

### Marine Robotics in ISME: stato dell'arte ed attività di ricerca.

*Giovanni Indiveri ISME Director, DIBRIS, University of Genova* 

16 maggio 2023









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### NATIONAL INTER-UNIVERSITY CENTER TO SUPPORT RESEARCH ACTIVITIES IN THE FIELDS OF MARINE TECHNOLOGIES AND OCEANIC ENGINEERING





#### **Competences and applications include**

- Navigation, Guidance and Control for autonomous marine robots
- Underwater Manipulation and Intervention robotics
- Communication systems
- Marine Acoustics for communication and perception including active and passive sonars
- Acoustic Imaging
- Underwater systems mechanical design
- Networking and underwater IoT for underwater environment monitoring and surveillance
- Al and Machine Learning methods
- System identification methods for marine systems
- Proprioceptive and exteroceptive perception
- Mission planning and execution + Human-Machine Interface
- Cooperative Robotics

www.isme.unige.it

#### - Main background

Systems and Control Engineering

**Applied Mechanics** 

**Computer Science** 



#### **Established in 1999**

- 9 Italian University members
- 35- Structured researchers; 15-20 young researchers
- Shared Infrastructures, labs, equipments
- Funding from EU, National, Industrial res. projects
- 1MEuro/year (approximate average of last 5 years)
- CSSN-ISME Joint Lab (SEALab)





A national academic collaborative network of wide-spectrum synergic competences, devoted to research and development on marine unmanned system.







# Polo Nazionale Subacquea



This site of Marina Militare Italiana is chosen to host the new "Polo Nazionale della Subacquea" from 2023





SEA

# Brief Presentation - 2







Scientific-Technological Demands	SEALab Project	
Persistence	PATH (Persistent Auv Through marine energy Harvesting)	
Deployability, Autonomy & Unmanned Systems	ASAP (Auv for Seabed monitoring And intervention with high Projectability)	
Interoperability	UBIqUItous (Underwater Bridging for Improving Unmanned Interoperability)	TEST &
Modularity-Reconfigurability, Scalability	MOSAiC (Modularity & Scalability for Autonomous detection and Classification)	EVALUAT ION
Autonomy & Unmanned Systems	ASSeT (Autonomous Self-reliant Systems Technology)	
Information & Communications Dominance	UNICA (UNderwater Information & Communications Assurance)	
Modeling & Simulation/Mission planning tool/Command& Control/Computer Based Training	CoMPASS (Cross Mission Planning And Simulation Software for AUV)	



### Projects Logos





![](_page_11_Picture_0.jpeg)

An integrated modular approach is adopted, developing throughout the following

- Components, sensors, devices, agent-subsystems
- Sensor Integration & data fusion/interpretation
- Individual Agent Autonomy
- Underwater Communication infrastructures and methods
- Multi-agent Cooperative Autonomy
- Multi-agent Mission Planning and Supervision

![](_page_11_Picture_9.jpeg)

![](_page_11_Picture_10.jpeg)

![](_page_12_Picture_0.jpeg)

### Attività di ricerca e sviluppo per la protezione delle infrastrutture critiche posate sul fondale marino

• MEDUSA – Monitoring maritimE areas by a cooperative Distributed Unmanned System made of heterogeneous Assets Ongoing – Involved ISME nodes: UNIPI, UNIROMA

- BiSS Non-cooperative Bistatic Sonar System Ongoing – Involved ISME nodes: UNIPI
- DAMPS Distributed Autonomous Mobile Passive Sonar system
  Ongoing Involved ISME nodes: UNICAS, UNIFI, UNIGE, UNIPI, UNIROMA, UNISAL
- RECON-UV Reconfigurable Autonomous Underwater Vehicle Ongoing – Involved ISME nodes: UNIFI, UNIGE
- HYDRONE-D Defence: Modular Multi-mission Underwater Drone Starting – Involved ISME nodes: UNIGE, UNIPI
- PACMAN Proficient Artificial intelligence Counter Mine AutoNomous vehicles Negotiation Involved ISME nodes: UNIFI, UNIPI

![](_page_12_Picture_8.jpeg)

![](_page_13_Picture_0.jpeg)

### Widely scalable Mobile Underwater Sonar Technology – the big picture (H2020 2015 – 2018)

![](_page_13_Picture_2.jpeg)

![](_page_14_Figure_0.jpeg)

