



Stato dell'arte ed attività di ricerca del Centro ISME.

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

13 febbraio 2024





Università di Genova



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ISME Director*

*Associate Professor in Systems and Control Engineering,
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GENOVA
Legal Headquarter



PISA



FIRENZE



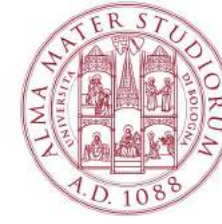
ANCONA



CASSINO



LECCE



BOLOGNA



ROMA 1



COSENZA

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



ISME
Integrated Systems for Marine Environment

- Main background

Systems and Control Engineering

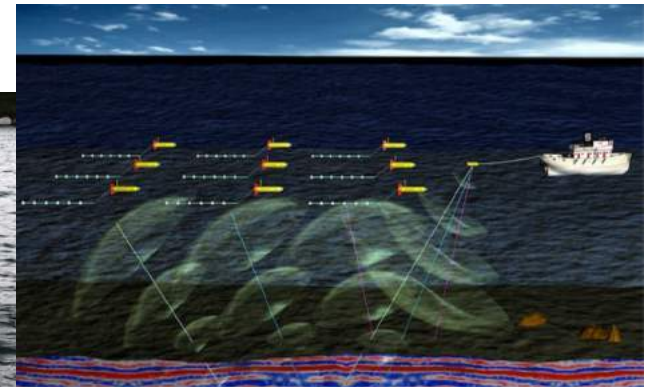
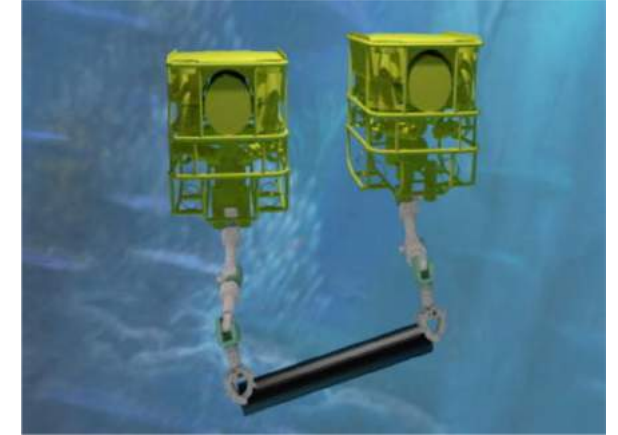
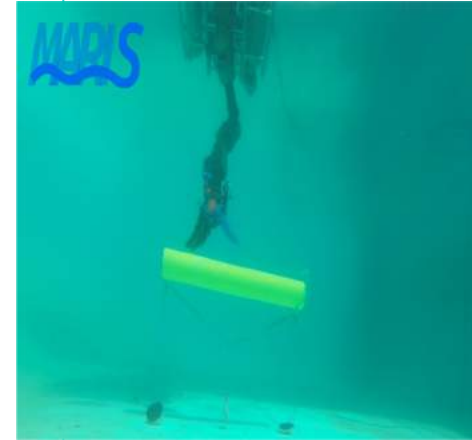
Applied Mechanics

Computer Science

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
- AI and Machine Learning methods
- System identification methods for marine systems
- Proprioceptive and exteroceptive perception
- Mission planning and execution + Human-Machine Interface
- Cooperative Robotics

- Underwater manipulation (intervention robotics)
- Divers Assistance & Support Technologies
- 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



Established in 1999

- 9 Italian University members;
- 60 (plus) Structured 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)

2013



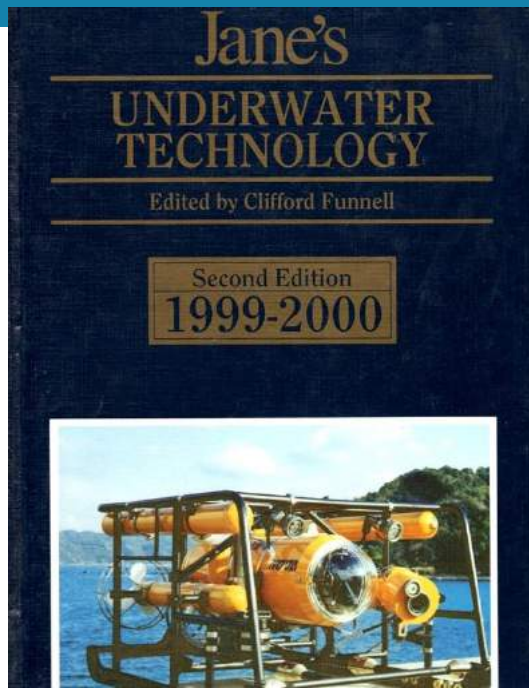
2014



2016







1999

2024



25 years
of research
and technology
progress





Projects Logos





(started in 2015) SEALab: Joint CSSN-ISME Laboratory on "Sistemi Eterogenei Autonomi"



