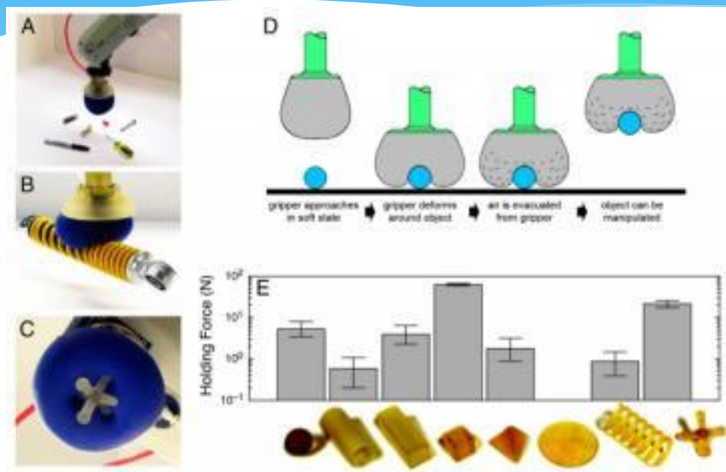
M.C. Carrozza; A. Arena; D. Accoto; A. Menciassi; P. Dario, (2003) A SMA-Actuated Miniature Pressure Regulator for a Miniature Robot for Colonoscopy, *Sensors and Actuators. A, Physical* - 105 : 119:131

Examples of state-of-the-art soft robots

Non-biomimetic approaches



Universal robotic gripper based on the jamming of granular material (Corneill University)

Brown, E., Rodenberg, N., Amend, J., Mozeika, A., Steltz, E., Zakin, M., Lipson, H., Jaeger, H. (2010) "Universal robotic gripper based on the jamming of granular material," *Proceedings of the National Academy of Sciences (PNAS)*, Vol. 107, no. 44, pp.18809-18814.

Jamming robot (iRobot)

Steltz, E.; Mozeika, A.; Rodenberg, N.; Brown, E.; Jaeger, H.M.; “JSEL: Jamming Skin Enabled Locomotion”, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2009)*, St. Louis, MO, USA, October 11-15, 2009

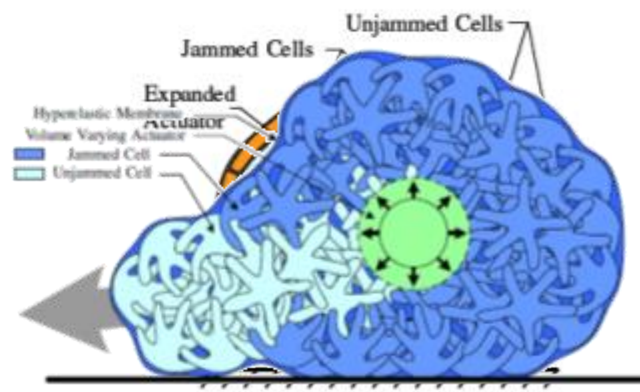


Fig. 2. Side view of proposed jamming based soft robot, 3 cells unjammed, internal actuator inflated partially.

Soft Robotics stems from robotics, from one side, and AI, from another side

Robotics

From industrial to service robotics

→

Soft robotics

Embodied Intelligence or Morphological Computation: the modern view of Artificial Intelligence

Any cognitive activity arises from the ***interaction*** between the body, the brain and the environment (embodiment).

Adaptive behaviour is not just control and computation, but it emerges from the complex and dynamic interaction between the morphology of the body, sensory-motor control, and environment (Embodied Intelligence).

=> A new, soft, bodyware is needed

Modern approach

The focus is on interaction with the environment. Cognition is emergent from system-environment interaction

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Rolf Pfeifer and Josh C. Bongard, *How the body shapes the way we think: a new view of intelligence*, The MIT Press, Cambridge, MA, 2007

A biomimetic soft robot with embodied intelligence

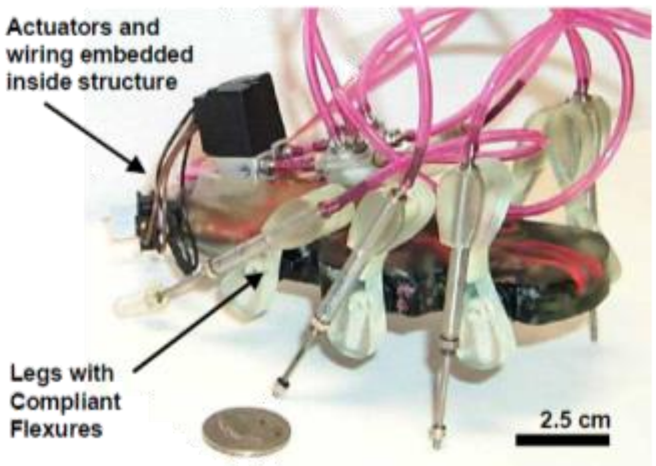
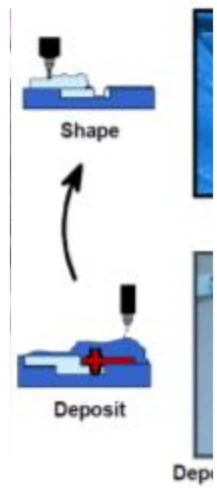


Figure 1. "Sprawlita", a dynamically-stable running hexapod based on functional principles from biomechanical studies of the cockroach. The prototype was fabricated using Shape Deposition Manufacturing and is capable of speeds of approximately 3 body-lengths per second.



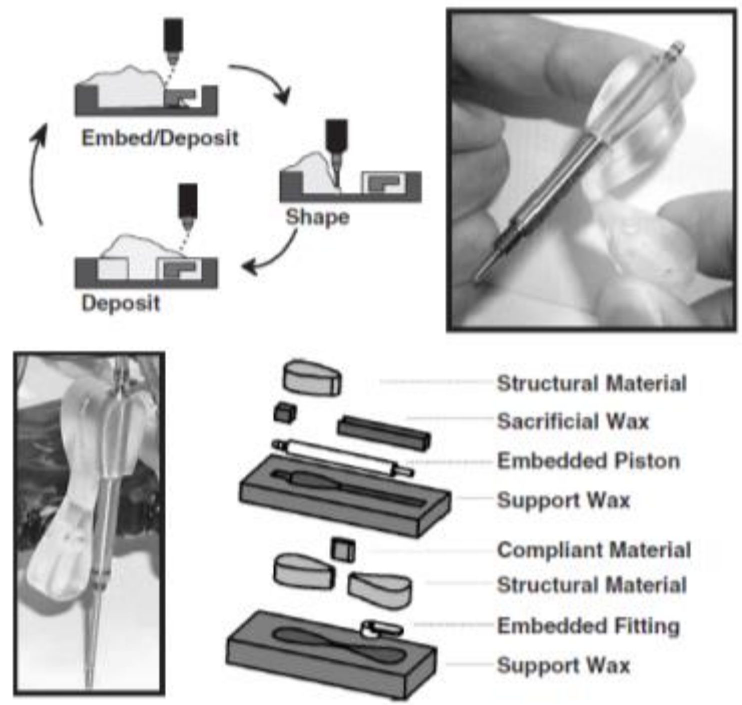


Fig. 7. Process plan for the robot legs. The figure shows the alternating layers of hard and soft material and embedded components used to make the compliant legs.

Shape Depo-
Ianufacturing
ısists of alter-
:les of mate-
osition and
'he hexapod's
l wiring were
inside the
f the body. As
the figure,
first placed in
l geometry of
us step, and
ıed by depos-
erial in the

J.G. Cham, S.A. Bailey, J.E. Clark, R.J. Full, M.R. Cutkosky, "Fast and Robust: Hexapedal Robots via Shape Deposition Manufacturing", *The International Journal of Robotics Research*, Vol. 21, No. 10–11, 2002, pp. 869-882.

Soft Robotics stems from robotics, from one side and AI, from another side

Soft Robotics at the convergence of Robotics and AI

Robotics

From industrial to service robotics

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

Soft robotics is going to stand as a **novel approach to robotics and artificial intelligence**, and it has the potential to produce a new generation of robots, in the support of humans in our natural environments.

Artificial Intelligence

From central processing to Morphological Computation

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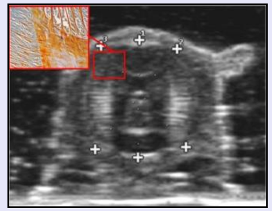
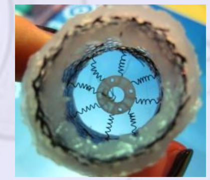
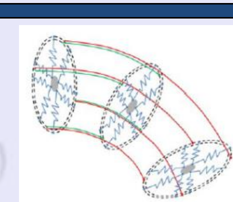
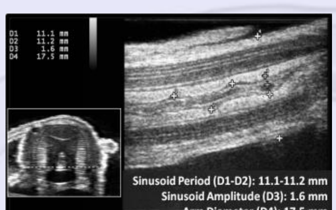
Soft Robotics is at the merge of many disciplines and technologies

From biology to robotics

L. Margheri, C. Laschi, B. Mazzolai, "Soft robotic arm inspired by the octopus. I. From biological functions to artificial requirements", *Bioinspiration & Biomimetics*, Vol.7, No.2, June 2012.
B. Mazzolai, L. Margheri, M. Cianchetti, P. Dario, C. Laschi, "Soft robotic arm inspired by the octopus. II. From artificial requirements to innovative technological solutions", *Bioinspiration & Biomimetics*, Vol.7, No.2, June 2012.