![](_page_15_Picture_0.jpeg)

### Widely scalable Mobile Underwater Sonar Technology – the big picture (H2020 2015 – 2018)

![](_page_15_Figure_2.jpeg)

![](_page_16_Picture_0.jpeg)

### DAMPS - Distributed Autonomous Mobile Passive Sonar System

![](_page_16_Picture_2.jpeg)

![](_page_17_Picture_0.jpeg)

### Distributed underwater Robotic-based Infrastructure Inspection for Maintenance

![](_page_17_Picture_2.jpeg)

Scope: a) Research and Innovation Actions (RIA) - Robotics Core Technology. Name of the coordinating person: Giovanni Indiveri e-mail: giovanni.indiveri@unige.it tel.: (+39) 010 33 5 2799 fax :(+39) 010 33 5 2154

![](_page_17_Picture_4.jpeg)

Figure 1: General concept art of the DRIIM system.

![](_page_18_Picture_0.jpeg)

### Distributed underwater Robotic-based Infrastructure Inspection for Maintenance

![](_page_18_Picture_2.jpeg)

Scope: a) Research and Innovation Actions (RIA) - Robotics Core Technology. Name of the coordinating person: Giovanni Indiveri e-mail: giovanni.indiveri@unige.it tel.: (+39) 010 33 5 2799 fax :(+39) 010 33 5 2154

#### 2 - Participants & contacts

#	Participant Legal Name	Country
1	UNIVERSITA DEGLI STUDI DI GENOVA	Italy
2	ASSOCIACAO DO INSTITUTO SUPERIOR TECNICO PARA A INVESTIGACAO E DESENVOLVIMENTO	PT
3	CINTAL - CENTRO INVESTIGACAO TECNOLOGICA DO ALGARVE	РТ
4	EVOLOGICS GMBH	DE
5	GRAAL TECH SRL	IT
6	GEO MARINE SURVEY SYSTEMS BV	NL
7	GEOSURVEYS-CONSULTORES EM GEOFISICALDA	РТ
8	D3 Brightlab S.r.L.	IT
9	SEABED GEOSOLUTIONS SAS	FR
10	CORONIS COMPUTING SL	ES

![](_page_19_Picture_0.jpeg)

![](_page_19_Picture_1.jpeg)

Studio e Sviluppo di un Sistema di Sistemi Autonomi e Riconfigurabili ai fini dell'innovazione e potenziamento delle capacità di Test & Evaluation nell'UnderWater Warfare del CSSN

### **BOOMER (2020 - 2022)**

![](_page_19_Picture_4.jpeg)

![](_page_20_Picture_0.jpeg)

### **BOOMER (2020 - 2022)**

![](_page_20_Picture_2.jpeg)

![](_page_20_Picture_3.jpeg)

![](_page_20_Picture_4.jpeg)

Modulo ottico per navigazione accurata

Boa autonoma

![](_page_21_Picture_0.jpeg)

### Ondogeno @ CSSN (from PNRM Sea WHAM)

![](_page_21_Picture_2.jpeg)

![](_page_21_Picture_3.jpeg)

![](_page_21_Picture_4.jpeg)

![](_page_21_Picture_5.jpeg)

![](_page_21_Picture_6.jpeg)

![](_page_22_Picture_0.jpeg)

### **Ondogeno** @ CSSN (from PNRM Sea WHAM)

Integrated Systems for Marine Environment

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# **Training & Higher Education**

Integrated Systems for Marine Environment

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![](_page_23_Picture_4.jpeg)

Over 20 years track record in training Researchers and experts in Marine Robotics. Former students include generations of

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![](_page_23_Picture_8.jpeg)

![](_page_23_Picture_9.jpeg)

Master Students

- Ph.D. •
- Navy Officers •
- **Applied Industrial Researchers**
- Academic Researchers and Prof.

Dottorato Nazionale di Robotica (capofila UNIGE)

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Università di Genova

Centro del Mare - Università di X

≊ Mare

sea.unige.it/#

### Genova as Headquarter

# https://sea.unige.it/#

Events

Courses

Teaching units PhD Rese

PhD Research Liguria and sea

IT EN

### **Centro del Mare**

Centro del Mare encompasses all marine related disciplines, resulting in a collection of **highly specialized and multidisciplinary skills**.

Here, **more than 400 researchers** carry out their teaching and research activity about the sea.

