

La politica UE in materia di ricerca e sviluppo tecnologico

Programma Infoday su Ricerca e Sviluppo

28 Maggio 2018

Cisternino di Città, Livorno



Scuola Superiore
Sant'Anna



Ricerca e sviluppo tecnologico nell'esperienza dell'Istituto Sant'Anna di Pisa alla luce della politica UE

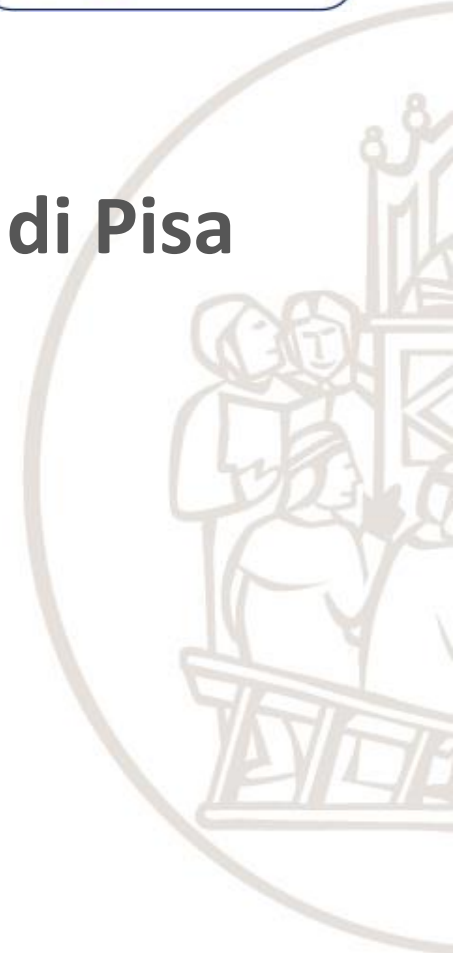


Cecilia Laschi

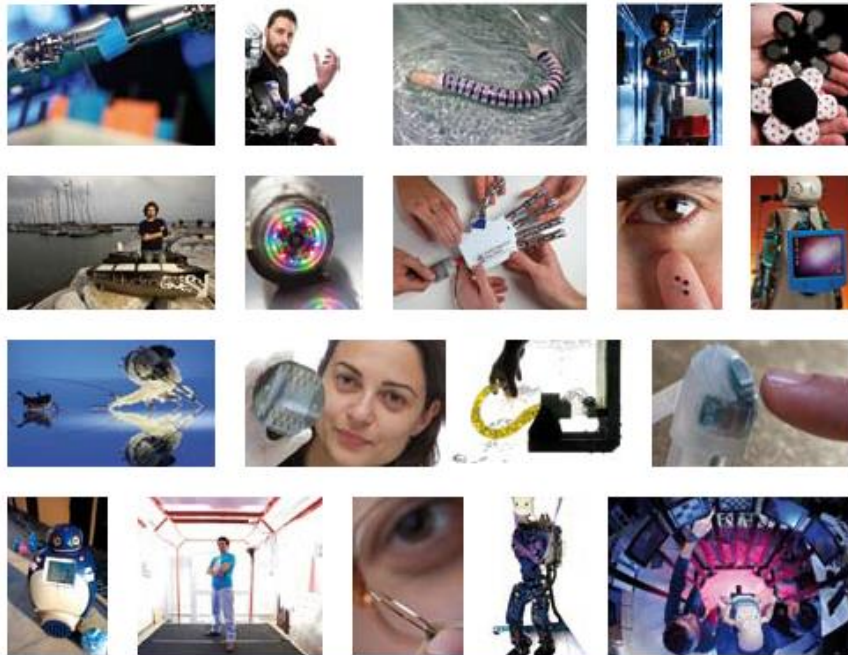
Istituto di BioRobotica

Scuola Superiore Sant'Anna, Pisa

Centro di Ricerca sulle Tecnologie
per il Mare e la Robotica Marina,
Livorno



the BioRobotics Institute



BioRobotics and Bionics Science and Engineering

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Deputy Director,
The BioRobotics Institute