From biology to robotics

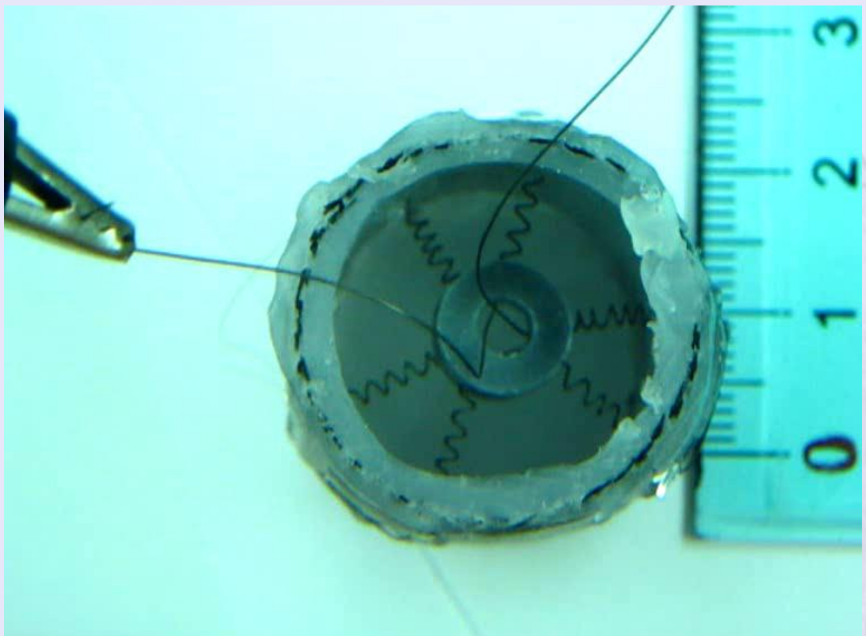
		Biological Specification (*Octopus vulgaris*)			Robotic Solution and Performance	
Transverse Muscles	Design Arrangement					Patent pending
	Mechanical performance	70% of arms mean elongation corresponding to 23% of diameter reduction			Input to model for the design of the SMA: · NiTi Alloy mechanical properties · Wire diameter · Average spring diameter · Number of coils · Heat treatments	
Longitudinal Muscles	Design Arrangement					
	Mechanical performance	**Max Pulling Force**	**Mean Pulling Force**	**Time**	· Longitudinal cables · sheaths to reduce friction and avoid silicon damages · Calibration parameters (*t*, *F*)	
		49.8N @ 400mm (m=1600g) 26.8 @ 200mm (m=476g)	40 N with arm length 400mm (~100g)	1-2 sec.		
Grasp Point Position		0.75 of total arm length			End effector position and active arm length	
Nerve Cord Arrangement	Design Arrangement		Sinusoidal arrangement at the arm rest length while has a distension during the elongation		Wire sinusoidal arrangement 	

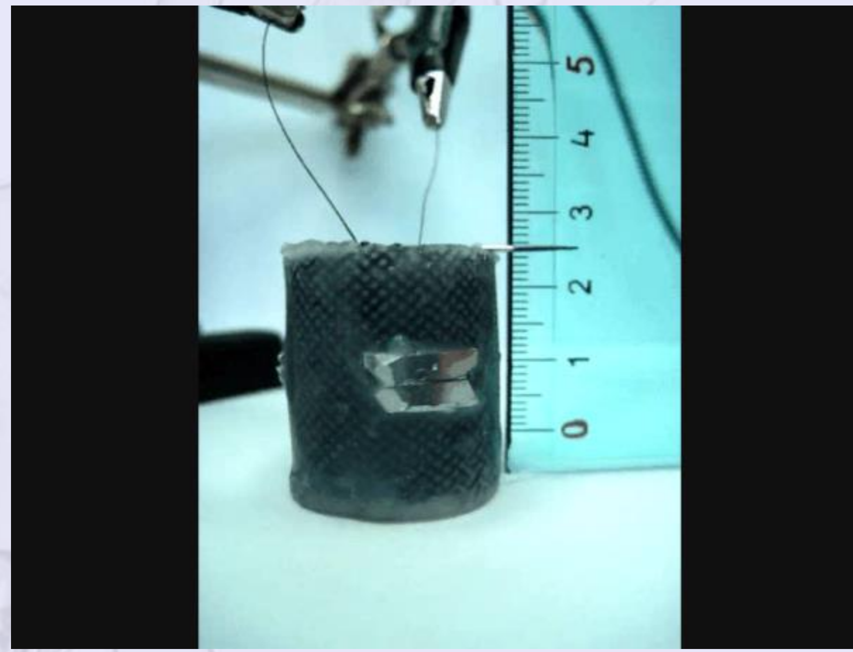
OCTOPUS

Soft Robotics is at the merge of many disciplines and technologies: **soft actuators**

Development of the soft actuator for transverse contraction

1 second of 600 mA direct current and then 50% duty cycle pulse current





6 SMA springs:
- 0.2 mm Flexinol® wire diameter
- <D>/d = 6 (cycle life parameter)
- Spring internal diameter = 1 mm

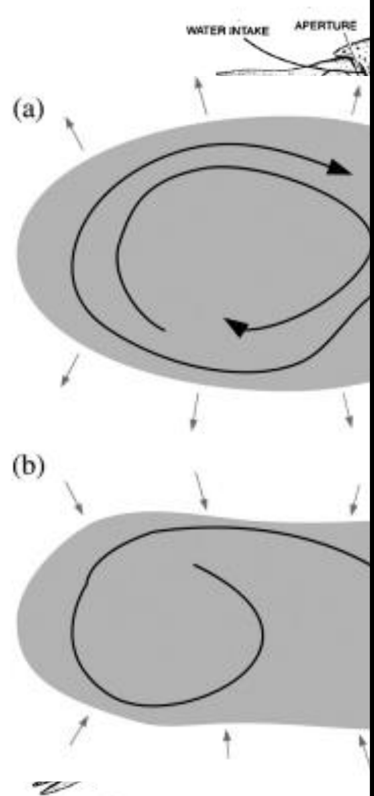
Silicone / braided sleeve:
- External diameter = 28mm
- Internal diameter = 20mm

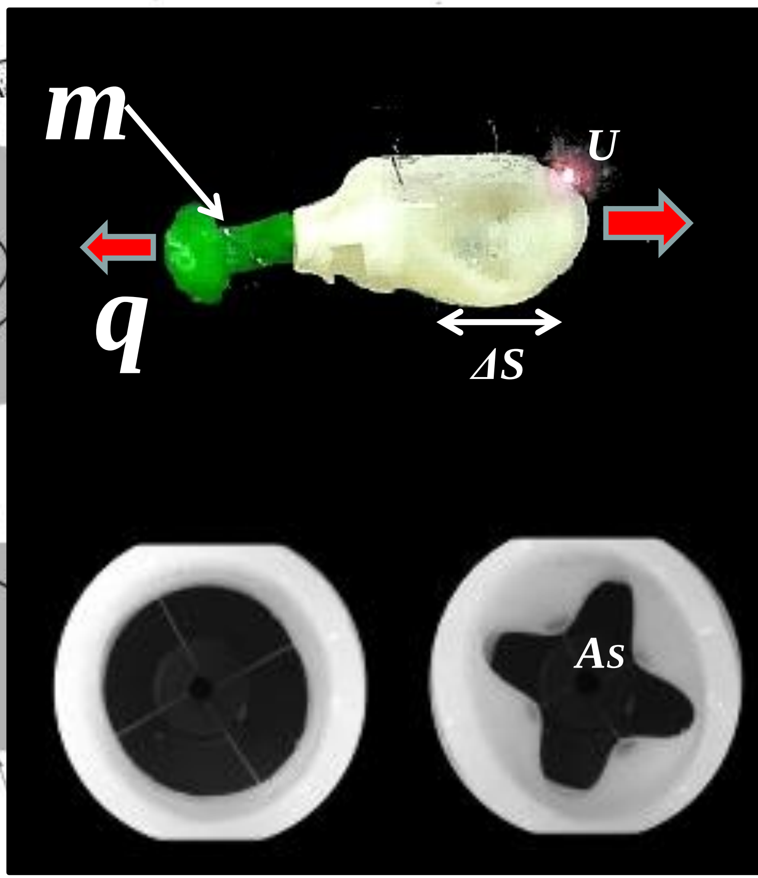
OCTOPUS

Soft Robotics is at the merge of many disciplines and technologies: **fluido-dynamics**

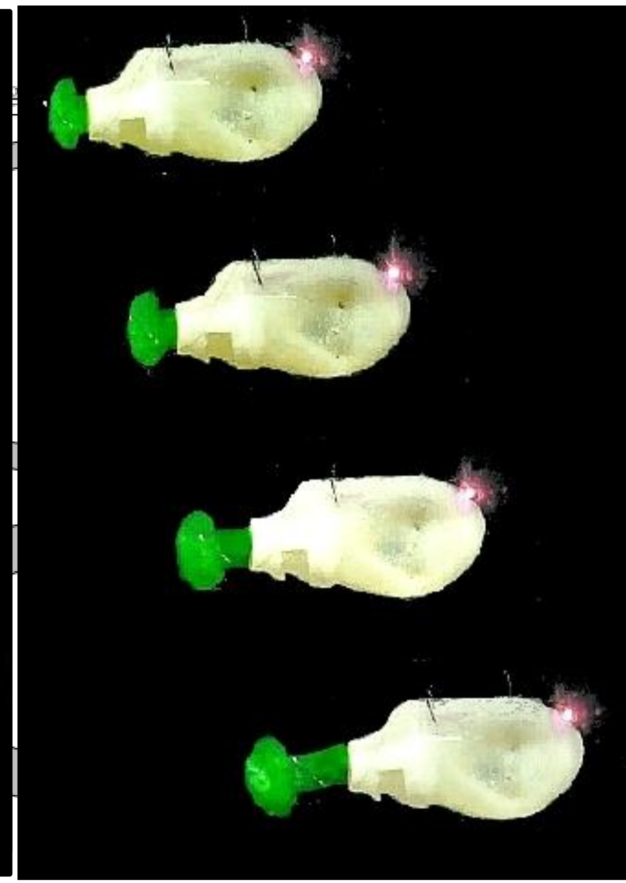
Pulsed-jet propulsion in cephalopods

How does a cephalopod swim?





How do we translate this into a soft robot?