Thanks to their activities, **Università di Genova ranks** among the best universities in the world on marine and maritime topics. Liguria is the Italian region where the **sea economy** has the greatest impact on the business sector. Our region offers the most important shipbuilding companies in the world, ports, companies and professional studios, protected marine areas, cruise ships and tourism.

Università di Genova and Liguria are therefore the ideal place to study and experience the sea in its various forms: environmental, productive, recreational and social.

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![](_page_27_Picture_0.jpeg)

![](_page_27_Picture_1.jpeg)

![](_page_27_Picture_2.jpeg)

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### EUMR

### **European Marine Robotics**

ISME has been one of the major promoters of EUR: the European collaborative network grouping all major European research labs in Marine Robotics

Supported by the EU within the H2020 program, has the main objective of of improving research via opening European Infrastructures and collaborative experimentation programs

![](_page_28_Figure_6.jpeg)

ISME representative: Gianluca Antonelli University of Cassino and Southern Lazio ISME node of Cassino

![](_page_28_Picture_8.jpeg)

![](_page_28_Picture_9.jpeg)

![](_page_29_Picture_0.jpeg)

# ULISSE Catamaran ASV

• 3 m x 1.8 m; 2 electrical motors (2 kW each)

- Batteries inside each hulls (more than 8h autonomy)
- 200 kg of payload can be installed
- Speed (5 m/s w/o payload, 2.5 m/s w/ payload)
- Autonomous platform

Reference: Enrico Simetti

Università di Genova

• Way-points and parameterized path following

![](_page_29_Picture_8.jpeg)

Underwater sensing and comm devices assembly

![](_page_29_Picture_10.jpeg)

![](_page_29_Picture_11.jpeg)

![](_page_30_Picture_0.jpeg)

# **AUV Development and testing**

Typhoon-class AUV

- o Vehicle design
- o GNC development
- ROS-based software architecture
- Optical and acoustical acquisitions
- Underwater 2D mosaicing and 3D reconstructions

![](_page_30_Picture_8.jpeg)

![](_page_30_Picture_9.jpeg)

Contacts in Florence (University of Florence – ISME node): Benedetto Allotta and Alessandro Ridolfi

![](_page_30_Picture_11.jpeg)

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![](_page_31_Picture_0.jpeg)

# **AUV Development and testing**

- MARTA and FeelHippo AUVs
  Optical and acoustical acquisitions
  - HMI for multi-vehicle management
  - Mechanical and electrical modular architecture
  - Low-cost technologies to be used in different fields, e.g. archaeology or geology

![](_page_31_Picture_6.jpeg)

![](_page_31_Picture_7.jpeg)

![](_page_31_Picture_8.jpeg)

![](_page_31_Picture_9.jpeg)

![](_page_31_Picture_10.jpeg)

![](_page_32_Picture_0.jpeg)

## WAVE

#### Wave powered Autonomous Vehicle for marine Exploration

- Long Endurance AUV
- *Energy harvesting* from wave motion with releasable wings
- Charging/*Wings* system as a module of eFolaga vehicle
- Re-charge of low power *payload battery*
- o Possible integration with *solar panels*
- Possible exploitation for *wave-generated motion* at the sea surface

PNRM Project – industrial partner:

![](_page_32_Picture_10.jpeg)

![](_page_32_Picture_11.jpeg)

![](_page_32_Picture_12.jpeg)

![](_page_33_Picture_0.jpeg)

### WAVE

#### Wave powered Autonomous Vehicle for marine Exploration

![](_page_33_Figure_3.jpeg)

![](_page_33_Picture_4.jpeg)

![](_page_34_Picture_0.jpeg)

# Seaspoon Wave Harvesting Microturbine

 $\odot$  Energy harvesting from ocean wave:

- **Seaspoon** wave energy converter: continuous functioning, adaptability to different sea state conditions, robustness, offshore solution, several power take off, green solution
- o <u>Microturbine</u>, pneumatic application, oil-free application
- o **Docking station** for AUV/sensors/offshore actuators

#### o WAVE Lab

- Wave front = 5 m
- Wave height = up to 0,7 m
- Wave Period = 3 4 s
- Wave Lenght = up to 12 m

![](_page_34_Picture_11.jpeg)

PNRM project Coordinated by A. Traverso – ISME University of Genoa

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![](_page_34_Picture_14.jpeg)