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Sant'Anna

di Studi Universitari e Perfezionamento

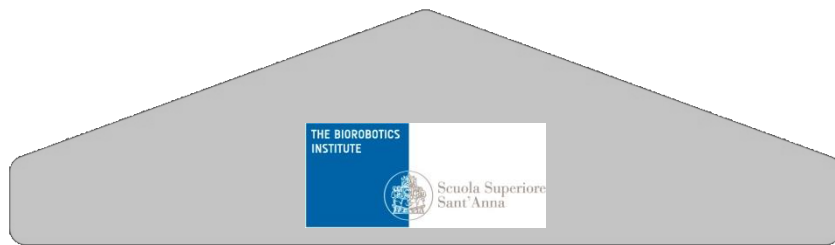
Scuola Superiore Sant'Anna
Pisa, Italy

25 May 2018
Pisa, Italy

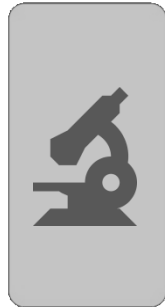


Mission and Vision:

Pursuing new frontiers in engineering, by integrating science and technology



**Advanced
Education**



**Frontier
Research**



**Exploitation
Innovation**

We aim at educating a new kind of engineers who are **researchers**, **inventors (NOT DESIGNERS)** and **entrepreneurs (NOT MANAGERS)**.

Our PhDs are trained to work in teams, on complex and interdisciplinary problems in a deeply international network.



Biorobotics Science and Engineering



Biorobotics Science:
using robotics to
discover new principles...

Biorobotics Engineering:
using robotics to
invent new solutions....



Contents 18 JANUARY 2017
VOL 2, ISSUE 2

[MORE FROM SCIENCE ROBOTICS](#)
• Current Table of Contents

Science for Robotics and Robotics for Science

Paolo Dario, Editorial Board

Scuola Superiore Sant'Anna, Pisa, Italy

One of the ambitions of *Science Robotics* is to root robotics research deeply into science. Biorobotics represents such an ambition: It keeps the living world (and thus life sciences) at its core and investigates different applications of bioinspired machines and robots, as well as validates scientific hypotheses. The power of the latter is somewhat underestimated, but in fact it may represent what really makes robotics worthy of constituting a scientific and not only a technological or engineering pursuit. Robotics science can be pursued in two different ways: the first, according to the model of synthetic science, in which engineers create new knowledge (and thus science) by addressing and solving a series of problems; the second, by using robots to unveil natural principles. The latter approach has been pursued explicitly by some seminal papers in robotics that have appeared in the past 15 years.



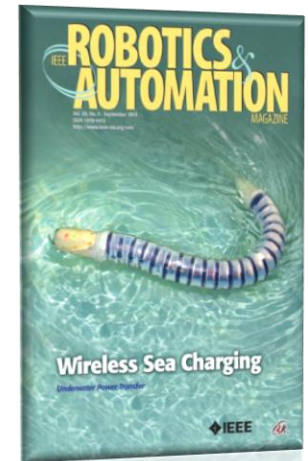
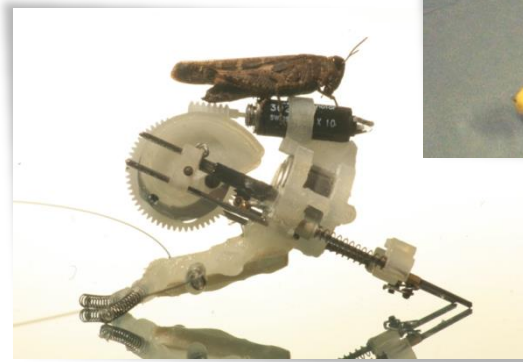
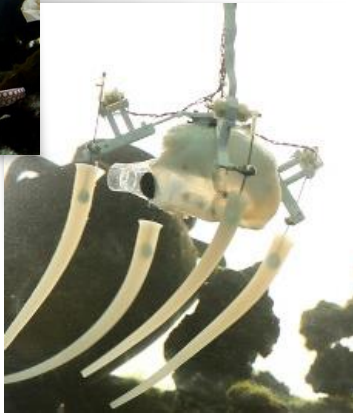
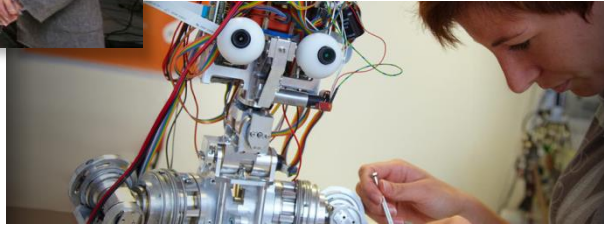
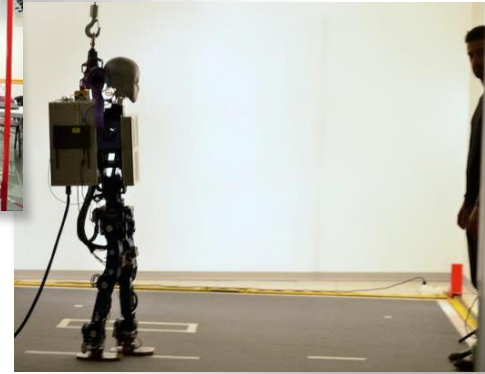
Pasteur's Quadrant: science-grounded and use-inspired research