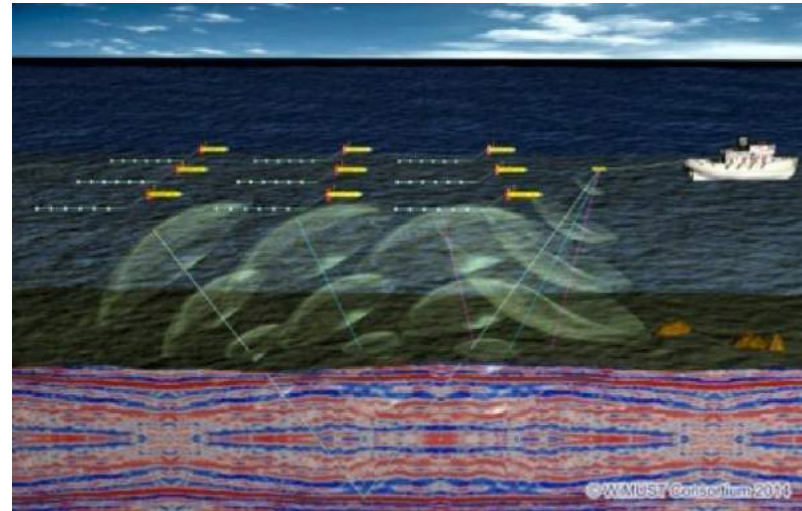
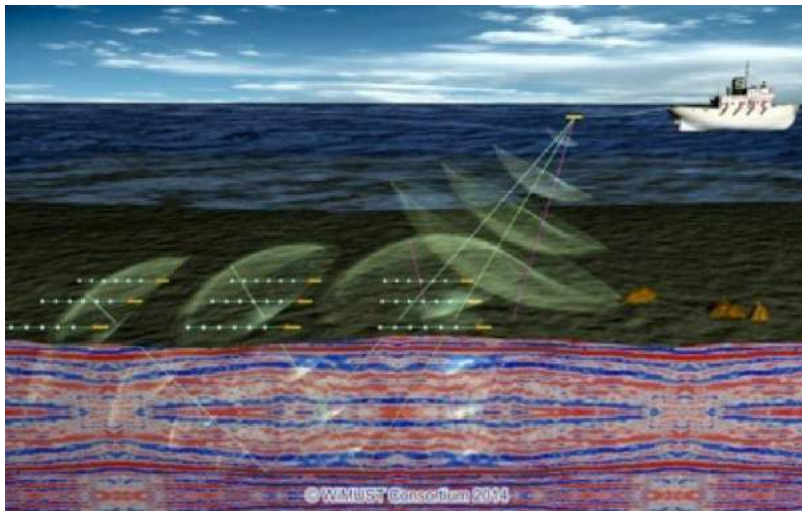
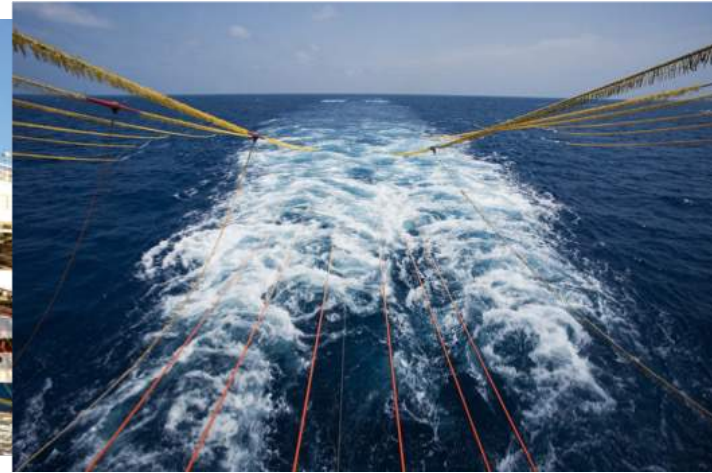
This site of Marina Militare Italiana is chosen to host the new “Polo Nazionale della Subacquea” from 2023



- MEDUSA – Monitoring maritime areas by a cooperative Distributed Unmanned System made of heterogeneous Assets
Recently Finished – Involved ISME nodes: UNIFI, UNIROMA
- BiSS – Non-cooperative Bistatic Sonar System
Just Finished – Involved ISME nodes: UNIFI
- DAMPS – Distributed Autonomous Mobile Passive Sonar system
Ongoing – Involved ISME nodes: UNICAS, UNIFI, UNIGE, UNIFI, UNIROMA, UNISAL
- RECON-UV – Reconfigurable Autonomous Underwater Vehicle
Ongoing – Involved ISME nodes: UNIFI, UNIGE
- HYDRONE-D – Defence: Modular Multi-mission Underwater Drone
Ongoing – Involved ISME nodes: UNIGE, UNIFI
- PACMAN – Proficient Artificial intelligence Counter Mine AutoNomous vehicles
Ongoing – Involved ISME nodes: UNIFI, UNIFI