![](_page_34_Picture_15.jpeg)

![](_page_34_Picture_16.jpeg)

Techcom

![](_page_34_Picture_17.jpeg)

![](_page_34_Picture_19.jpeg)

![](_page_35_Picture_0.jpeg)

![](_page_35_Picture_1.jpeg)

![](_page_35_Picture_2.jpeg)

#### Autonomous navigation and guidance for ASV

- Path following over multiple GPS waypoints
- Avoidance of dynamic obstacles according to the International Regulations for Preventing Collisions at Sea (COLREGS)
- Management of multiple obstacles at once
- Duration (months): 12, from 2016-11-01 to 2017-10-31.

![](_page_35_Picture_8.jpeg)

European Commission

![](_page_35_Picture_10.jpeg)

![](_page_35_Picture_11.jpeg)

Coordinated by Claudio Melchiorri, University of Bologna

![](_page_35_Picture_13.jpeg)

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# AAN Acoustic AUV's Navigation

Networked cooperative navigation & localization

- Exploit mobile and fixed acoustic nodes
- Networked communicatinss
- Deep-water navigation without DVL (with/for CMRE)
- Environmental support (CTD) to ASW applications (with CMRE & CSSN)
- Tested in several cruises since 2013 up to Oct 2017

![](_page_36_Picture_8.jpeg)

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NEMO

![](_page_37_Picture_2.jpeg)

ENvironmEntal MOnitoring of Offshore Underwater Fish Farms

- Wireless sensors network for monitoring water quality in underwater fish farms
- Surface gateway with 4G Internet connection for remote interrogation and database population
- Four SUNRISE nodes equipped with modems, battery packs and multi-parametric probes
- o Underwater acoustic modem developed by University of Calabria and AppliCon
- o Small energy harvesting device for recharging batteries from sea currents

#### o<u>http://projects.dimes.unical.it/nemo/</u>

- Founded under Second Open Call SUNRISE project
- o Duration (months): 6, from 2016/03/01 to 2016/09/01

![](_page_37_Picture_12.jpeg)

(local coordinator) Alessandro Casavola Università della Calabria, Cosenza ISME node

![](_page_37_Picture_14.jpeg)

![](_page_37_Picture_15.jpeg)

![](_page_37_Picture_16.jpeg)

![](_page_38_Picture_0.jpeg)

![](_page_38_Picture_1.jpeg)

## **Widely scalable Mobile** Underwater Sonar Technology

- *Multi-vehicle AUV system* for geophysics
  Each AUV with a *thin towed array*
  - Reconfigurable formation for *adaptive 3-D sonar*
  - Application for gas&oil industry
  - Autonomous navigation
  - Synchronized atomic clocks for comms & localization
  - Sources (sparker) at the surface with autonomous catamarans

![](_page_38_Picture_9.jpeg)

![](_page_38_Picture_10.jpeg)

![](_page_38_Picture_11.jpeg)

Coordinated by Giovanni Indveri, University of Salento, Lecce ISME node

![](_page_38_Picture_13.jpeg)

![](_page_39_Picture_0.jpeg)

![](_page_40_Picture_0.jpeg)

### Sines, Portugal, 26 January 2018

![](_page_41_Picture_1.jpeg)

### **WiMUST** Widely scalable Mobile Underwater Sonar Technology

![](_page_41_Picture_3.jpeg)

![](_page_42_Picture_0.jpeg)

Widely scalable Mobile Underwater Sonar Technology

![](_page_42_Picture_2.jpeg)

![](_page_43_Picture_0.jpeg)

Co<sub>3</sub>-AUVs

![](_page_43_Picture_2.jpeg)

![](_page_43_Picture_3.jpeg)

Cooperative Cognitive Control for Autonomous Underwater Vehicle

Multiple vehicles, both surface and underwater, patrolling a given area with a decentralized, fault-tolerant, algorithm

![](_page_43_Picture_6.jpeg)

![](_page_43_Figure_7.jpeg)

![](_page_43_Figure_8.jpeg)

![](_page_44_Picture_0.jpeg)

![](_page_44_Picture_1.jpeg)

### PASSport (2020-2023)

Operational Platform managing a fleet of semi-autonomous drones exploiting GNSS high Accuracy and Authentication to improve Security & Safety in port areas

![](_page_44_Picture_4.jpeg)