Giorgio Serchi F., Arienti A. and Laschi C. (2013) “Biomimetic Vortex Propulsion: Toward the New Paradigm of Soft Unmanned Underwater Vehicles”, *IEEE/ASME Transactions on Mechatronics*, 18(**2**), pp. 484-493

Soft Robotics is at the merge of many disciplines and technologies

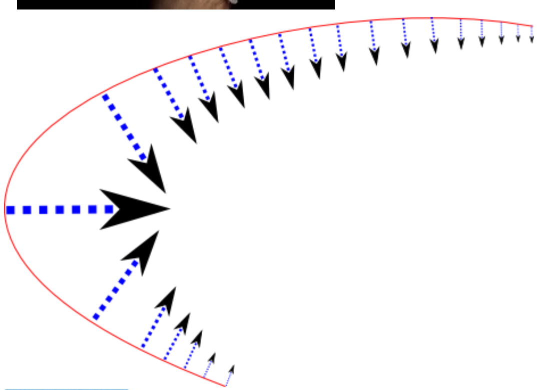
Modelling and control

RoboSoft

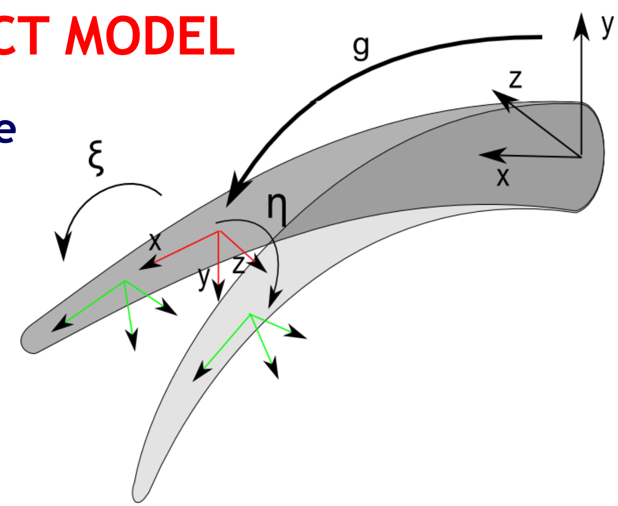
CABLES TENSION function of time → ROBOT CONFIGURATION parameterized by the curvilinear abscissa X and time t

FORWARD DYNAMICS with a:

COSSERAT GEOMETRICALLY EXACT MODEL



- **The cables are embedded inside the body of the soft robot**
- **They exert a load proportional to the cable tension and to the curvature and it is directed toward the centre of the curvature**



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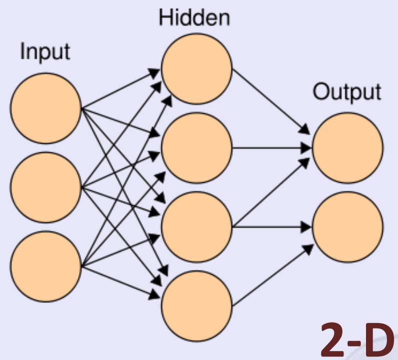
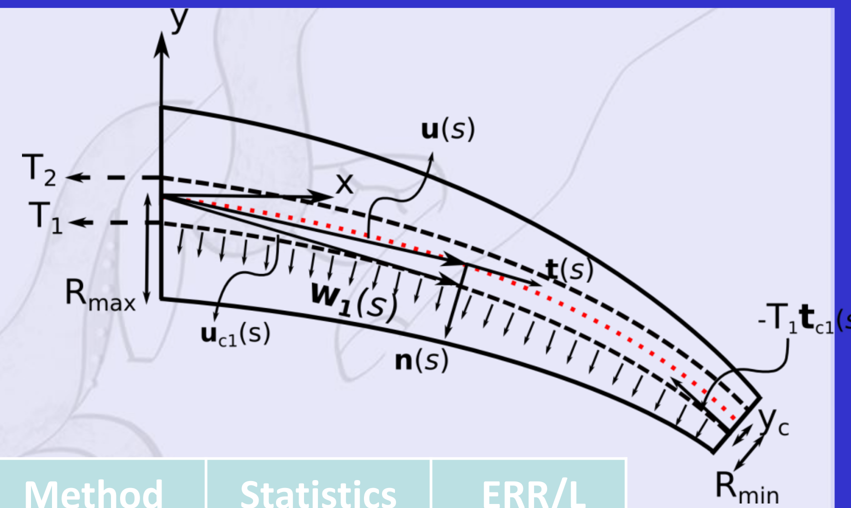
F. Renda, M. Cianchetti, M. Giorelli, A. Arienti, C. Laschi, "A 3D Steady State Model of a Tendon-Driven Continuum Soft Manipulator Inspired by Octopus Arm", *Bioinspiration & Biomimetics*, Vol.7, No.2, June 2012.

Inverse Kinetics: Neural Networks (NN) or Jacobian Method (JM)?

Tip Position



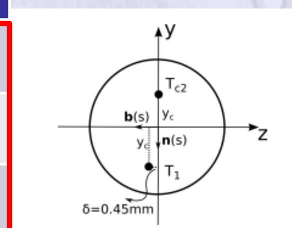
Cable Forces



2-D Space
2 Cables

Defective Model

Method (Cost)	Statistics Index	ERR/L [%]
JM (351ms)	Mean	1.30
	Std	0.55
	Max	2.62
NN (0.125ms)	Mean	0.75
	Std	0.68
	Max	3.51

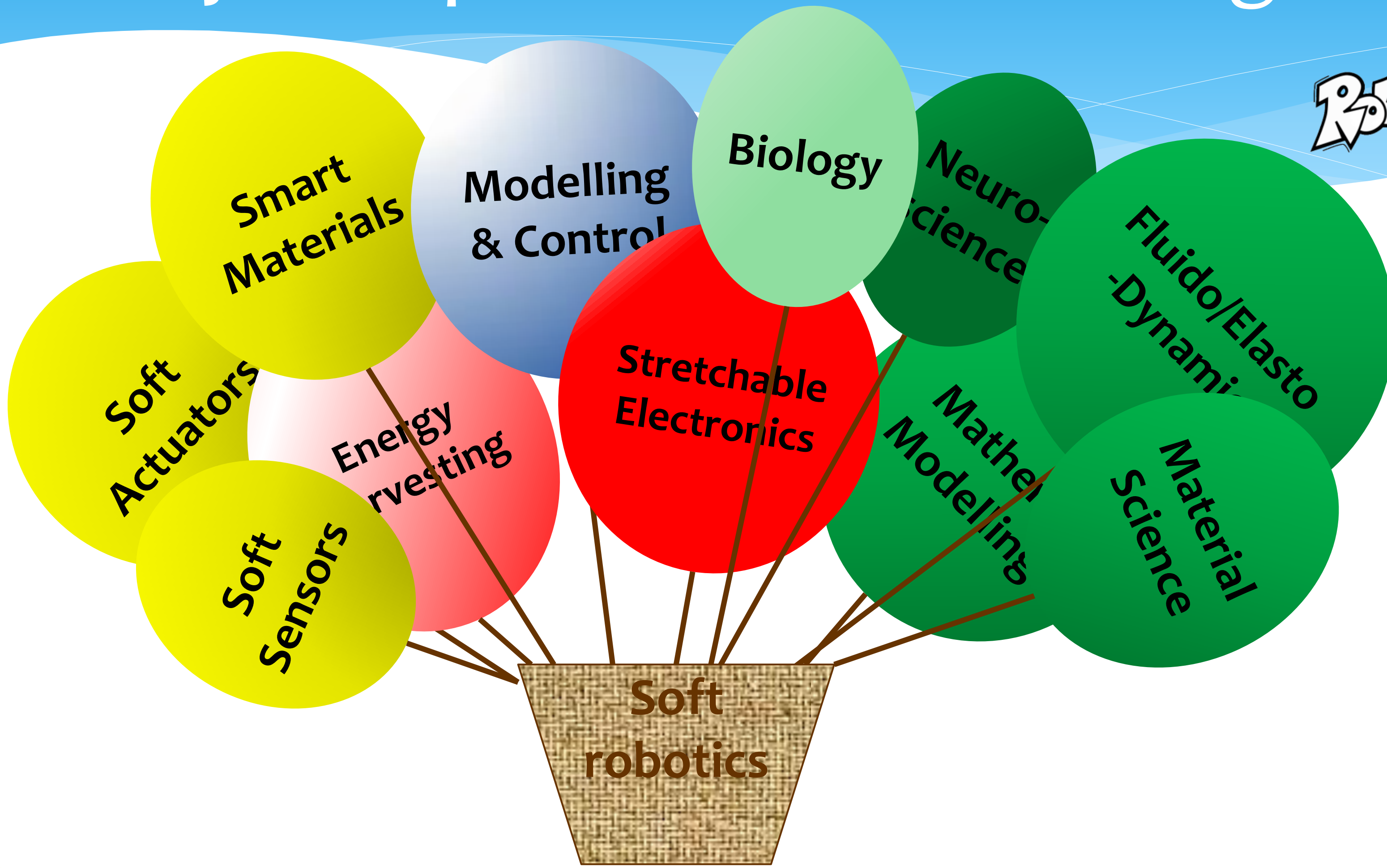


Method (Cost)	Statistics Index	ERR/L [%]
JM (351ms)	Mean	0.27
	Std	0.03
	Max	0.32
NN (0.125ms)	Mean	0.73
	Std	0.55
	Max	3.1

M Giorelli, F Renda, G Ferri, C Laschi, "A Feed-Forward Neural Network for Solving the Inverse Kinetics of Non-Constant Curvature Soft Manipulators Driven by Cables", *ASME Dynamical Systems and Control Conference*, October 21-23, Stanford University, Palo Alto, CA, USA, 2013

OCTOPUS

Soft Robotics is at the merge of many disciplines and technologies



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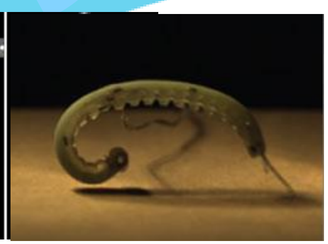
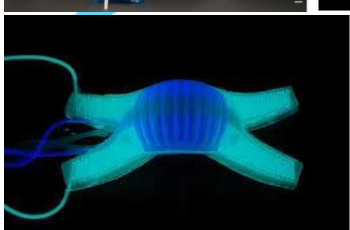
C. Laschi, M. Cianchetti, "Soft Robotics: New Perspectives for Robot Bodyware and Control", *Frontiers in Bioengineering and Biotechnology*, N.2 (2014)