**CURRENT PNRM
PROJECTS
INVOLVING
ISME NODES**

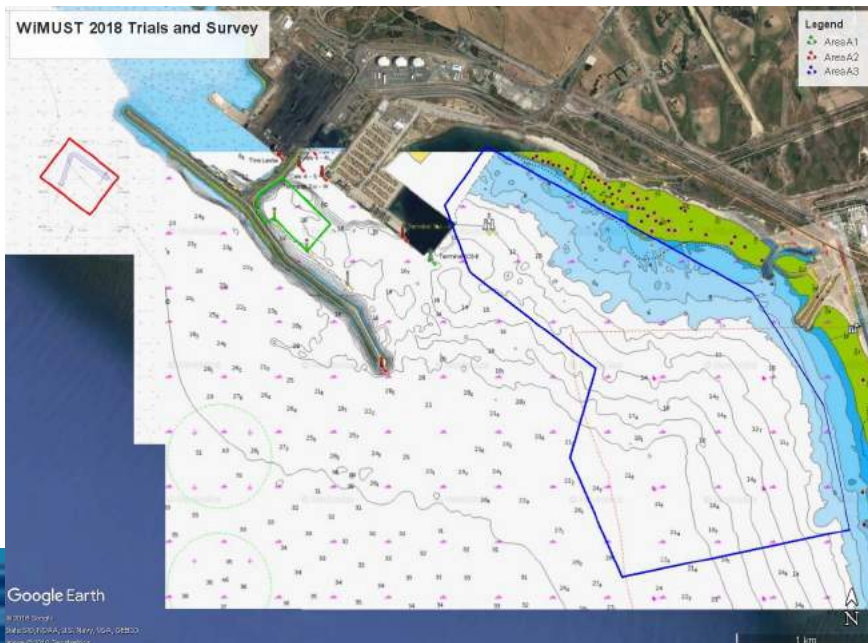
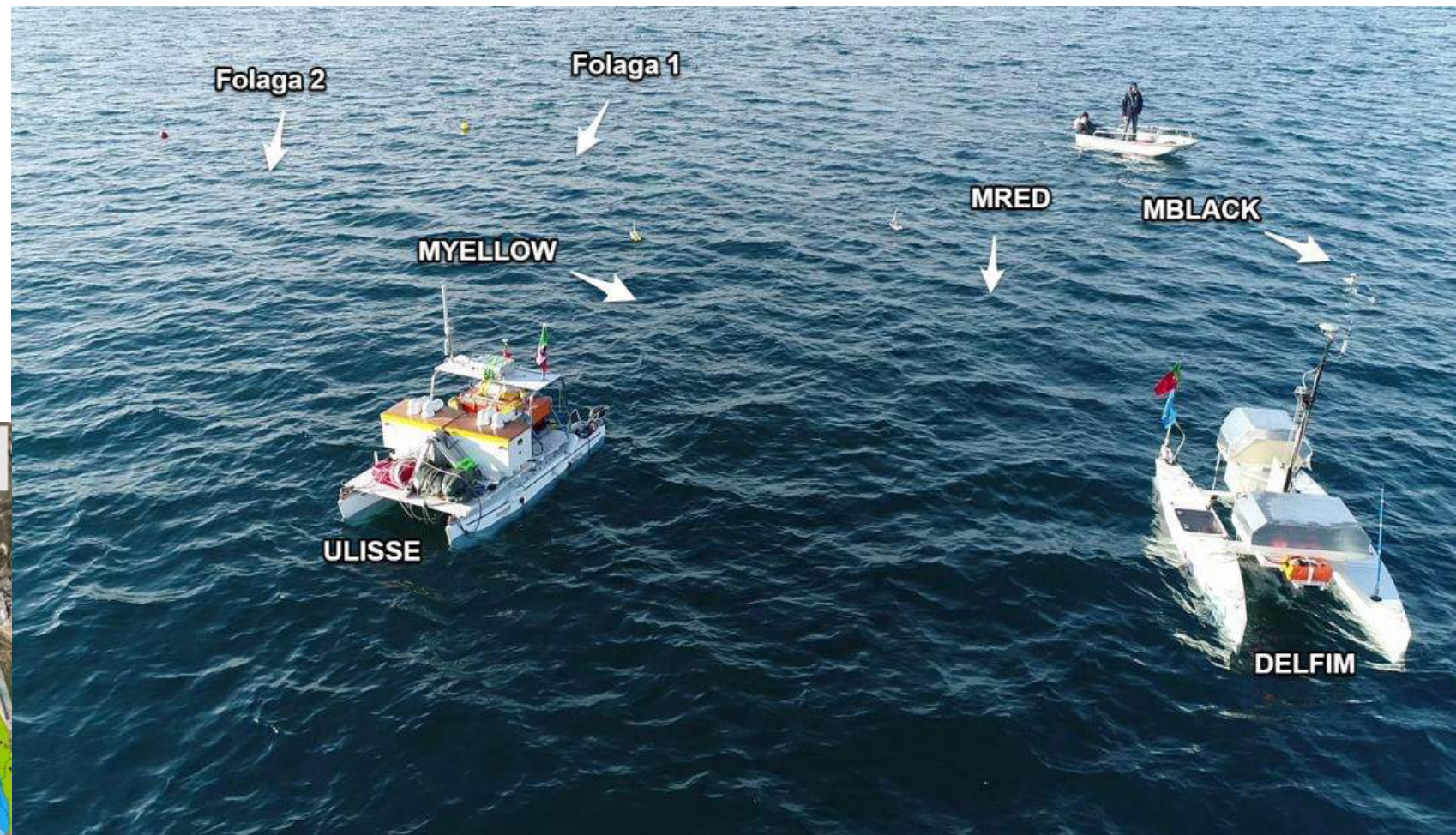
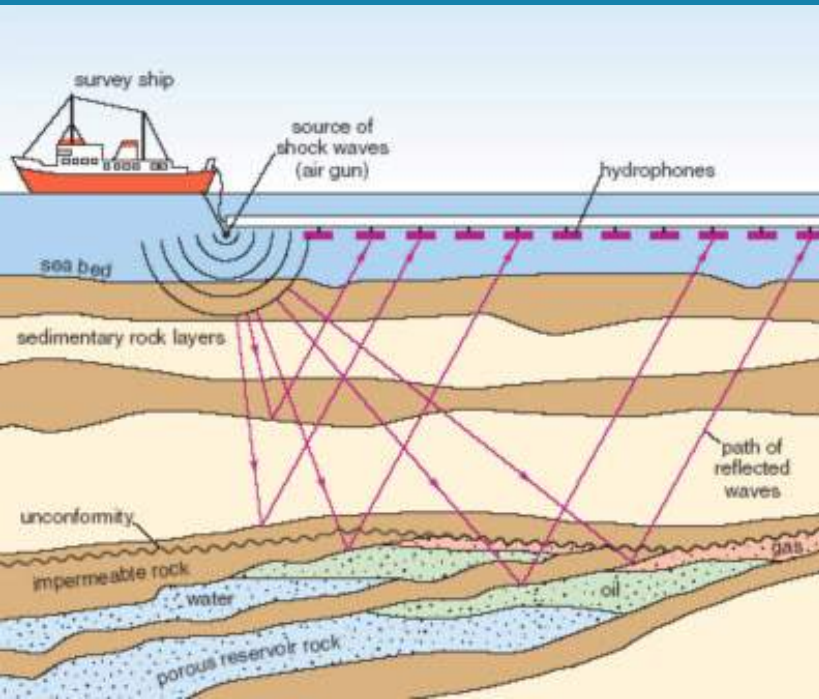