Engineering and qualifying a solution to improve **safety and security in port areas** trough a fleet of semiautomated **aerial** fixed/rotary wing and **underwater** drones integrating **Galileo** services

![](_page_44_Picture_6.jpeg)

Support to e-navigation

![](_page_44_Picture_8.jpeg)

Critical buildings/infrastructures

protection Protection against non-cooperative small craft approaching the areas

![](_page_44_Picture_11.jpeg)

Underwater threats monitoring

![](_page_44_Picture_13.jpeg)

https://h2020-passport.eu/

info@h2020-passport.eu

![](_page_44_Picture_16.jpeg)

![](_page_44_Picture_17.jpeg)

Automatic Target Recognition to detect and geolocalize potential targets of interest on acoustic and optical imagery

Bathymetry and occupancy maps of the seabed to analyze the seafloor morphology and detect protruding objects

### **PATHFINDER (2021-2023)**

**PNT** as **A TecH**nology to support a scalable Fleet of IINked Drones operating in BVLOS scenarios for preventive monitoring and **EmeR**gency missions

### Configurable robotic system for several application scenarios

![](_page_45_Figure_3.jpeg)

![](_page_45_Picture_4.jpeg)

### FeelHippo AUV from ISME-UNIFI

![](_page_45_Picture_6.jpeg)

![](_page_45_Picture_7.jpeg)

**DI INGEGNERIA** 

INDUSTRIALE

Project funded by ESA (NAVISP programme)

![](_page_46_Picture_0.jpeg)

## TARMEM

### Team of Aquatic/Aerial Robots for Marine Environmental Monitoring

Teams of Aquatic/Aerial Robots for Marine Environmental Monitoring

To develop planning, coordination and communication tools for the distributed control of a team of UAV's AUV for surface monitoring marine environments

Timeline: 2018-2021

Funding requested: 600 kUSD

Principal Investigator: Gianni Di Caro, CMU Doha

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![](_page_46_Picture_9.jpeg)

![](_page_46_Picture_10.jpeg)

![](_page_46_Picture_11.jpeg)

![](_page_46_Picture_12.jpeg)

Local coordinator: Filippo Arrichiello University of Cassino and Southern Lazio ISME node Cassino

![](_page_46_Picture_14.jpeg)

![](_page_46_Picture_15.jpeg)

![](_page_47_Picture_0.jpeg)

### **RIMA** Rete Integrata Monitoraggio Ambientale

Distributed Sampling of Marine Areas

- Optimal data driven distributed sensor allocation
- Centralized & decentralized Task-priority based approach for
  - Connectivity maintenance
  - Inter-vehicle and external collision avoidance

![](_page_47_Picture_7.jpeg)

![](_page_47_Figure_8.jpeg)

![](_page_47_Picture_9.jpeg)

![](_page_47_Picture_10.jpeg)

![](_page_47_Picture_11.jpeg)

![](_page_47_Picture_12.jpeg)

![](_page_47_Picture_13.jpeg)

![](_page_47_Picture_14.jpeg)

![](_page_48_Picture_0.jpeg)

### **C3ISR** C3 Intelligence-Surveillance-Patrolling

Surface patrolling & threads Intercept with realtime collision avoidance

- Task-priority patrolling and interception:
  - connectivity maintenance
  - maximal currently covered connected area
  - Inter vehicle and external Collision avoidance
  - interception with dynamic obstacle avoidance
  - residua patrolling team optimal reconfiguration

![](_page_48_Picture_9.jpeg)

![](_page_48_Picture_10.jpeg)

![](_page_48_Picture_11.jpeg)

![](_page_48_Picture_12.jpeg)

#### **DLTM-supported** project

![](_page_48_Picture_14.jpeg)

![](_page_48_Picture_15.jpeg)

![](_page_49_Picture_0.jpeg)

# **Projects and Activities**

### ISME's Underwater

### Manipulation

## experience has a

long story....