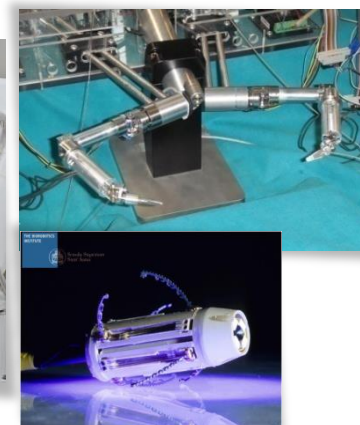
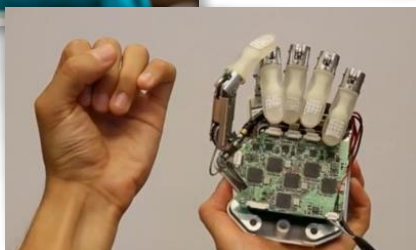
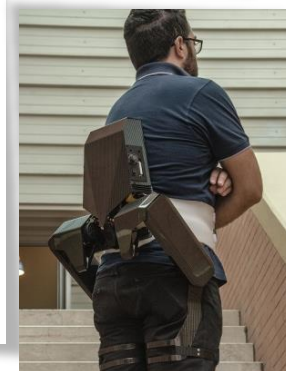
	Consideration of use? <i>No</i>	Consideration of use? <i>Yes</i>
Quest for fundamental understanding? <i>Yes</i>	Pure basic research (Bohr)	Use-inspired Basic research (Pasteur)
Quest for fundamental understanding? <i>No</i>	N/A	Pure applied research (Edison)

A target graphic with a central bullseye and concentric circles is overlaid on the table. The bullseye is centered on the 'Use-inspired Basic research (Pasteur)' cell. The target has a thick gold outer ring and a thinner gold inner ring. The bullseye is a small gold circle. The target is centered on the intersection of the 'Yes' row and 'Yes' column.

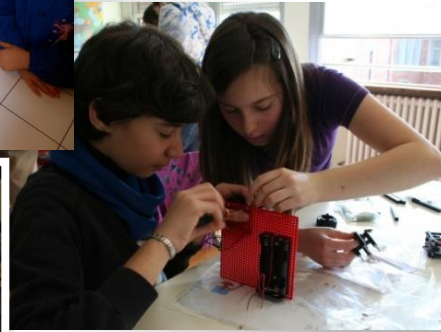
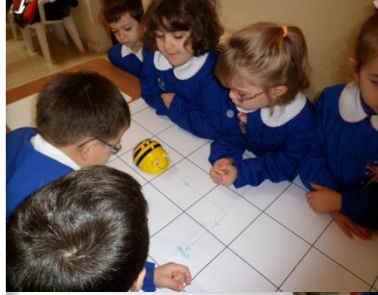
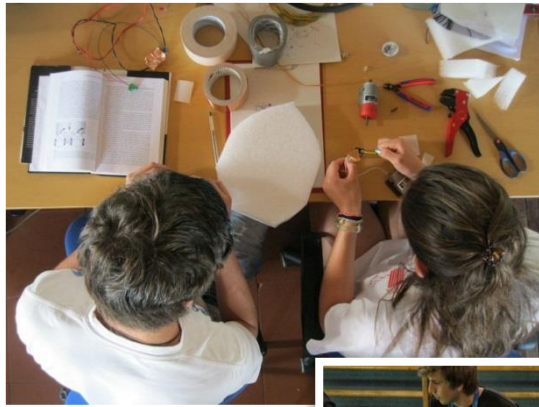
Use robotics to mimic life and unveil its principles