Widely scalable Mobile Underwater Sonar Technology – the big picture (H2020 2015 – 2018)



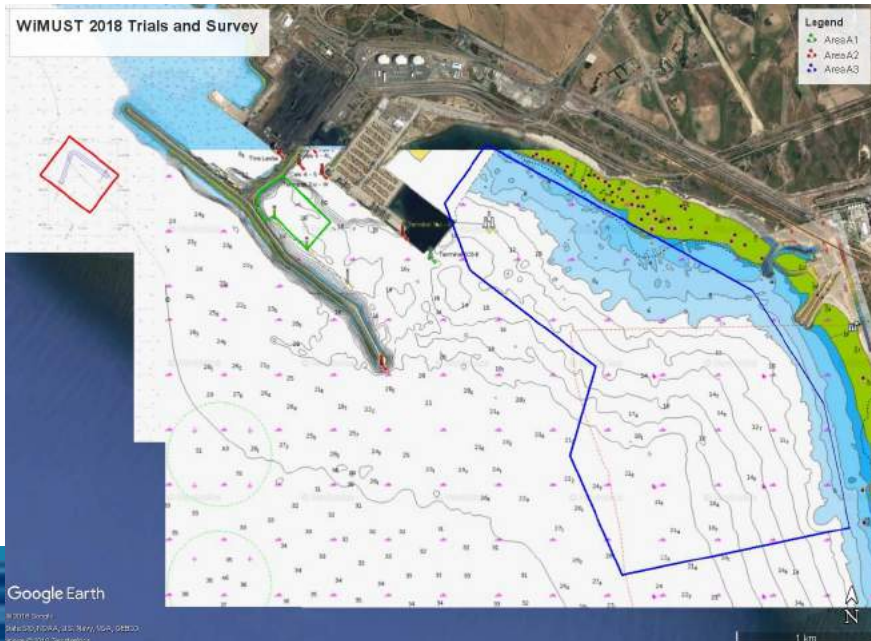
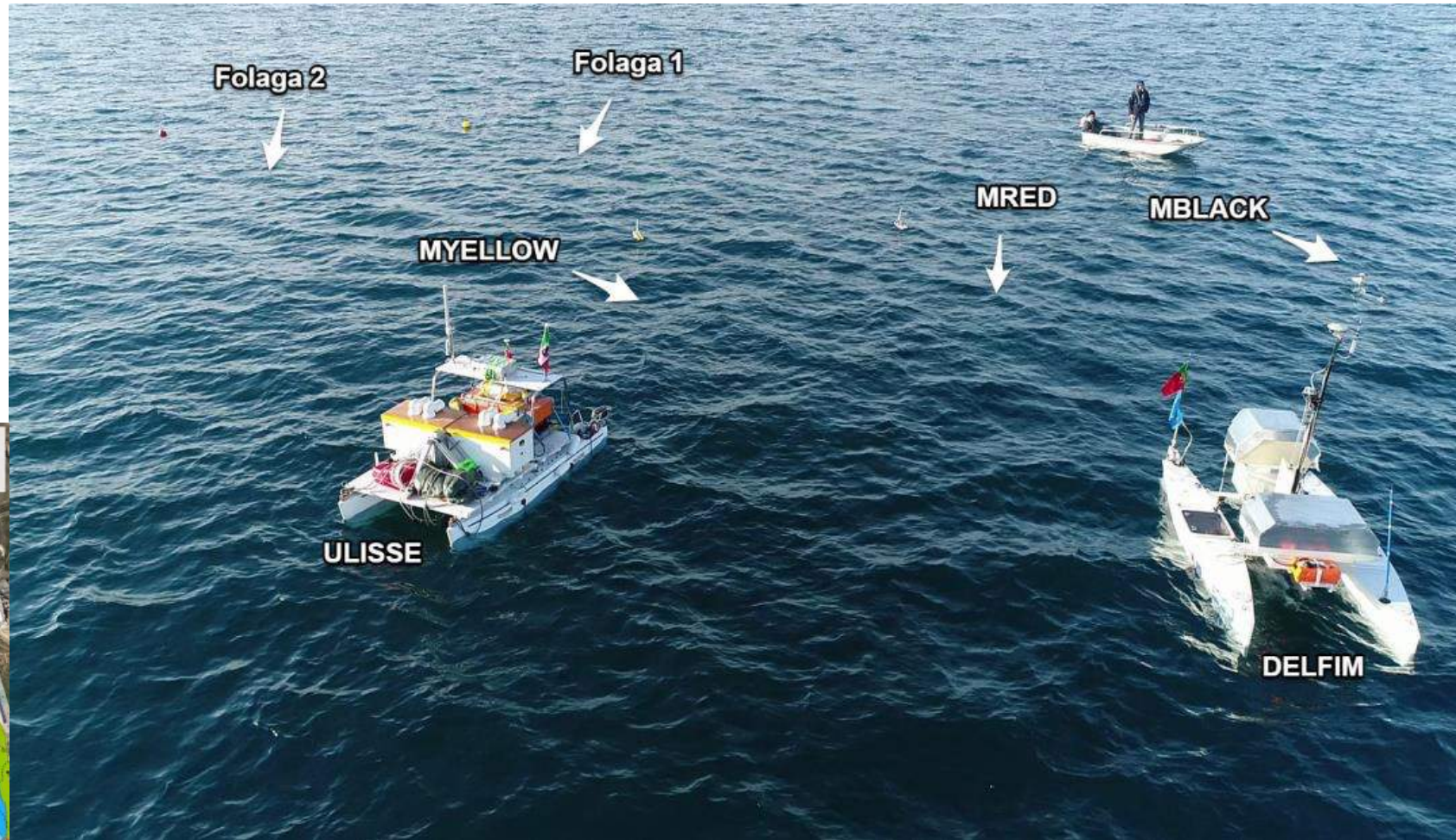
9 partners (5 Ind. + 4 Acad.)
from 6 EU Countries