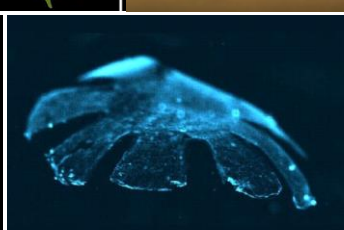
Soft Robotics applications

Biomedical applications: endoscopy, assistance to elderly and disabled people

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





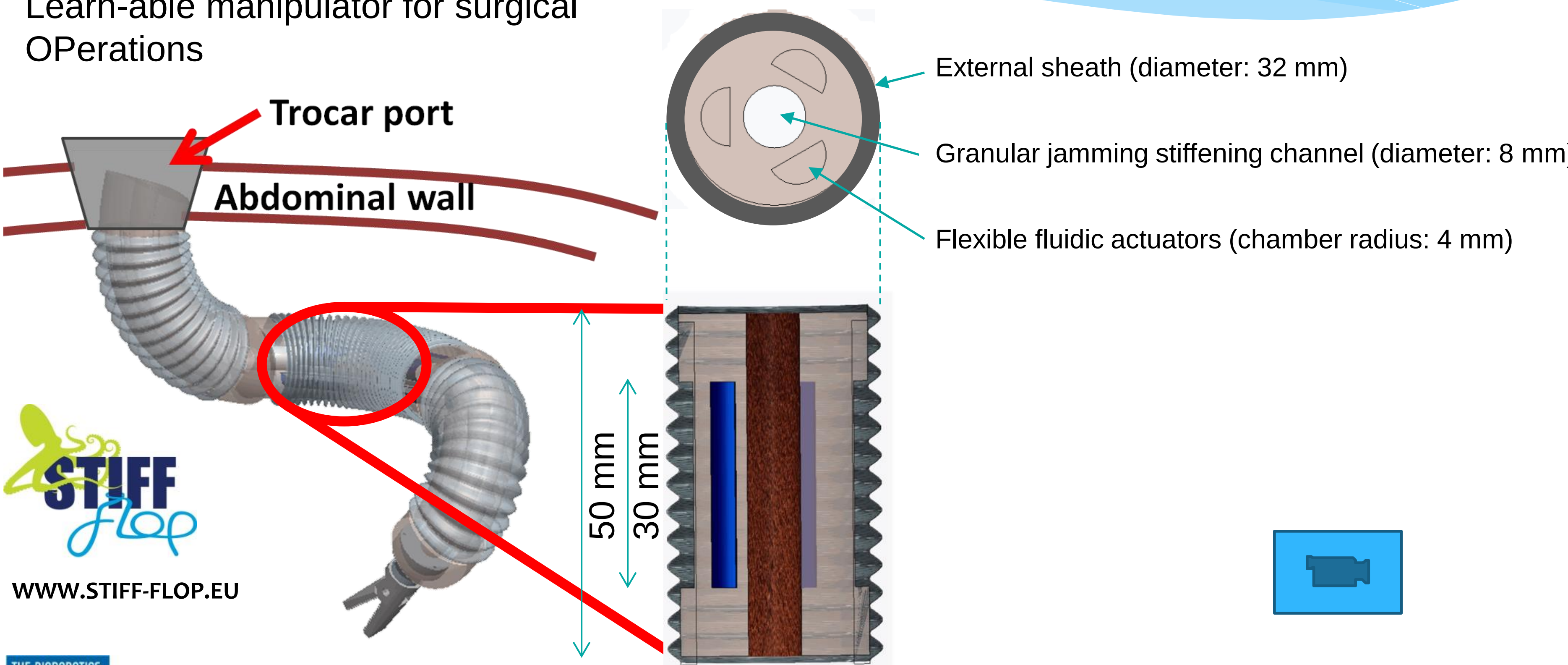


Application of OCTOPUS technologies in surgery

http://www.stiff-flop.eu/index.php/home

The STIFF-FLOP robotic manipulator

STIFFness controllable Flexible and Learn-able manipulator for surgical OPerations



WWW.STIFF-FLOP.EU

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Cianchetti M, Ranzani T, Gerboni G, De Falco I, Laschi C, Menciassi A (2013) "STIFF-FLOP Surgical Manipulator: mechanical design and experimental characterization of the single module", Conf Proc IEEE on Intelligent and Robotic Systems – IROS 2013, 3567-3581

Soft Robotics applications

Biomedical applications: endoscopy, assistance to elderly and disabled people

Realistic simulators of body parts

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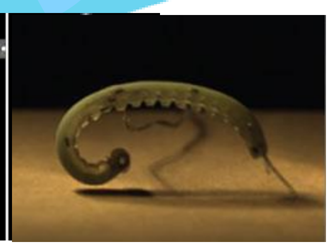
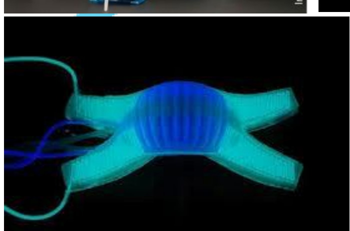
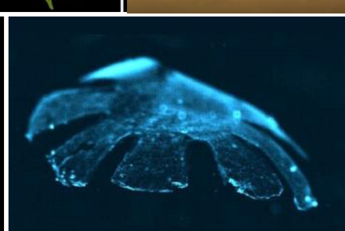
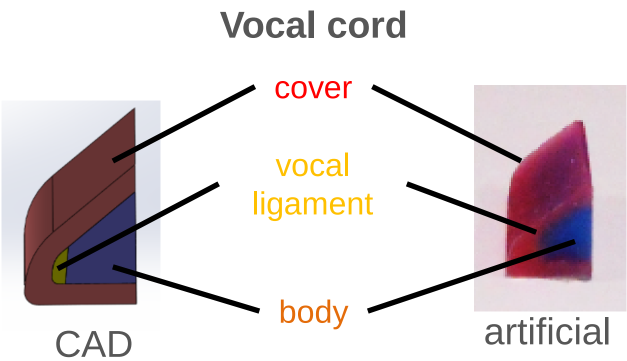




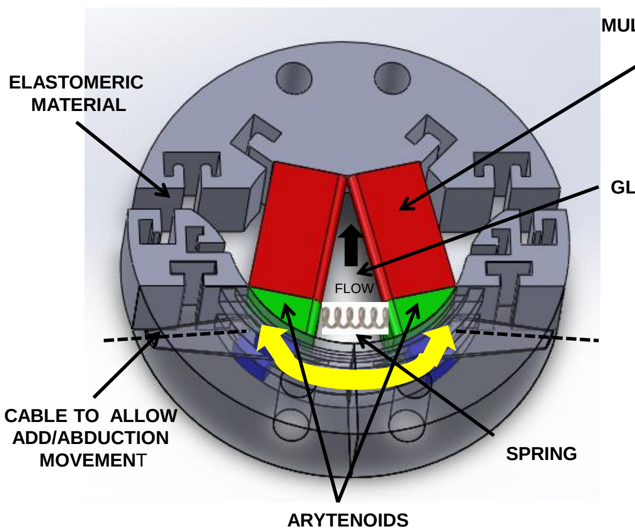


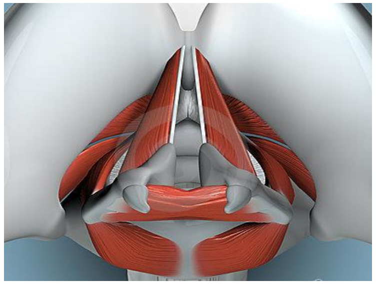
Realistic larynx simulator

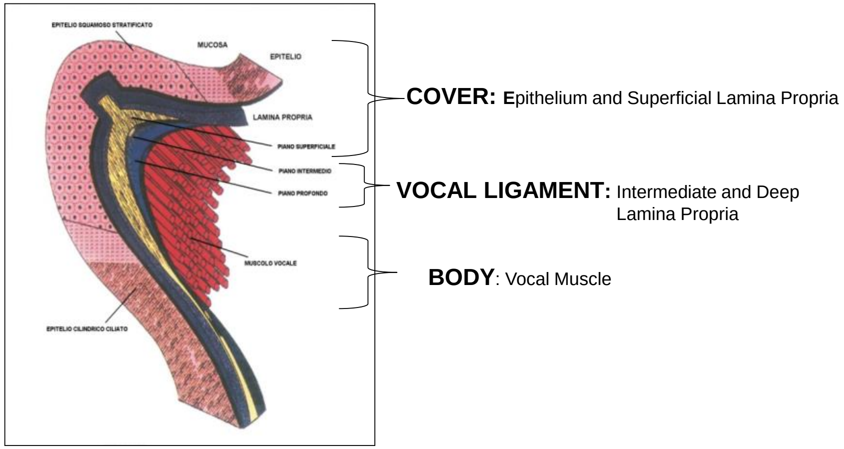
Artificial biomimetic device mimicking the principal functions of a larynx by replicating its **main structures and material properties**.