Use robotics to rehab, assist and treat human beings



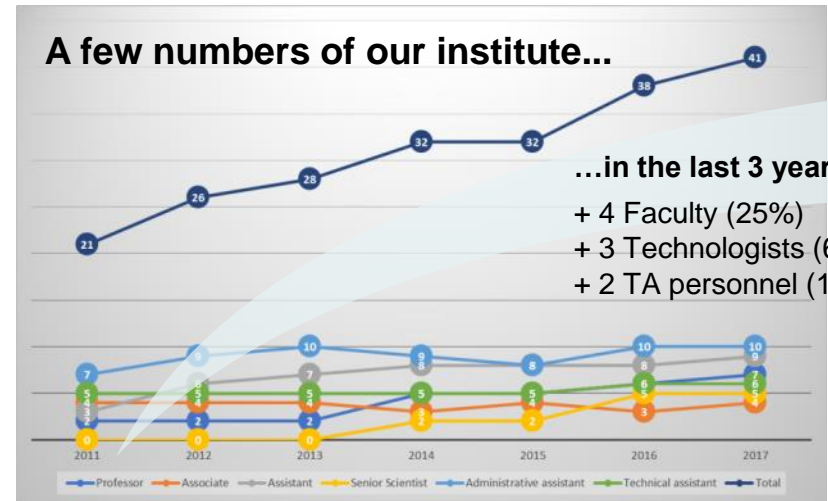
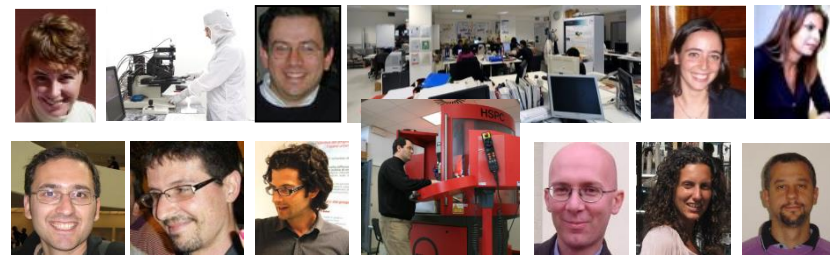
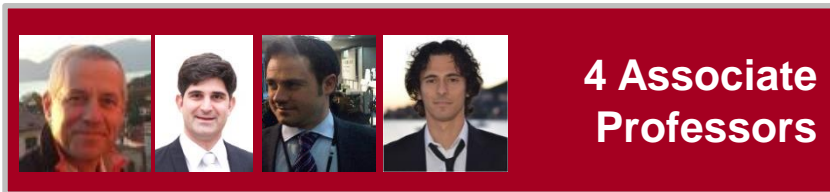
Use robotics to educate and change society



This and more at:
<https://www.santannapisa.it/en/institute/biorobotics/biorobotics-institute>



The BioRobotics Institute 2018



10 Administrative Assistants

6 Technical Assistants

8 Technologists

56 Post Doc Research Assistants

94 PhD Students

≈200 people

≈25 % foreigners

≈40 % women



Centro di Ricerca sulle Tecnologie per il Mare e la Robotica Marina, Livorno



- 500 m² area totale
- Officine per prototipi (elettronica, chimica, meccanica, stampa 3D, taglio laser, testing, lavorazione silicone)
- Acquari, strumenti per l'osservaz. di specie marine
- Sala riunioni
- Sala convegni (70 posti)

ISTITUTO
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Scuola Universitaria Superiore Pisa



COMUNE DI LIVORNO



Obiettivi del Centro di Ricerca sulle Tecnologie per il Mare e la Robotica Marina

- **Ricerca e sviluppo** su nuove tecnologie e sistemi robotici per applicazioni marine
- Formare **capitale umano** per la ricerca e l'innovazione
- Promuovere programmi di sperimentazione, **innovazione industriale** e trasferimento tecnologico alle imprese





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Strutture del Centro

- **Laboratorio di Biomeccanica delle specie marine**
 - **Acquari per l'osservazione e la misurazione in vivo di animali**
 - **Sistema di videocamere ad alta velocità ed alta risoluzione**
 - **Sistema per la ricostruzione 3D**
 - **Ecografo portatile**
- **Laboratorio di Meccanica e di Elettronica**
 - **Banco di meccanica per l'assemblaggio di prototipi**
 - **Banco di elettronica**
 - **Banco di chimica per lavorazione e stoccaggio di materiali polimerici**
 - **Stampante 3D**
 - **Macchina taglio laser**
- **Ambiente per prove a mare**
 - **Accesso diretto al mare**
 - **Area marina protetta dalle perturbazioni ambientali**