Coordinated by ISME
(Prof. Giovanni Indiveri)

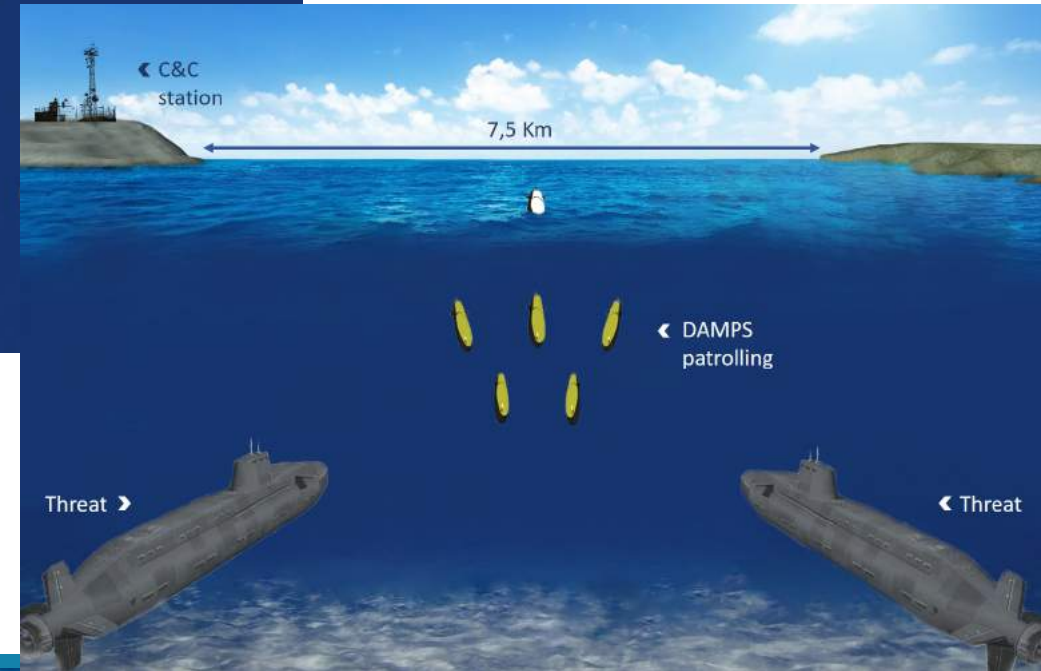
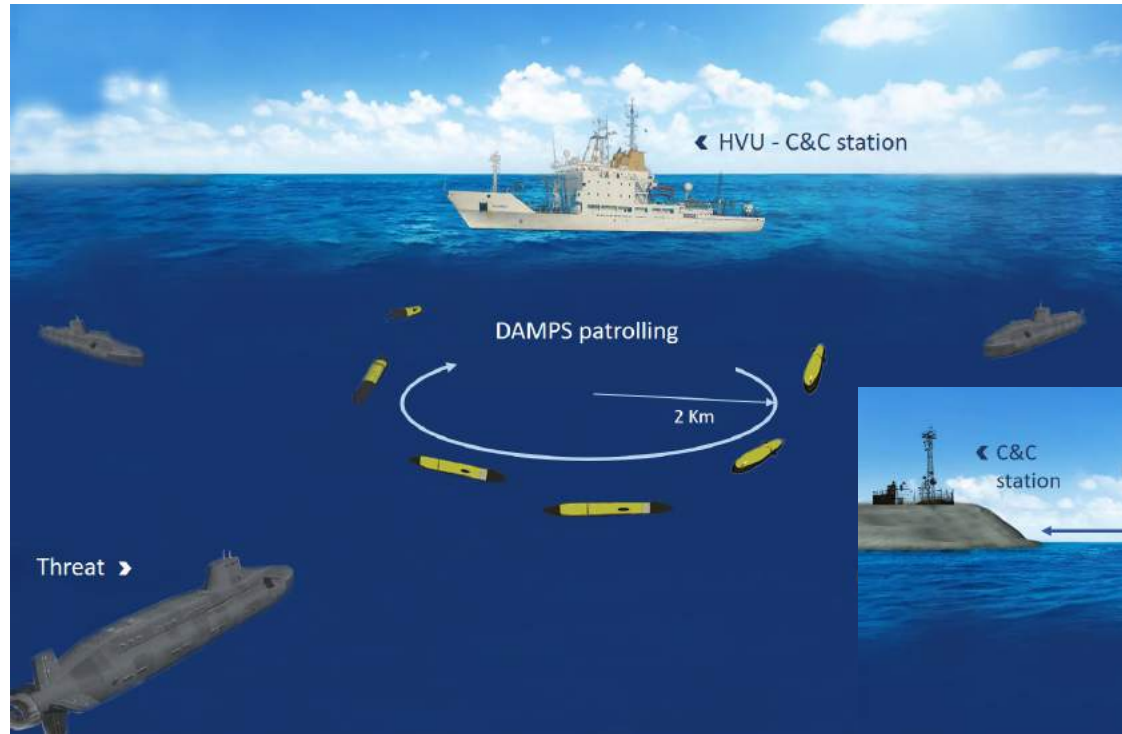
Widely scalable Mobile Underwater Sonar Technology – the big picture (2015 – 2018)