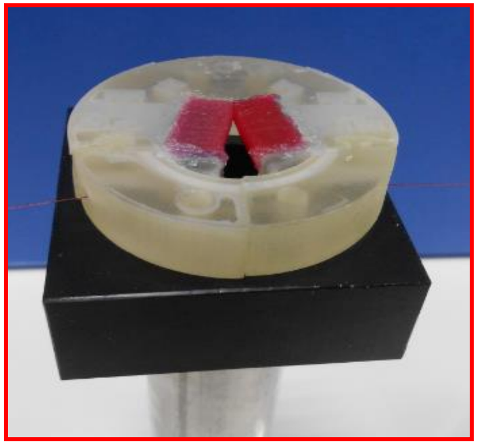


Anisotropic materials





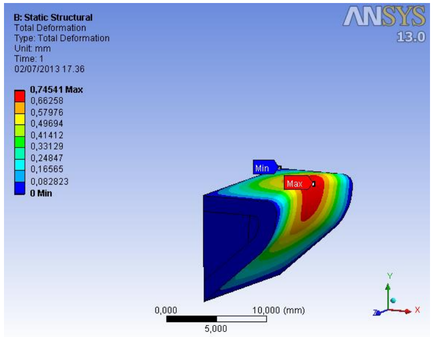




Electro- magneto- rheological fluids

Pneumatic actuation

Cable driven actuation system



In collaboration with University of Pisa, Cisanello Hospital, Prof. Ursino

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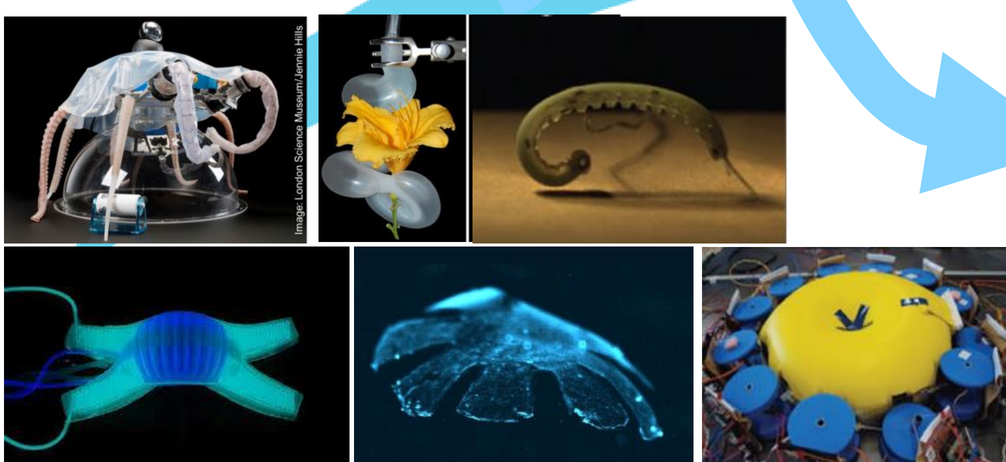
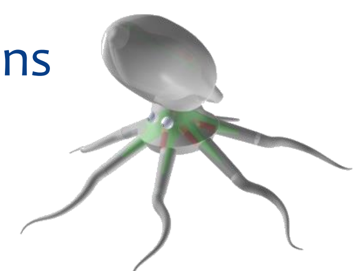


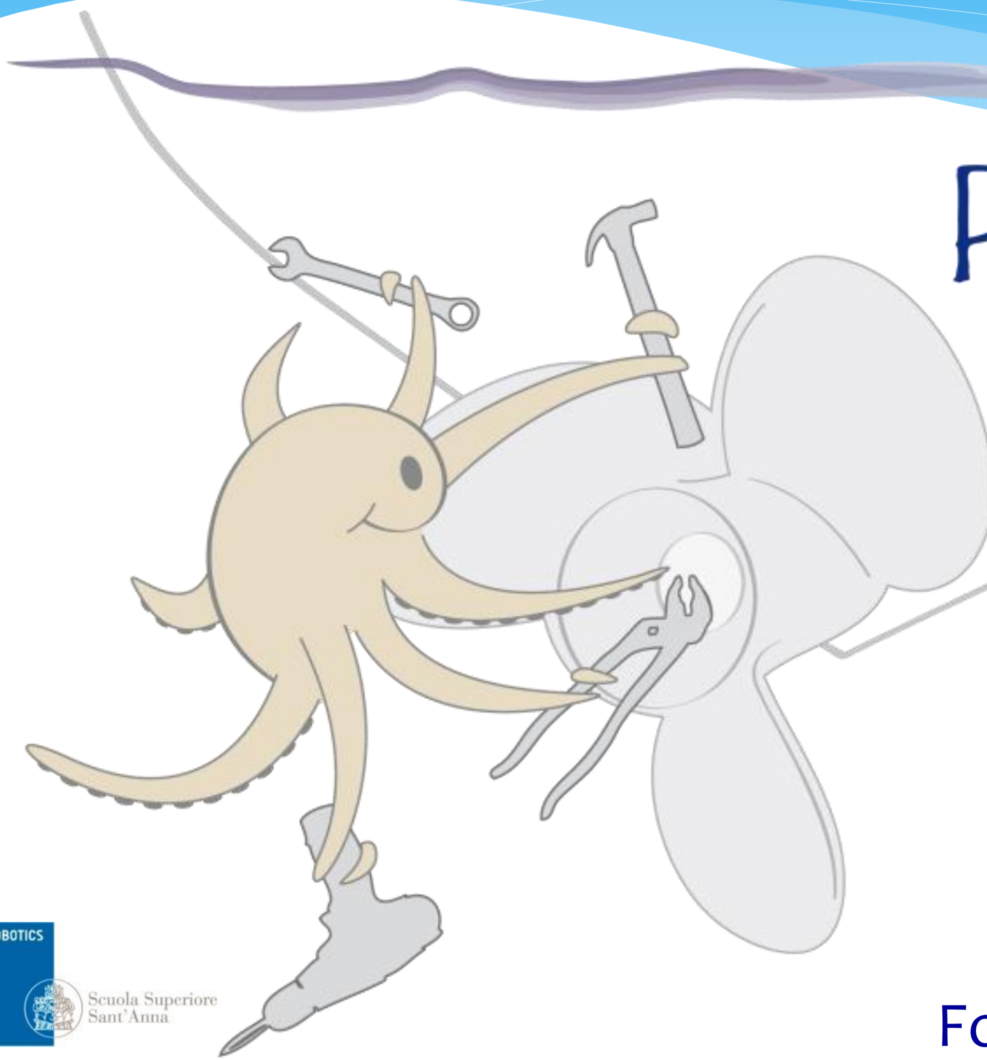
Marine applications



Soft Robotics for marine applications

RoboSoft

PoseiDrone



* Marine ‘soft’ robot
* Can operate in contact with the sea bottom or the manufacts to explore
* Locomotion and grasping capabilities

Fondazione Livorno, 2012 – 2015

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PoseiDRONE: a Soft Robot for a novel generation of Underwater Vehicles

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Fondazione Livorno, 2012 - 2015

Soft Robotics applications

Biomedical applications: endoscopy, assistance to elderly and disabled people

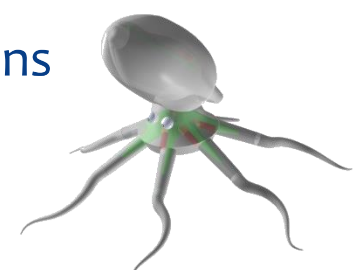
Realistic simulators of body parts

More to come!

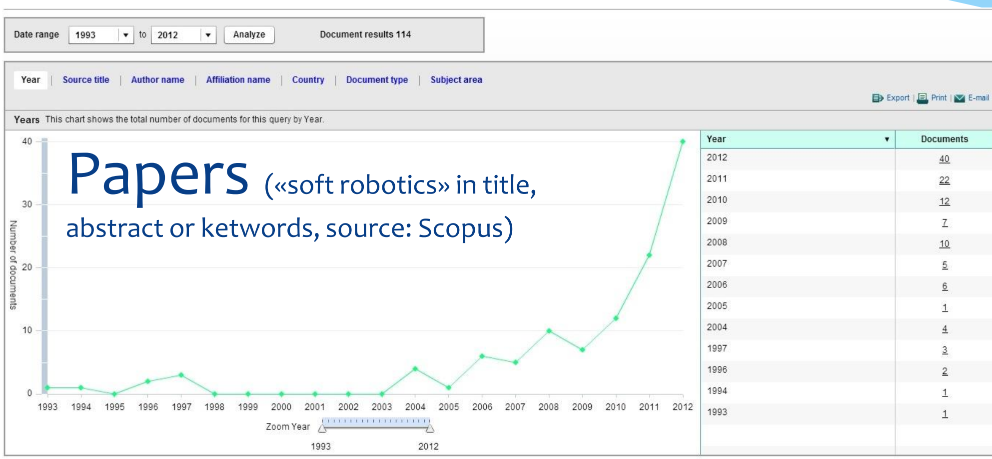
The initial challenge: can we build robots with soft materials?

Marine applications

Manufacturing, Agriculture

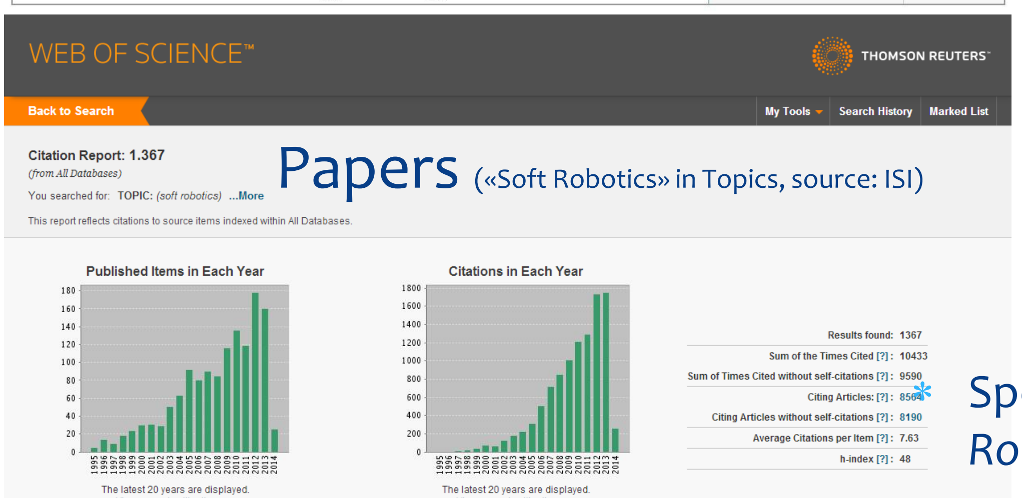


Soft Robotics: a growing research field at international level

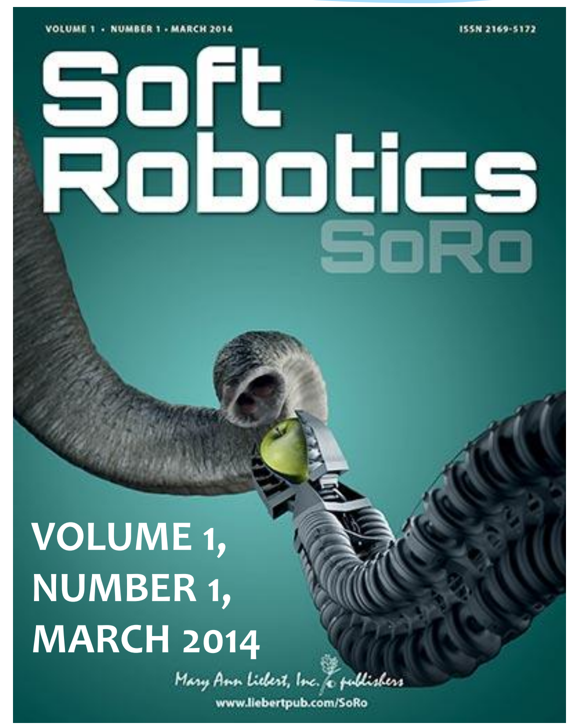


Year	Documents
2012	40
2011	22
2010	12
2009	7
2008	10
2007	5
2006	6
2005	1
2004	4
1997	3
1996	2
1994	1
1993	1