Research Centre on Sea Technologies and Marine Robotics

Investment by the Municipality of Livorno: 14+ M€

2009

Official opening of the Centre (temporary site) 'Bagnetti dello Scoglio della Regina'

HydroNET project

OCTOPUS project

2010

Posidonia project

Local funding

OCTO-PROP project

Marie Curie Reintegration grant

2011

V-FIDES project

COMAS project

Regional projects, collaborations with local companies

2012

Official opening of the construction site

PoseiDRONE I & II projects

Local funding

2013

RoboSoft FET-Open CA

2015

Building restored

2017

Official opening of the area

2018

Transfer of the Research Centre on Sea Technologies and Marine Robotics



Main Activities

- Design and development of new biomimetic technologies inspired by marine species for marine applications
- Observation and biomechanical analysis of marine species
- Design and development of marine robots for observation, exploration and monitoring of aquatic environment
- Novel concepts of marine soft robots

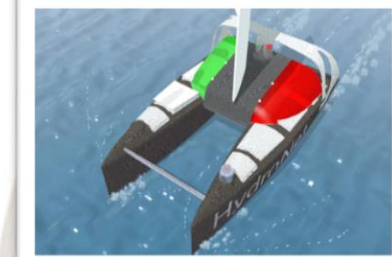




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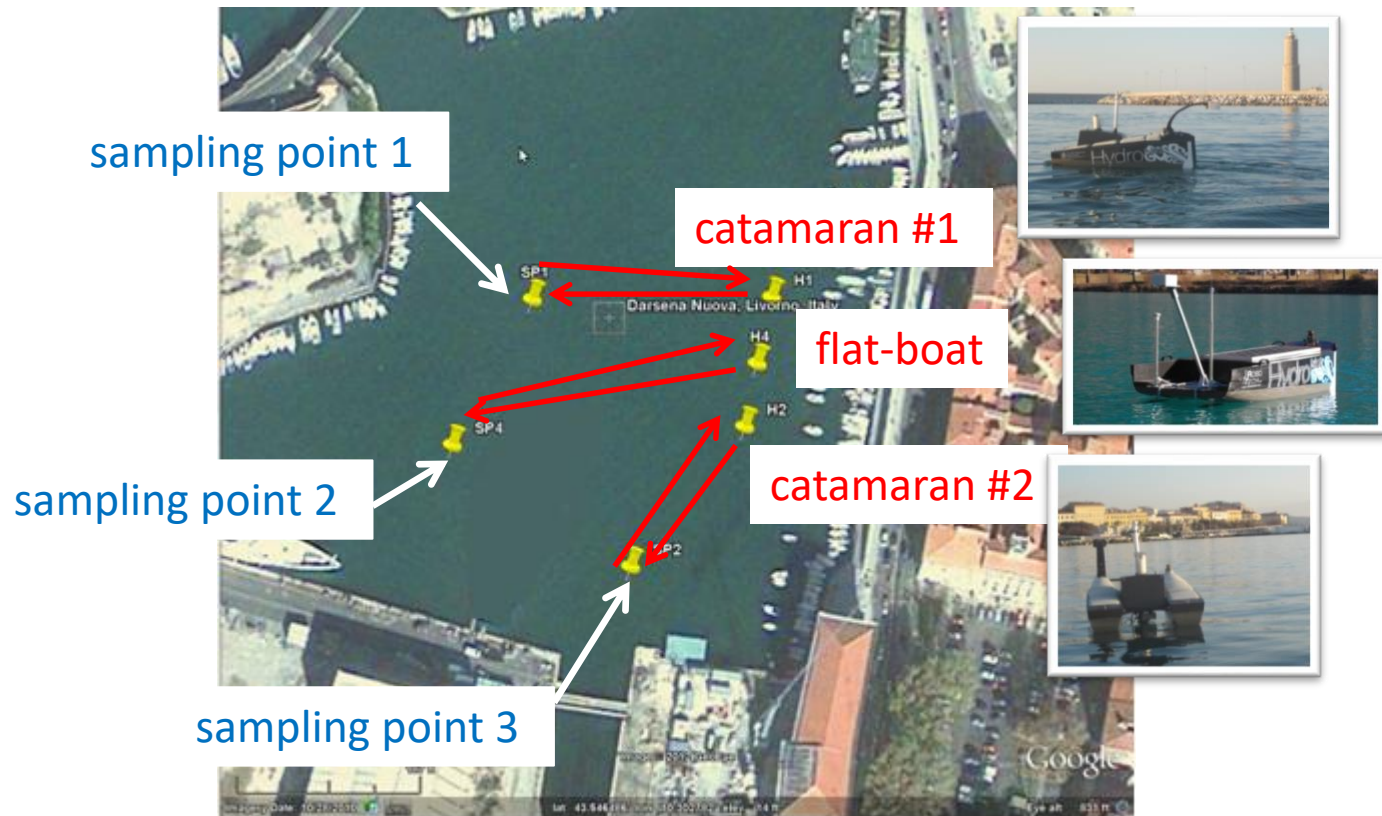
Linee di ricerca