**DEMO @ CSSN DI LA
SPEZIA A LUGLIO 2018**



DAMPS - Distributed Autonomous Mobile Passive Sonar System



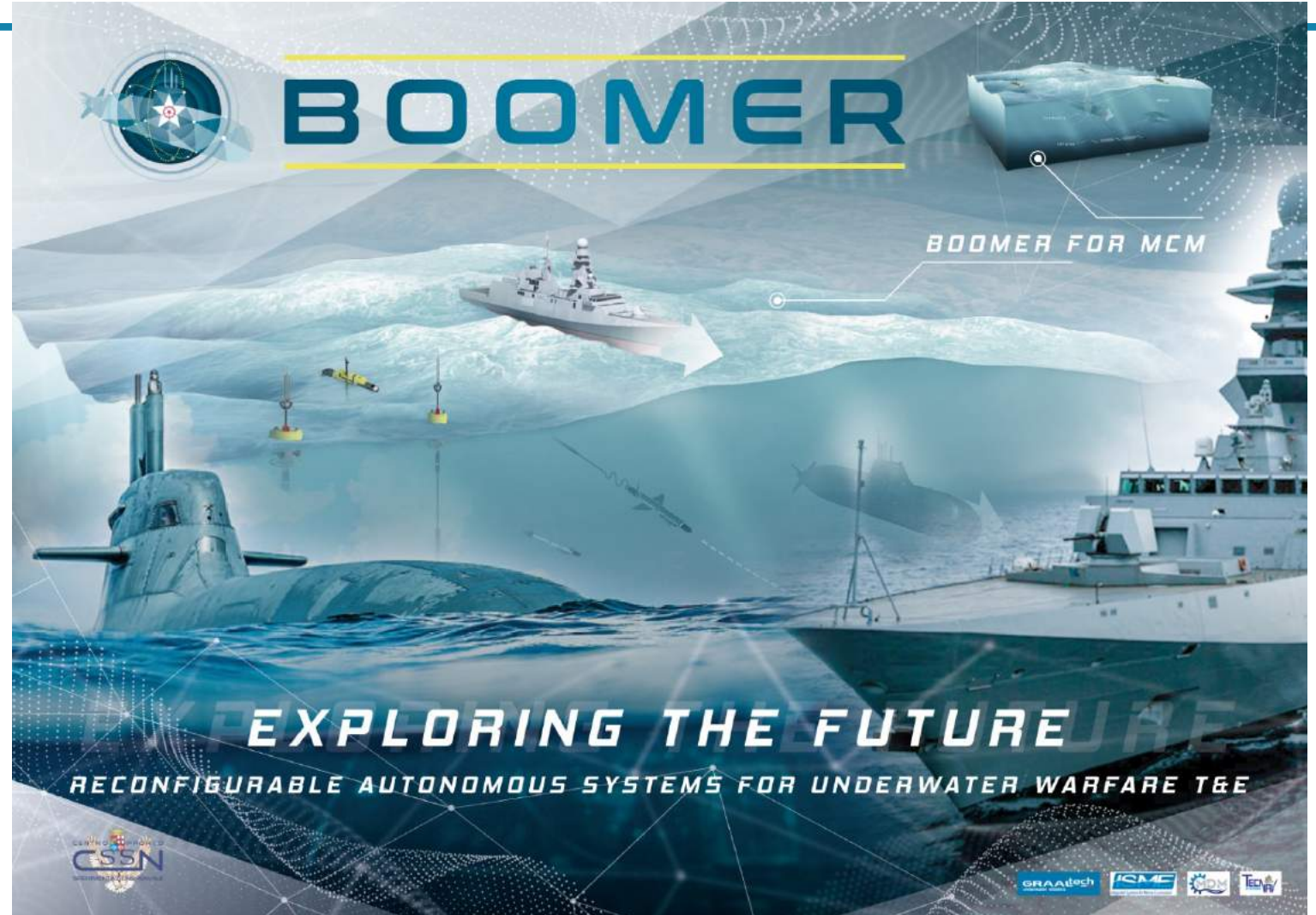


Integrated Systems for Marine Environment



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

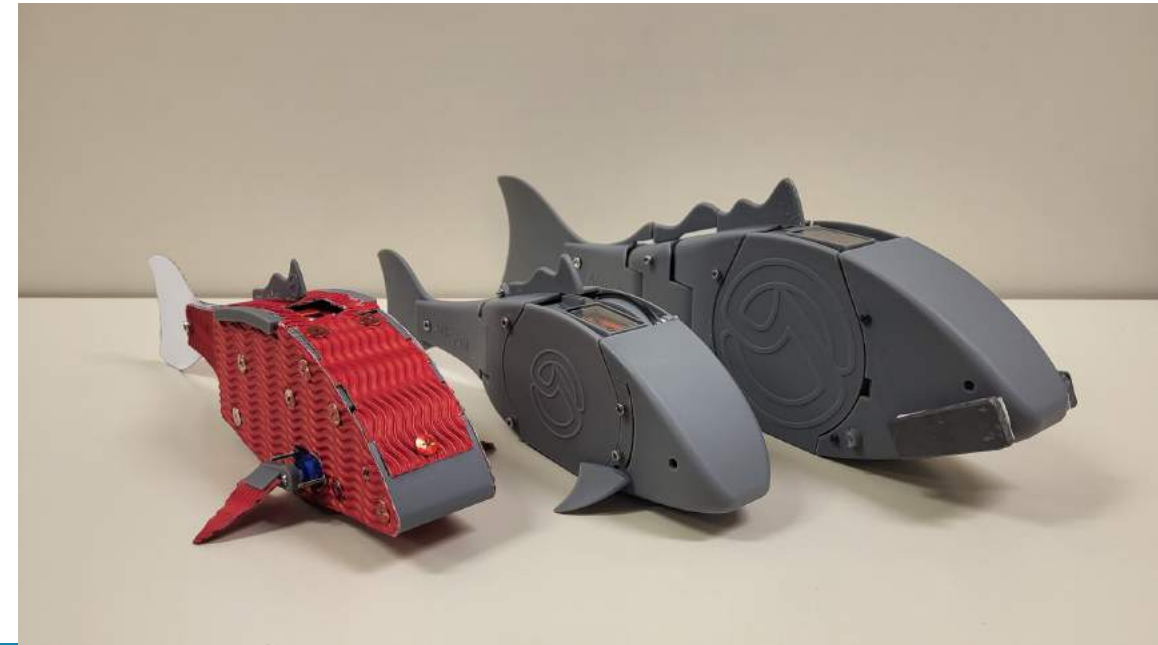
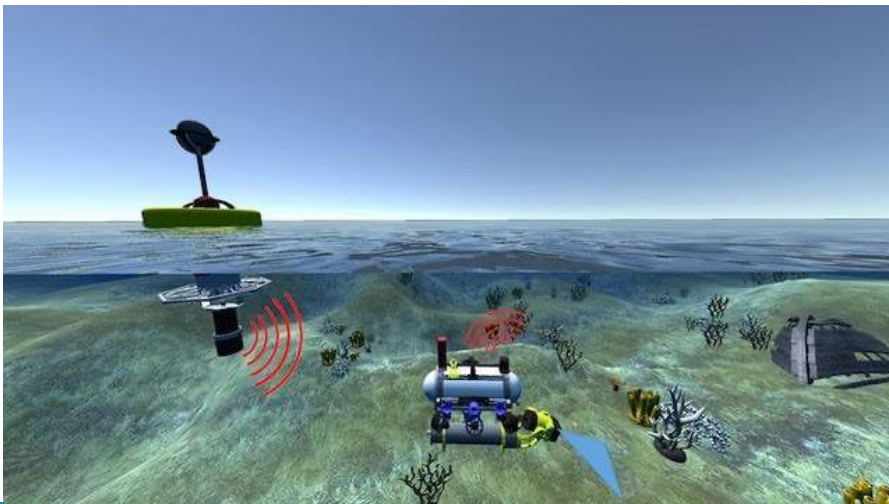
BOOMER (2020 - 2022)



PRIN 2022

Three *fresh* national projects (start sept 2023)

- ✓ MAXFISH (UNICAS + UNIVPM + UNIBO) : multiagent, distributed, biomimetics, maxplus algebra
- ✓ PANACEA (UNIPI + UNIFI) : surface+underwater, human-robot interaction, coverage
- ✓ COMET (UNIPI + UNICAS) : multiagent, distributed





UNIVERSITÀ DI PISA



UNIVERSITÀ
DEGLI STUDI
FIRENZE

DIEF
DIPARTIMENTO
DI INGEGNERIA
INDUSTRIALE

PANACEA - Posidonia monitoring Activities for the conservation of the NATural Coastal Environment using Autonomous robots

2023 - 2025

PANACEA project

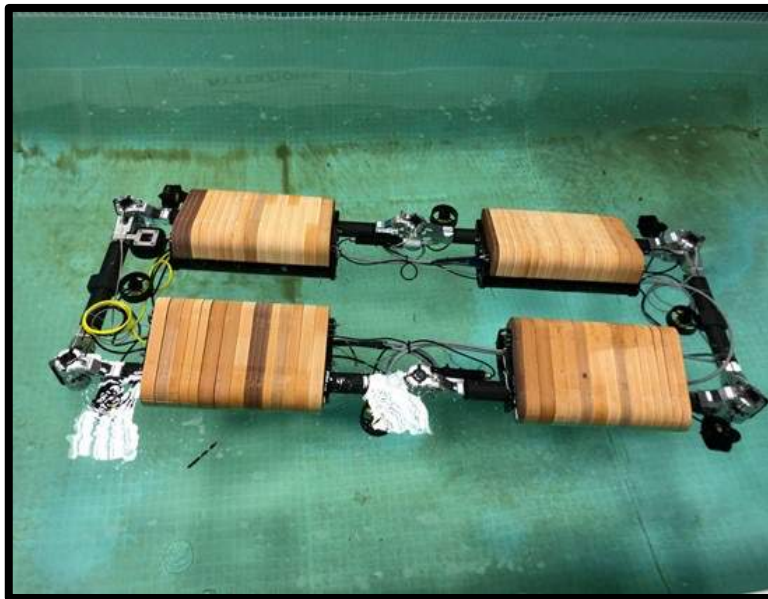


UNIVERSITÀ DI PISA

DIIP DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Reconfigurable Underwater Vehicle for Inspection, Free floating Intervention and Survey Tasks

Thanks to two actuated joints, the vehicle can autonomously change its shape, switching between two extreme configurations



Survey Configuration

- Hydrodynamic efficiency
- 4 Thrusters along surge direction



	MDMlab	
Length (m)	1.8	1.2
Width (m)	0.6	1.3
Height (m)	0.3	0.3
Weight (kg)	90	90
Horizontal plane propellers	4	4
Vertical plane propellers	4	4
Controlled DOFs	5	6
Free Joints	4	4
Actuated Joints	2	2
Absolute Encoders	6	6