Papers («soft robotics» in title, abstract or ketwords, source: Scopus)



Papers («Soft Robotics» in Topics, source: ISI)



Editor-in-Chief: Barry A. Trimmer

* Special issue on "Soft Robotics" of *Advanced Robotics* 26(7), 2012
* Special issue on "Soft Robotics" of *Actuators*

Soft Robotics: a growing research field at international level

Events

- Swiss-Japan Joint Seminar on "Soft Robotics: Morphology, materials, and functionalities", University of Tokyo, June 20-23, 2010
- Special session on "Soft Robotics" at *FET11 conference*, Budapest, May 4-6, 2011
- Workshop at the IEEE International Conference on Advanced Robotics (ICAR 2011),
- Workshop at the IEEE International Conference of Robotics and Automation (ICRA 2011).
- Organized sessions on "Smart Materials and Actuators for Soft robotics", in *IEEE-RAS/EMBS International Conference on Biomedical Robotics* (BioRob2012), June 24-27, 2012
- 4 organized session on related topics at IEEE International Conference of Robotics and Automation (ICRA 2012).
- Organized sessions on "Soft Robotics" in *IEEE-RAS/EMBS International Conference on Biomedical Robotics* (BioRob2012), June 24-27, 2012
- ETH Summer School on "Soft Robotics", Zurich, Switzerland, 2012 & 2013
- IEEE IROS 2013 Workshop on "Soft Technologies for Wearable Robots"
- IEEE ICRA 2014 Workshop on "Soft and Stiffness-Controllable Robots for Minimally Invasive Surgery"
- International Workshop on "Soft Robotics and Morphological Computation", Monte Verità, Switzerland, July 14-19, 2013

Soft Robotics: a growing research field at international level

IEEE Robotics & Automation Society

- RAS TC on Soft Robotics
- Co-Chairs: Fumiya Iida, Cecilia Laschi, Akio Ishiguro, Robert Wood

IEEE

Soft Robotics
Activities
Contact
Join Us
Back to Technical Committees

Soft Robotics

http://www.softrobotics.ethz.ch

Scope:

There has been an increasing interest in the use of soft and deformable structures in the robotic systems. Soft and deformable structures are crucial in the systems that deal with uncertain and dynamic task-environments, e.g. grasping and manipulation of unknown objects, locomotion in rough terrains, and physical contacts with living cells and human bodies. Moreover the investigations on soft materials are also necessary for more visionary research topics such as self-repairing, growing, and self-replicating robots. Despite its importance and considerable demands, the field of Soft Robotics faces a number of fundamental scientific challenges: the studies of unconventional materials are

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

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.

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Objective ICT-2013.9.1 Challenging current thinking

RoboSoft

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 structure

EC

CA Coordinator — **Project Manager**

RoboSoft consortium

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ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

University of BRISTOL

Executive Board

- Chair: CA Coordinator (SSSA)
- One representative from ETH
- One representative from UOB

Advisory Board

Rolf Pfeifer (Chair), George Jeronimidis

Partners

- SSSA WP leader
- ETH WP leader
- UOB WP leader

Stakeholders and other scientific communities

RoboSoft community (*members*)

WG — WG — WG ······ WG

You ☺
22 members up to now

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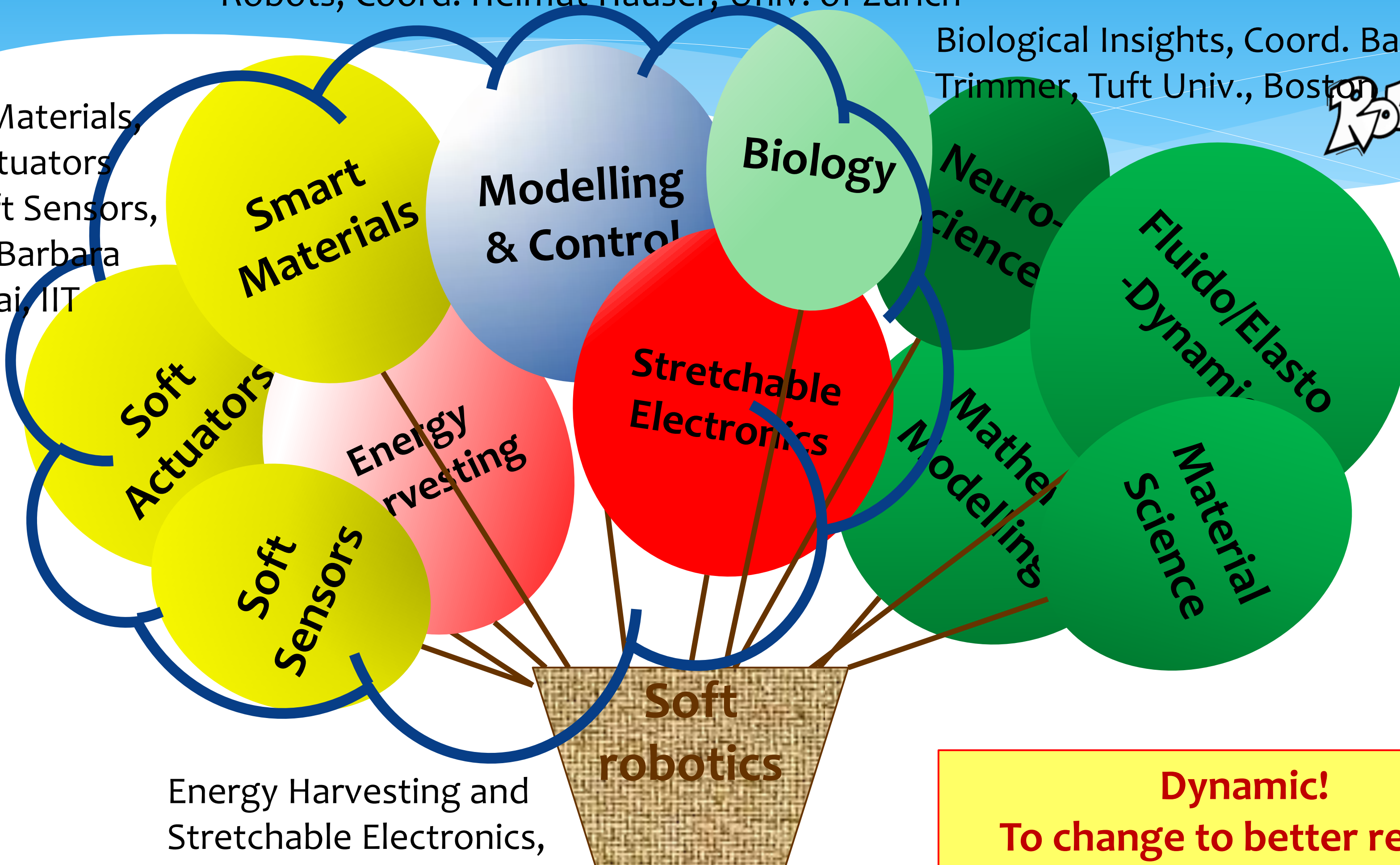
RoboSoft Working Groups (D2.2)

Control Architectures and Paradigms for Soft Robots, Coord. Helmut Hauser, Univ. of Zurich

Biological Insights, Coord. Barry Trimmer, Tuft Univ., Boston

Smart Materials, Soft Actuators and Soft Sensors, Coord. Barbara Mazzolai, IIT



Energy Harvesting and Stretchable Electronics, Coord. Jamie Paik, EPFL

Dynamic!
To change to better reflect scientific and technological progress and challenges

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RoboSoft community (D2.1)