- Progettazione e sviluppo di **robot marini** per l'osservazione e l'esplorazione dell'ambiente acquatico
 - **HydroNet** : Floating Sensorized Robots for Water Monitoring (European Commission, Environment Programme, 2009-2012)
 - Monitoraggio della ***Posidonia oceanica*** con robot e tecniche di visione artificiale” (Fondazione Cassa di Risparmi di Livorno, 2010)
 - **V-FIDES**: Veicolo Filoguidabile per l'Identificazione, la Detezione e l'Esplorazione Subacquea (Regione Toscana, 2011-2013)
 - **COMAS**: COnservazione “in situ” di Manufatti Archeologici Sommersi (Regione Calabria, 2012-2014)
 - **Sea-on-a-Chip**: Monitoraggio dell'acqua negli impianti di acquacoltura (European Commission, Environment Programme, 2013-2016)
 - **SWARMS**: interoperabilità di robot subacquei di profondità (European Commission, 2015-2018)





HydroNet Demo in Darsena Nuova, Livorno, 28/1/2012

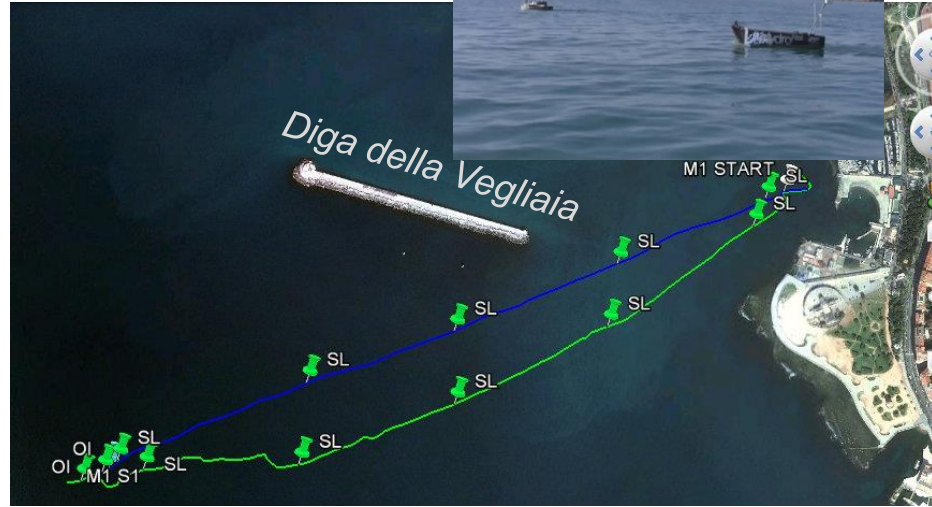


HydroNet - Diga della Vegliaia, Livorno, 13/3/2012

Planned Route



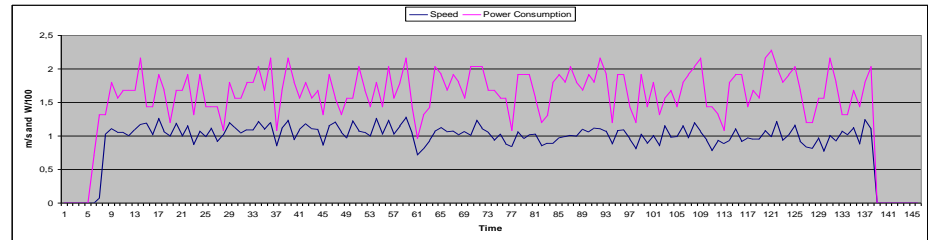
Actual Route



Navigation

Start Location	43°32'15.79"N	10°17'53.82"E
Sample Point Position	43°31'55.54"N	10°16'52.09"E
Path length	1500 m	
Time start	11:59	
Time end	12:26	
Travel duration	27'	
Travel length	1630 m	
Travel average speed	1.02 ms	1.98 kt
Travel average power consumption	167 W	
Battery level at start	13.7 V	
Battery level at end	13.6 V	