Hovering Configuration

- 6 DOFs
- High maneuverability

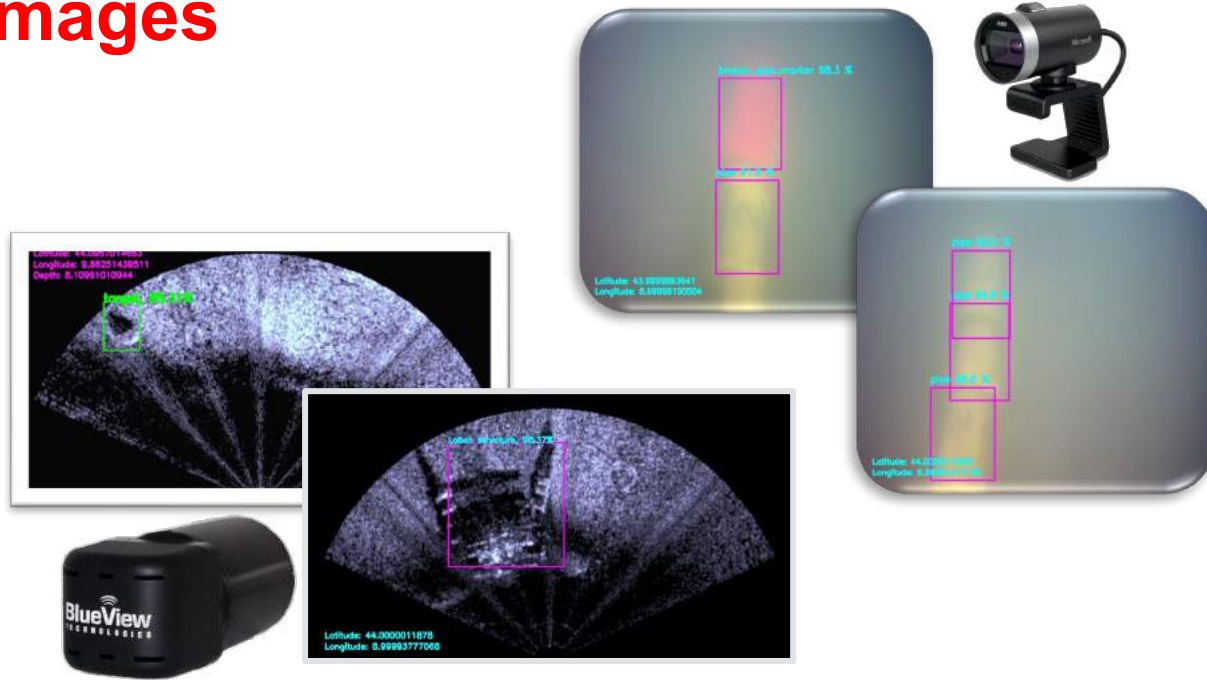


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DIPARTIMENTO
DI INGEGNERIA
INDUSTRIALE



Automatic Target Recognition

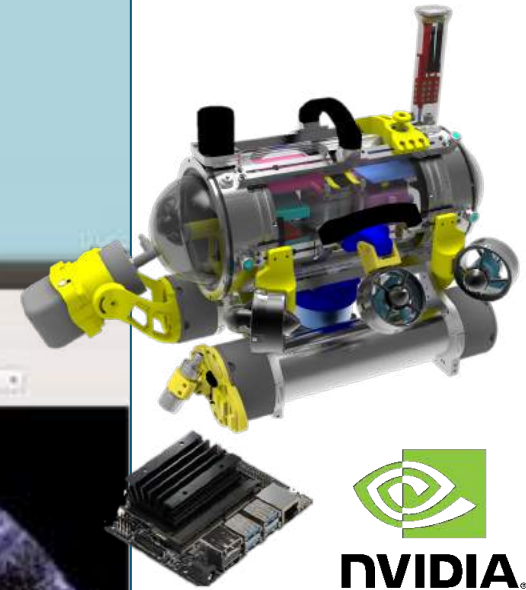
Optical & acoustic images



Zacchini et al., "Forward-Looking Sonar CNN-based Automatic Target Recognition: an experimental campaign with FeelHippo AUV", 2020 IEEE/OES Autonomous Underwater Vehicles Symposium (AUV).

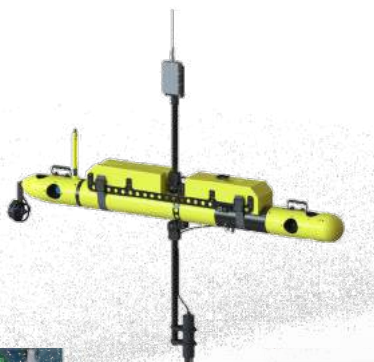


AI-based real-time onboard ATR





ATR for seep detection



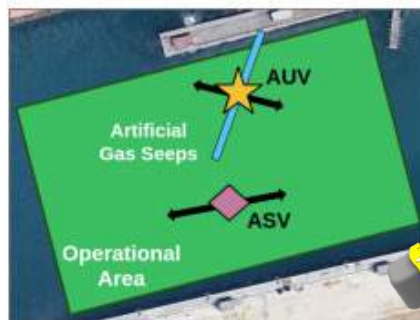
(a)



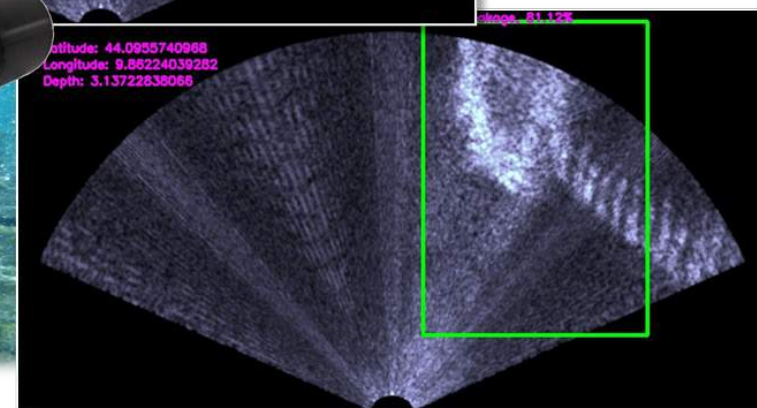
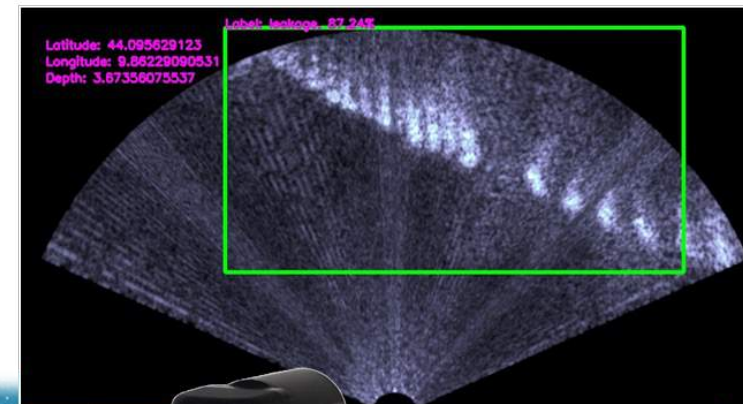
(b)



(c)



(d)