AMADEUS is a dexterous subsea robot hand incorporating force and slip contact sensing, using fluid filled tentacles for fingers. Hydraulic pressure variations in each of three flexible tubes (bellows) in each finger create a bending moment, and consequent motion or increase in contact force during grasping. Such fingers have inherent passive compliance, no moving parts, and are naturally depth pressure-compensated, making them ideal for reliable use in the deep ocean. In addition to the mechanical design, development of the hand has also considered closed loop finger position and force control, coordinated finger motion for grasping, force and slip sensor development/signal processing, and reactive world modeling/planning for supervisory 'blind grasping'. Initially, the application focus is for marine science tasks, but broader roles in offshore oil and gas, salvage, and military use are foreseen. Phase I of the project is complete, with the construction of a first prototype. Phase II is now underway, to deploy the hand

IEEE Robotics & Automation Magazine, December 1997

![](_page_50_Picture_0.jpeg)

TRIDENT

Marine robots and dexterous manipulation for autonomous underwater intervention missions

![](_page_50_Picture_3.jpeg)

Main achievements

- Full vehicle-manipulator-gripper coordinated control
- Task priority based unified control architecture
- Safety and fault-tolerant behaviors
- Sensorised underwater dexterous gripper
- Dexterous manipulation control algorithms

![](_page_50_Picture_10.jpeg)

![](_page_50_Picture_11.jpeg)

Industrial partner

![](_page_50_Picture_13.jpeg)

![](_page_50_Picture_14.jpeg)

![](_page_51_Picture_0.jpeg)

### Dexterous ROV Operations in Presence of Communications Latencies

![](_page_51_Picture_2.jpeg)

Dexterous ROV Operations in Presence of Communications Latencies

Remote operation of an underwater arm based on learning the operator actions and providing autonomy to the underwater vehicle-manipulator system

![](_page_51_Picture_5.jpeg)

![](_page_51_Picture_6.jpeg)

![](_page_51_Picture_7.jpeg)

![](_page_51_Picture_8.jpeg)

![](_page_52_Picture_0.jpeg)

# ROBUST <sub>B</sub>

#### Robotic Subsea Exploration Technologies

RÔBUST

Control of an I-AUV for sea-floor mining applications capable of:

- Survey of Sea-floor large areas
  - o acoustic and visual surveys
  - Automatic recognition of most promising mining zone
- Precise landing and in-situ inspection of the mining site
  - $\,\circ\,$  Landing w.r.t. a nodule to be examined
  - o In-situ material spectroscopy via a robotic arm
  - Possibly successive nodule collection

![](_page_52_Picture_12.jpeg)

![](_page_52_Picture_13.jpeg)

Local coordinator: Enrico Simetti University of Genova ISME node Genova

![](_page_52_Picture_15.jpeg)

![](_page_53_Picture_0.jpeg)

![](_page_53_Picture_1.jpeg)

#### Marine Robotics for Interventions

![](_page_53_Picture_3.jpeg)

![](_page_53_Picture_4.jpeg)

- Development of new sensorized dexterous grippers
- Enhancing underwater vision algorithms and proc.
- Extension to multi-arms systems
- Extension to cooperative Intervention agents
- Development of action-based Mission planning methods

![](_page_53_Picture_10.jpeg)

![](_page_53_Picture_11.jpeg)

![](_page_53_Picture_12.jpeg)

![](_page_54_Picture_0.jpeg)

### PhUMA – Phantom Underwater Manipulator

![](_page_54_Picture_2.jpeg)

Integrated Systems for Marine Environment

#### Achievement 1

 Development of an integrated robotic structure for light underwater intervention equipped with an advanced control system.

#### • Achievement 2

 Development of an assistive M/M interface to facilitate the operator'task.

![](_page_54_Figure_8.jpeg)

![](_page_54_Figure_9.jpeg)

### ISME Partners

Università Politecnica delle Marche Università di Genova

![](_page_54_Picture_12.jpeg)

![](_page_55_Picture_0.jpeg)

Integrated Systems for Marine Environment

#### Survey Marine Robotics

![](_page_55_Picture_3.jpeg)

![](_page_55_Picture_4.jpeg)

Intervention Marine Robotics

Now deemed sufficiently mature for jointly progressing toward their integration as Marine Cooperative Heterogeneous Multi-agents

![](_page_56_Picture_0.jpeg)

# **Projects and Activities**

### Divers Assistance & Support Projects

![](_page_57_Picture_0.jpeg)

![](_page_57_Picture_1.jpeg)

![](_page_57_Picture_2.jpeg)

, **21**m12s

#### • "Portable smart lab for Divers" :

- o based on Android or iOS tablet
- embedded with environmental sensors, high-resolution camera
- compatible with a number of commercial acoustic positioning systems (Sonardyne, Evologics, SeaTrac, etc.)
- Cloud support for the surveying and documentation phases