Power Consumption

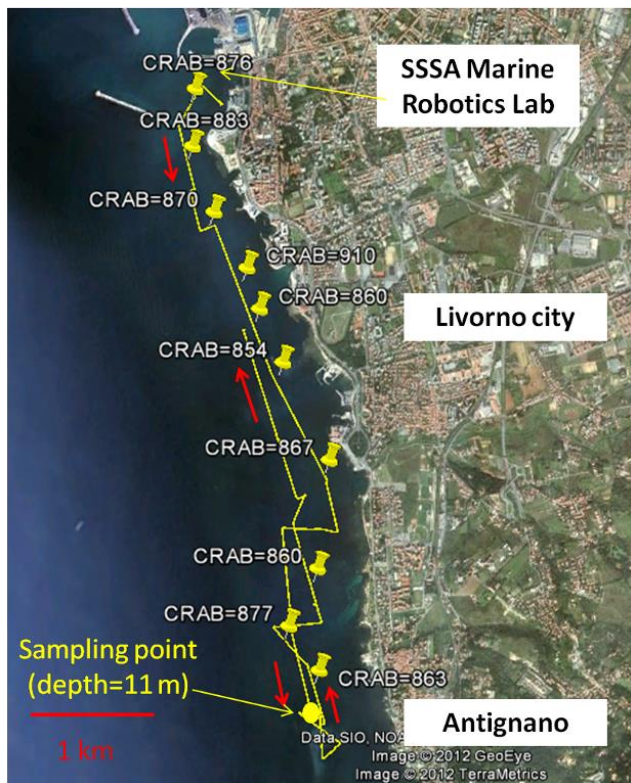


Oil Sensors Analysis

Sensor Type	Mission Point	Lat	Lon	Surface curvature	Reflection coeff.	Oil Conc. mg/l
LUMSL01		43°32'13.36"N	10°17'50.98"E	10	691	
LUMSL01		43°32'06.28"N	10°16'56.27"E	8	685	
LUMSL01		43°32'00.81"N	10°17'24.00"E	8	648	
LUMSL01		43°31'56.54"N	10°17'10.16"E	9	598	
LUMSL01		43°31'55.95"N	10°16'56.27"E	9	638	
LUMOIO1	M1 S1	43°31'55.06"N	10°16'50.73"E			0.002

HydroNet Long Range Test, Livorno, 16/3/2012

Executed



- The robot performed the mission navigating autonomously for **12,562km** for a total energy consumption of 812.52 Wh.
- the robot is able to navigate for more than **6 hours** (consuming 1380 Wh and covering a distance of about **26 km**) with the remaining available energy for the samplings.



Physical Parameters

Depth (m)	0.63	3.59	6.61	9.70	10.68
Temp (C)	13.68	13.63	13.35	13.26	13.27
Cond (mS/cm)	49145.00	49099.00	48768.00	48664.00	48669.00
Tds (g/l)	40.75	40.76	40.77	40.77	40.77
Salinity (ppt)	42.18	42.19	42.18	42.18	42.18
DO (mg/l)	9.20	7.67	7.87	7.83	7.72
pH (units)	8.16	8.17	8.17	8.18	8.18
NO ₃ (mg/l)	0.00	0.02	0.01	0.01	0.01
ORP (mV)	217.00	215.50	214.20	213.10	212.10