Current list of community members

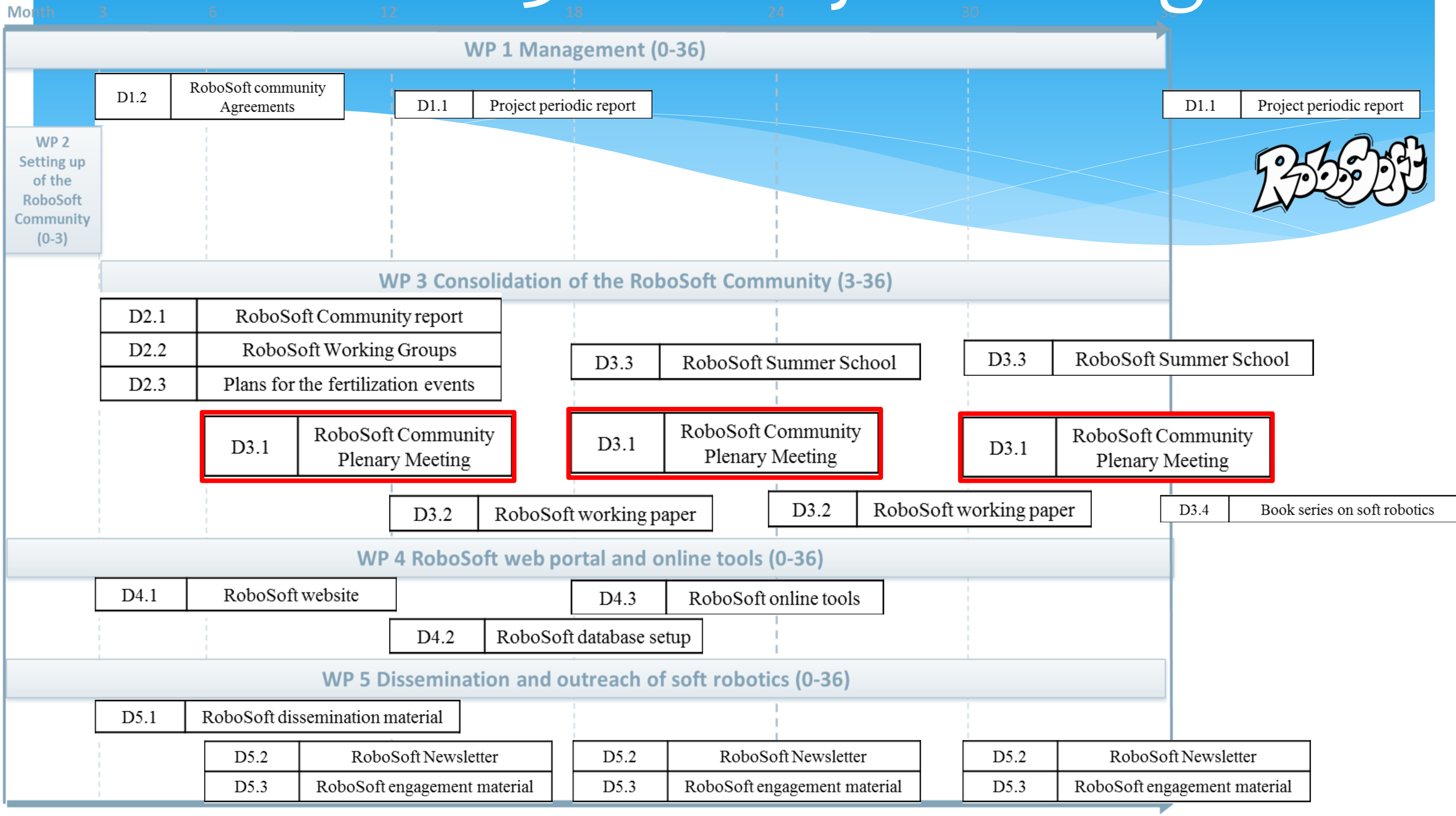
Total 22: 12 EU + 10 non-EU countries

* 2 Biological Insights
* 5 Control Architectures and Paradigms for Soft Robot
* 10 Smart Materials, Soft Actuators and Soft Sensors
* 4 Stretchable Electronics and Energy Harvesting

Institutions and key persons' list

#	Institution	Key Person	Tentative Working Group	Country
1	Hebrew University of Jerusalem	Benny Hochner	Biological insights	Israel
2	Tufts University	**Barry Trimmer**	Biological insights	USA
3	MIT	Daniela Rus	Control Architectures and Paradigms for Soft Robots	USA
4	Heron Robots	Fabio Bonsignorio	Control Architectures and Paradigms for Soft Robots	Italy
5	IRCCyN	Frederic Boyer	Control Architectures and Paradigms for Soft Robots	France
6	UZH - AI Lab	**Helmut Hauser**	Control Architectures and Paradigms for Soft Robots	Switzerland
7	University of Tsukuba - Flexible robotics Lab	Hiromi Mochiyama	Control Architectures and Paradigms for Soft Robots	Japan
8	Edinburgh University	Adam A. Stokes	Smart Materials, Soft Actuators and Soft Sensors	UK
9	IIT Center for Micro-BioRobotics	**Barbara Mazzolai**	Smart Materials, Soft Actuators and Soft Sensors	Italy
10	Tallin University, Centre for Biorobotics	Maarja Kruusmaa	Smart Materials, Soft Actuators and Soft Sensors	Estonia
11	TU Berlin	Oliver Brock	Smart Materials, Soft Actuators and Soft Sensors	Germany
12	Cornell University	Rob Shepherd	Smart Materials, Soft Actuators and Soft Sensors	USA
13	Seul National University	KyuJin Cho	Smart Materials, Soft Actuators and Soft Sensors	South Korea
14	Soft Materials Research Laboratory, UCLA	Qibing Pei	Smart Materials, Soft Actuators and Soft Sensors	USA
15	Osaka University	Koh Hosoda	Smart Materials, Soft Actuators and Soft Sensors	Japan
16	EPFL - Laboratory of Intelligent Systems	Dario Floreano	Smart Materials, Soft Actuators and Soft Sensors	Switzerland
17	Carnegie Mellon University - The Robotics Institute	Yong-Lae Park	Smart Materials, Soft Actuators and Soft Sensors	USA
18	The Chinese University of Hong Kong	Michael Wang	Smart Materials, Soft Actuators and Soft Sensors	China
19	EPFL - Reconfigurable robotics laboratory	**Jaimie Paik**	Stretchable Electronics and Energy Harvesting	Switzerland
20	University of Tokyo	Takao Someya	Stretchable Electronics and Energy Harvesting	Japan
21	Fraunhofer IZM	Thomas Löher	Stretchable Electronics and Energy Harvesting	Germany
22	Vrije Universiteit Brussel	Francis Berghmans	Stretchable Electronics and Energy Harvesting	Belgium

Events: 3 Plenary Meetings



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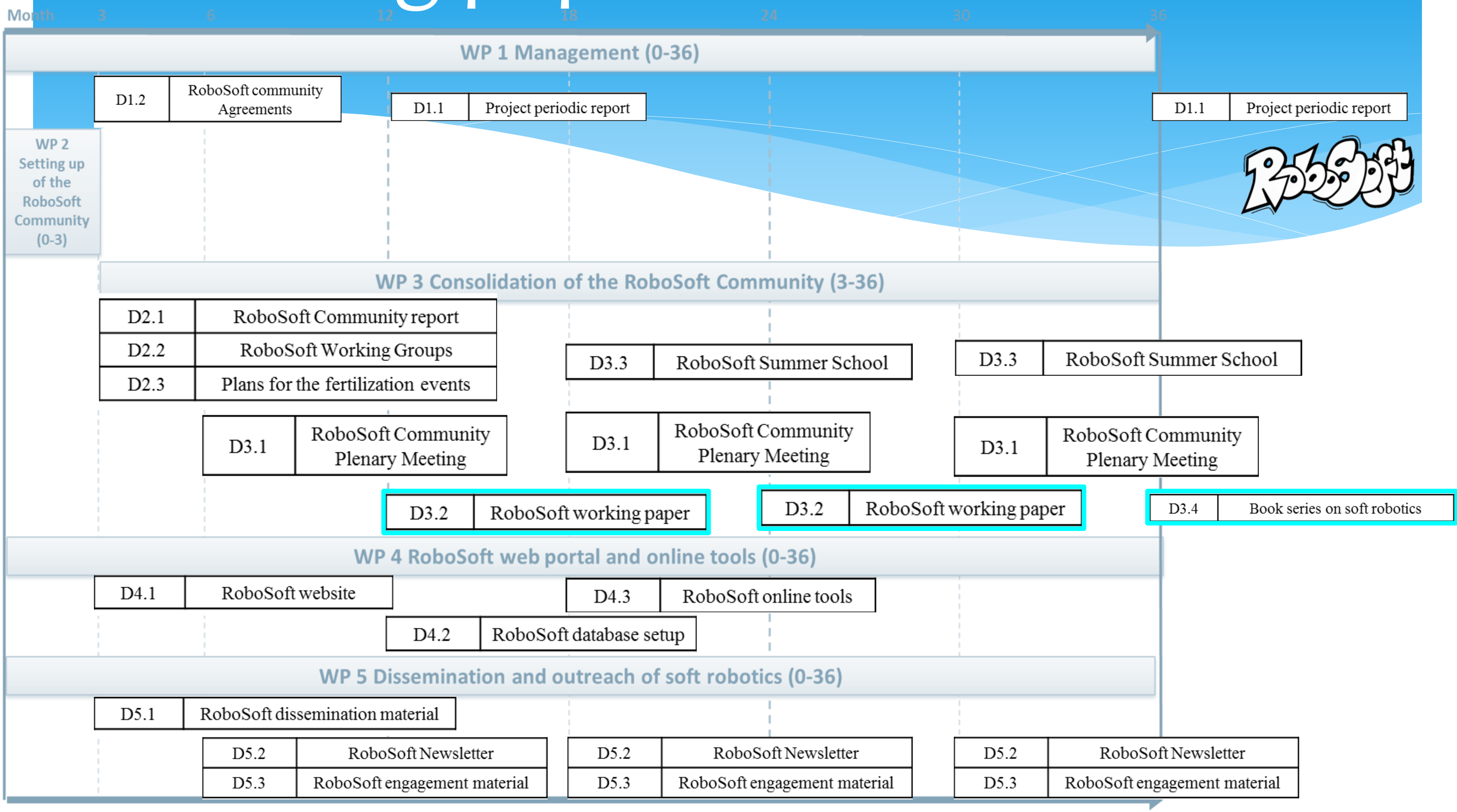
Working papers and book series