### o http://lab4dive.gr/en/

- EASME Call: EASME/EMFF/2016/1.2.1.4 Blue Labs innovative solutions for maritime challenges
- Duration (months): 24, 01/03/2017 28/02/2019.
- Maximum grant awarded to the Action (Euro): 343057

![](_page_57_Picture_13.jpeg)

Commission

Partner (UnivPM ISME Node) coordinated by David Scaradozzi Università Politecnica delle Marche, Ancona

**ISME** Partner:

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![](_page_57_Picture_18.jpeg)

![](_page_57_Picture_19.jpeg)

![](_page_58_Picture_0.jpeg)

#### ROAD Project

Integrated Systems for Marine Environment

#### o Achievement 1

• Development of a robotic system that integrates AUV's and Biometric Devices to monitor the physiological conditions of divers and to assist the dive supervisor in assessing risks and in managing dangerous situations.

#### o Achievement 2

• Development of a low cost, small ASV that can deploy/recover a micro-ROV.

![](_page_58_Figure_7.jpeg)

#### **ISME** Partners

Università Politecnica delle Marche

![](_page_58_Picture_10.jpeg)

![](_page_59_Picture_0.jpeg)

# GreenBubbles

A citizen science tool to maximize the benefits associated with sport diving while minimizing its negative impacts, achieving the environmental, economic and social sustainability of the system.

#### • DocuScooter:

- Add-on for underwater commercial scooters
- Collect data in autonomous way from the marine environment during a dive

#### o http://www.greenbubbles.eu

- H2020 call: MSCA-RISE-2014 Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE)
- Duration (months): 48, from 01-01-2015 to 31-12-2018.
- Maximum grant awarded to the Action (Euro) 1 611 000

![](_page_59_Picture_11.jpeg)

Commission

Partner (UnivPM\_ISME\_Node) coordinated by David Scaradozzi Università Politecnica delle Marche, Ancona

![](_page_59_Picture_13.jpeg)

![](_page_60_Picture_0.jpeg)

![](_page_60_Picture_1.jpeg)

![](_page_60_Picture_2.jpeg)

Virtual and augmented exploitation VISAS of Submerged Archaeological Sites

Augmented Diving System:

- Augmented reality system for exploitation of underwater archaeological sites.
- Aided navigation with 3D maps and points of Interest
- Underwater full touch tablet properly equipped with a waterproof case and an integrated IMU/Modem system for acoustic localization and inertial navigation.
- Acoustic LBL localization system for geo-localization of underwater tablets and divers

<u>http://visas-project.eu</u>

• Duration (months): 30, from 2014/04/01 to 2016/09/30

![](_page_60_Picture_11.jpeg)

(local coordinator) Alessandro Casavola Università della Calabria, Cosenza ISME node

![](_page_60_Picture_13.jpeg)

![](_page_60_Picture_14.jpeg)

![](_page_60_Picture_15.jpeg)

![](_page_61_Picture_0.jpeg)

![](_page_61_Picture_2.jpeg)

![](_page_62_Picture_0.jpeg)

![](_page_62_Picture_2.jpeg)

https://www.graaltech.com/

### UNIGE, not a spin-off any longer....

![](_page_63_Picture_0.jpeg)

![](_page_63_Picture_2.jpeg)

https://www.mdmteam.eu/

![](_page_63_Picture_4.jpeg)

![](_page_64_Picture_0.jpeg)

![](_page_64_Picture_2.jpeg)

### W • S E N S E

INTEGRATED CABLELESS SOLUTIONS

### La Sapienza

### https://wsense.it/

![](_page_65_Picture_0.jpeg)

![](_page_65_Picture_2.jpeg)

https://www.everybotics.it/

Uni Cassino

![](_page_66_Picture_0.jpeg)

![](_page_66_Picture_2.jpeg)

http://www.apphia.it/

#### UNISALENTO

![](_page_67_Picture_0.jpeg)

Integrated Systems for Marine Environment

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giovanni.indiveri@unige.it

![](_page_67_Picture_4.jpeg)

**DIBRIS** DIPARTIMENTO DI INFORMATICA, BIOINGEGNERIA, ROBOTICA E INGEGNERIA DEI SISTEMI

![](_page_68_Picture_0.jpeg)

![](_page_68_Picture_1.jpeg)

#### **Director**

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# Thank you!