Progetto *Posidonia oceanica* Fondazione Livorno, 2010

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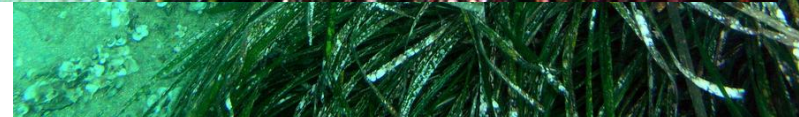
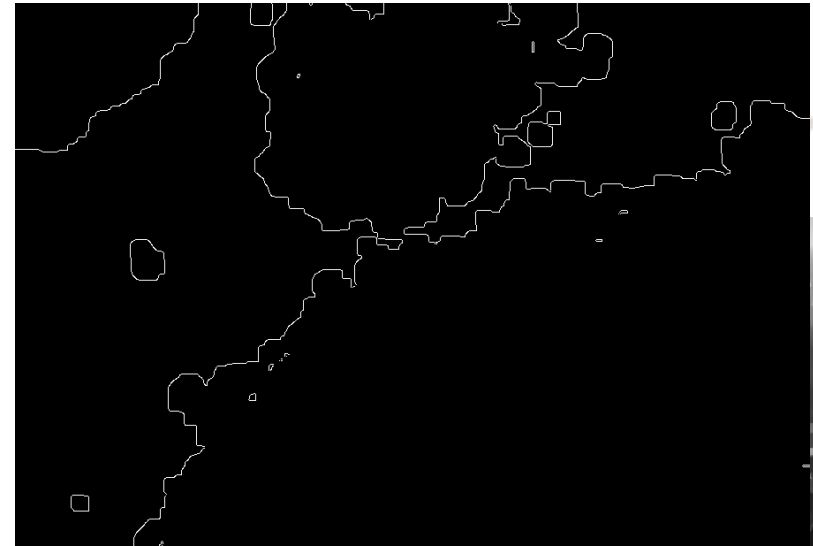
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Con la fotocamera puntata sul
fondale marino si scattano delle
fotografie

Le immagini vengono poi elaborate
per rilevare le aree di presenza di
Posidonia oceanica

Le immagini vengono elaborate
insieme ad altre informazioni, quali
la posizione geografica e la
profondità alle quali sono state
scattate

Il risultato è una mappa geografica
con indicate le zone in cui è
presente la prateria di posidonia





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V-FIDES - Veicolo Filoguidabile per l'Identificazione, la Detezione e l'Esplorazione

■ **V-FIDES** is a research project that involves the study of technologies suitable to the realization of a new type of multi-mission underwater vehicles.

■ The **general objective** of the program is the creation of a Technology Demonstrator in order to verify, in the laboratory and in the real environment, the suitability of technological solutions studied and subsequently developed with particular attention to the monitoring of the water through the system analysis of the concentration of mercury.



Progetto co-finanziato dalla Regione Toscana
Coordinatore: WASS, Livorno 2011-2014

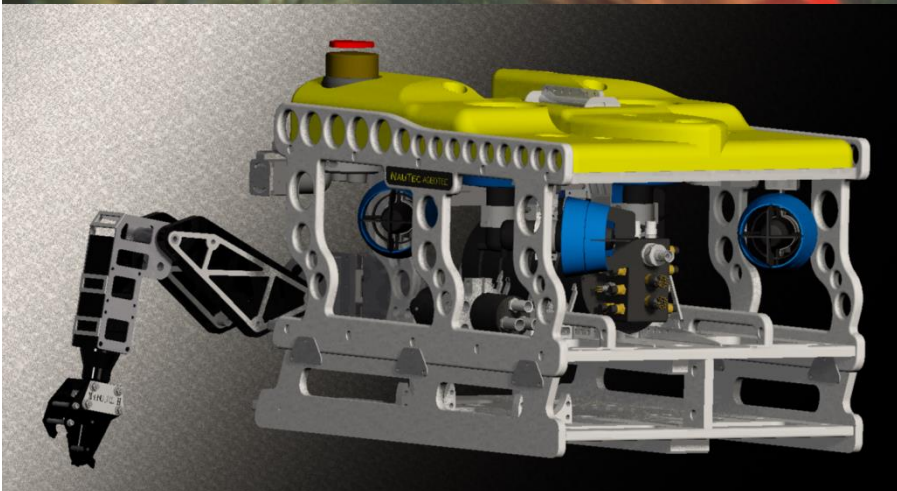




Progetto COMAS – COnservazione Programmata, in situ, dei Manufatti Archeologici Sommersi

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Regione Calabria
Coordinatore: WASS, Livorno



To remove the biological agents that attacked walls, mosaics, columns, we carried out a careful cleaning. They include axes, hammers, chisels and metal spatulas.

Refined cleaning can be carried out with scalpels and small hard-tipped chisels.

ROV with the installed arm to perform automatic cleaning operations