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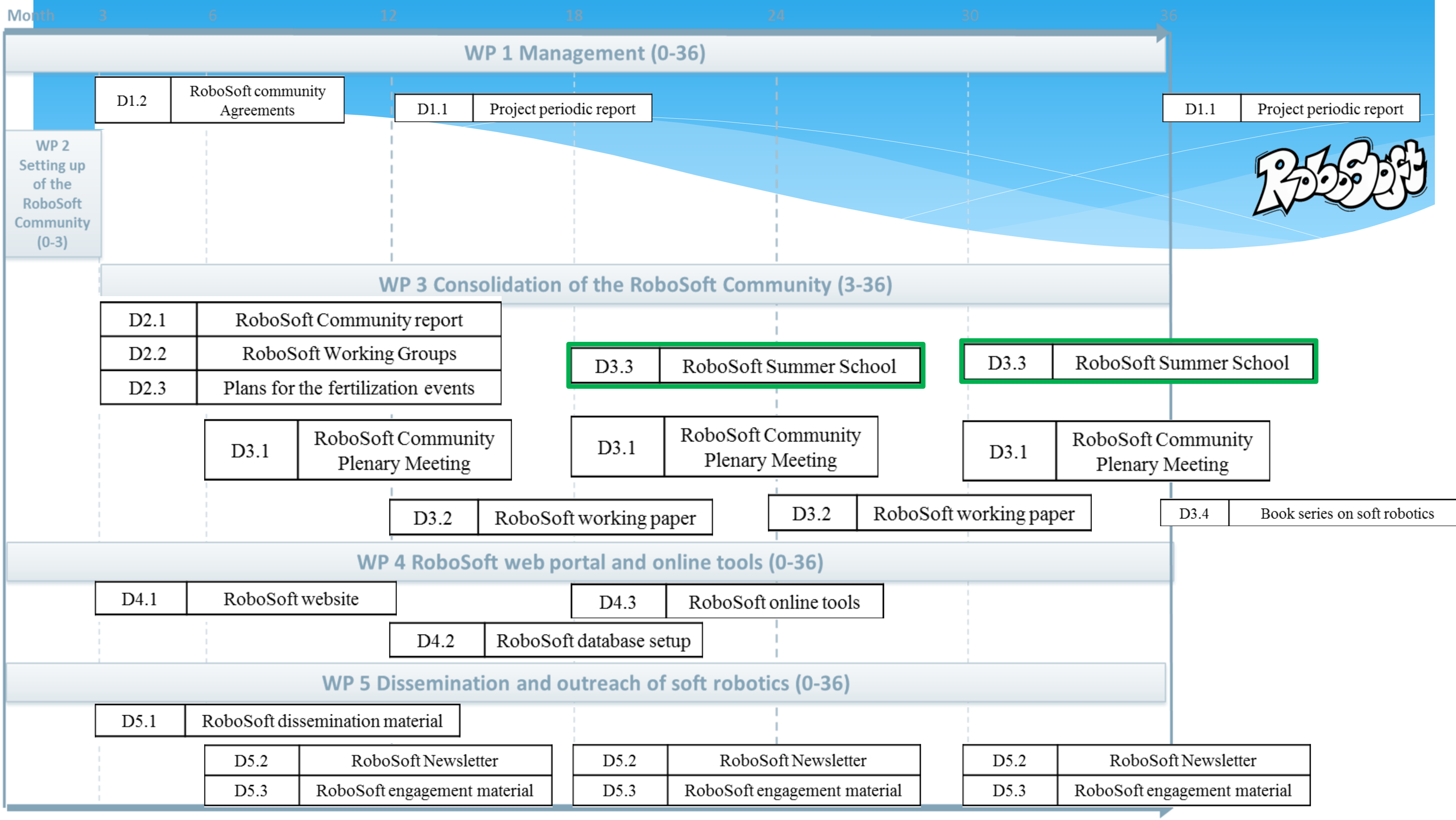
Events: 2 Summer Schools



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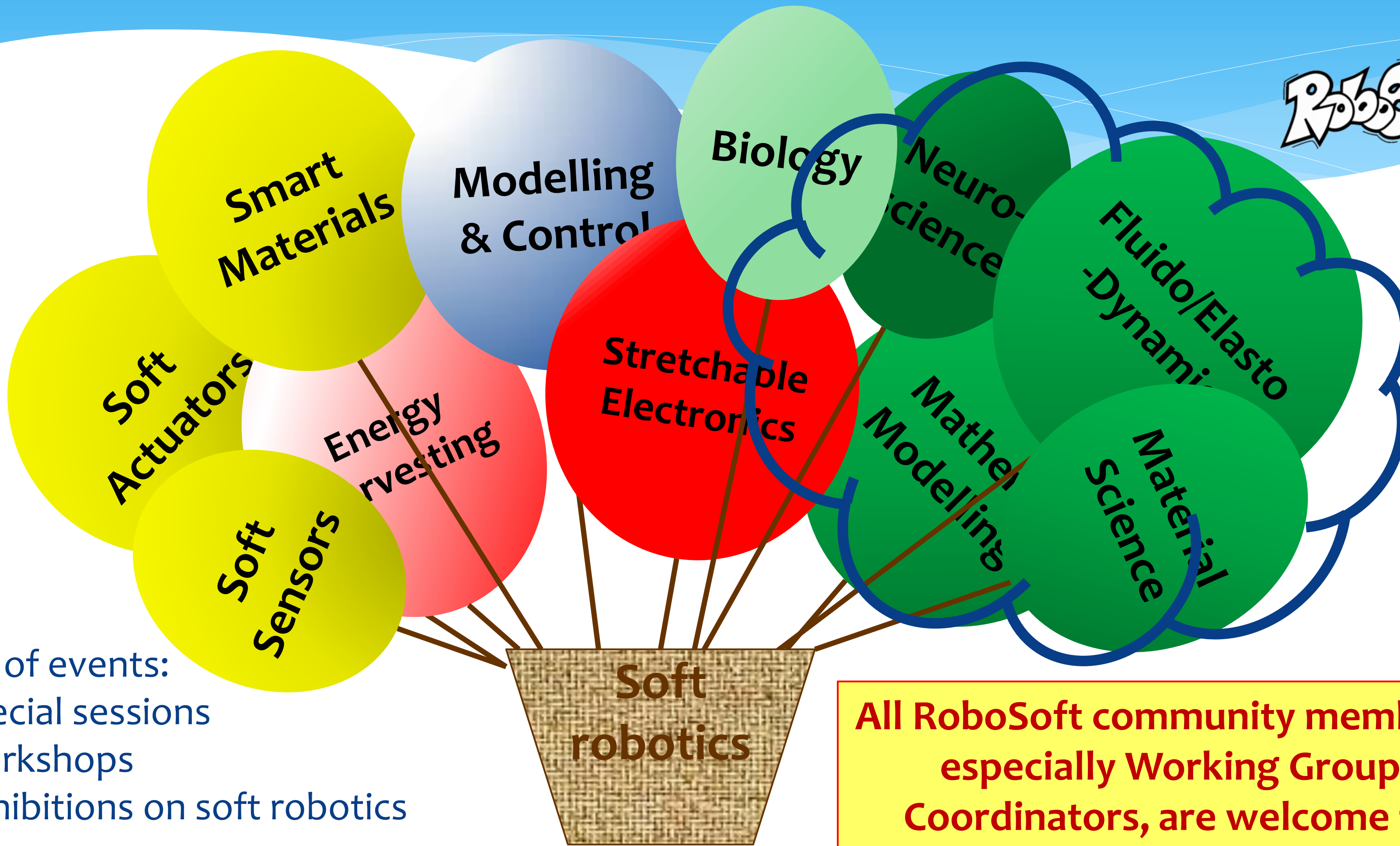
Plan for fertilization events (D2.3)



Types of events:

* special sessions
* workshops
* exhibitions on soft robotics
* at other communities events or in their journals

All RoboSoft community members, especially Working Group Coordinators, are welcome to propose and carry out fertilization events, with RoboSoft funds

Plan for fertilization events (2014-2015) (D2.3)

Addressed community	Event name and website	Type of event to propose (presentation, exhibition,…)
Materials, energy, actuators	EuroEAP 2014 conference	Joint event with ESNAM network
Neuroscience	Neuroscience 2014	Symposia or Minisymposia
Cognitive systems	Genetic and Evolutionary Computation Conference (GECCO)	Oral presentation
Materials science	Spring Conference of the European Materials Research Society (E-MRS)	Oral presentation or exhibition
Modeling	Natural Resource Modeling Conference	Oral presentation
Marine Technology	Oceans	Oral presentation
Natural, social sciences, environment	World Congress on Sustainable Technologies	Oral presentation or exhibition

Concluding remarks

* RoboSoft is representing an important opportunity for our community to consolidate and grow
* RoboSoft is providing resources for scientific initiatives and for dissemination, to the benefit of the members of the RoboSoft community
* RoboSoft is open to new members and to new initiatives – everyone is invited to be collaborative and proactive

Enjoy the meeting and good work!

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Thanks

Research Centre on Marine Robotics, Livorno

- CFD Octo-Prop, Marie Curie
- PoseiDRONE, Fondazione Livorno
- RoboSoft CA, FET-Open
- Smart-e, Marie Curie ITN

OCTOPUS

www.octopus-project.eu

Soft Robotics Team:

- Paolo Dario
- Matteo Cianchetti
- Davide Zambrano
- Laura Margheri
- Marcello Calisti
- Francesco Giorgio-Serchi
- Maurizio Follador
- Michele Giorelli
- Federico Renda
- Andrea Arienti
- Alessia Licofonte
- Serena Tricarico
- Mariangela Manti
- Vito Cacucciolo
- Francesco Corucci

First RoboSoft Plenary Meeting

	March 31, 2014	
Time	**Session**	**Room**
9.00 – 9.15	Registration	Aula Magna
9.15 – 9.45	**RoboSoft welcome and introduction**: ***Cecilia Laschi*** RoboSoft CA Coordinator (BioRobotics Institute, Scuola Superiore Sant'Anna)	Aula Magna
9.45 – 10.30	Invited talk: ***Paolo Dario*** (BioRobotics Institute, Scuola Superiore Sant'Anna) **"Soft robotics: new frontiers for BioRobotics and Robot Companions"**	Aula Magna
10.30 – 11.00	Teasers (I)	Aula Magna
11.00 – 11.30	Poster Session & Coffee Break	Aula Magna Storica
11.30 – 12.15	Invited talk: ***Rolf Pfeifer*** (AI Lab, University of Zurich) **"Soft robotics - the next generation of intelligent machines"**	Aula Magna
12.15– 13.00	Assignment of Working Groups	Aula Magna