NVIDIA



TensorFlow

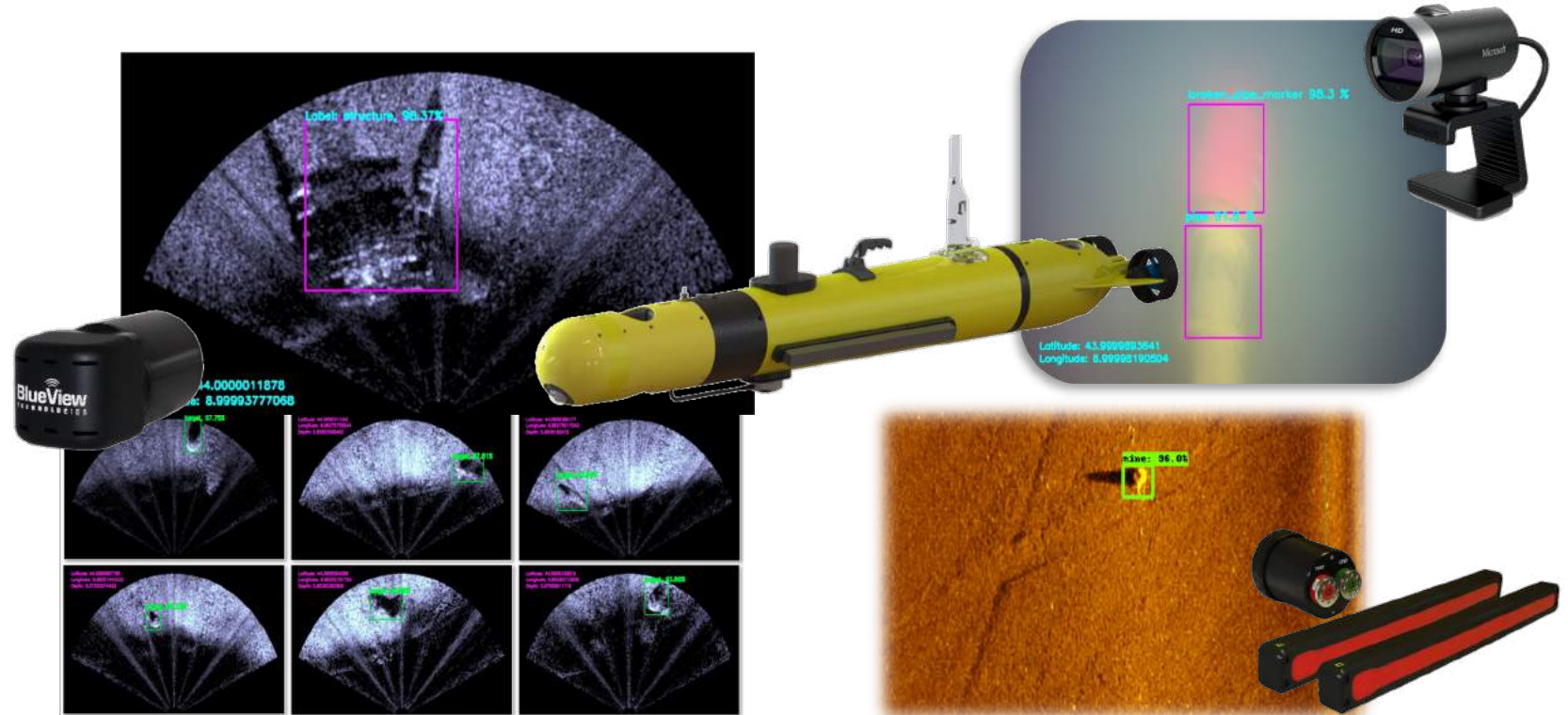
Bresciani, M., Zacchini, L., Topini, A., Ridolfi, A., & Costanzi, R. (2024). Automatic target recognition and geolocalisation of natural gas seeps using an autonomous underwater vehicle. *Control Engineering Practice*, 145, 105864.



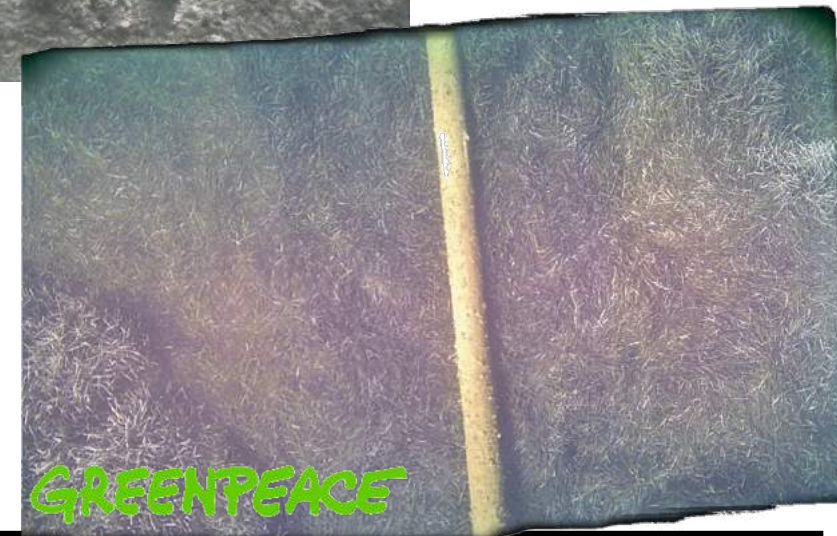
PACMAN project (PNRM)



Proficient Artificial intelligence Counter Mine AutoNomous vehicles – PACMAN



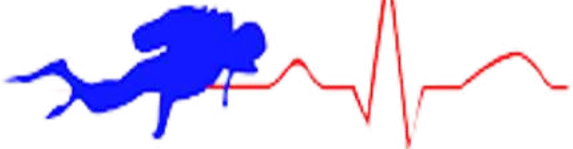
Autonomous monitoring based on optical



Divers assistance



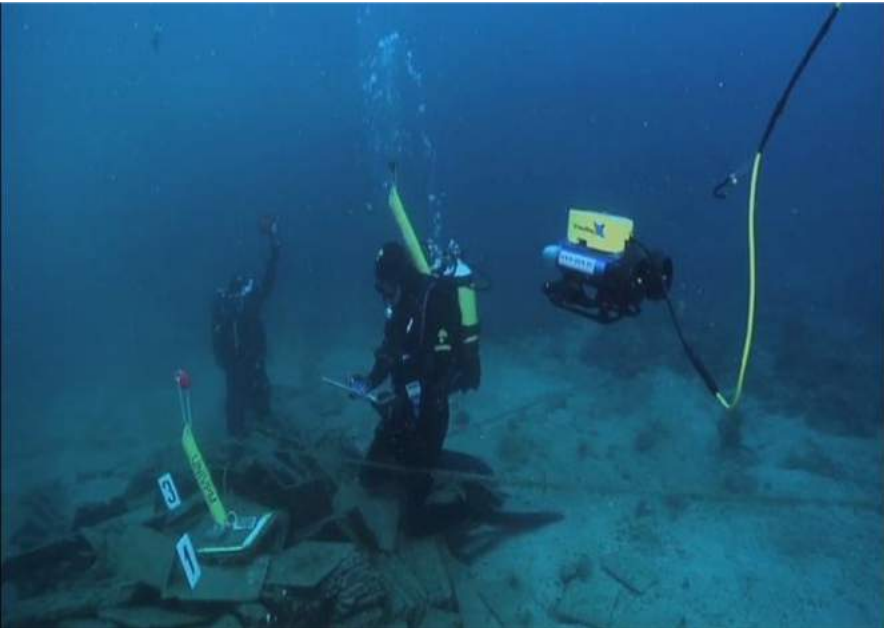
ROAD Project



David Scaradozzi
ISME node of Ancona



Alessandro Casavola
ISME node of Calabria



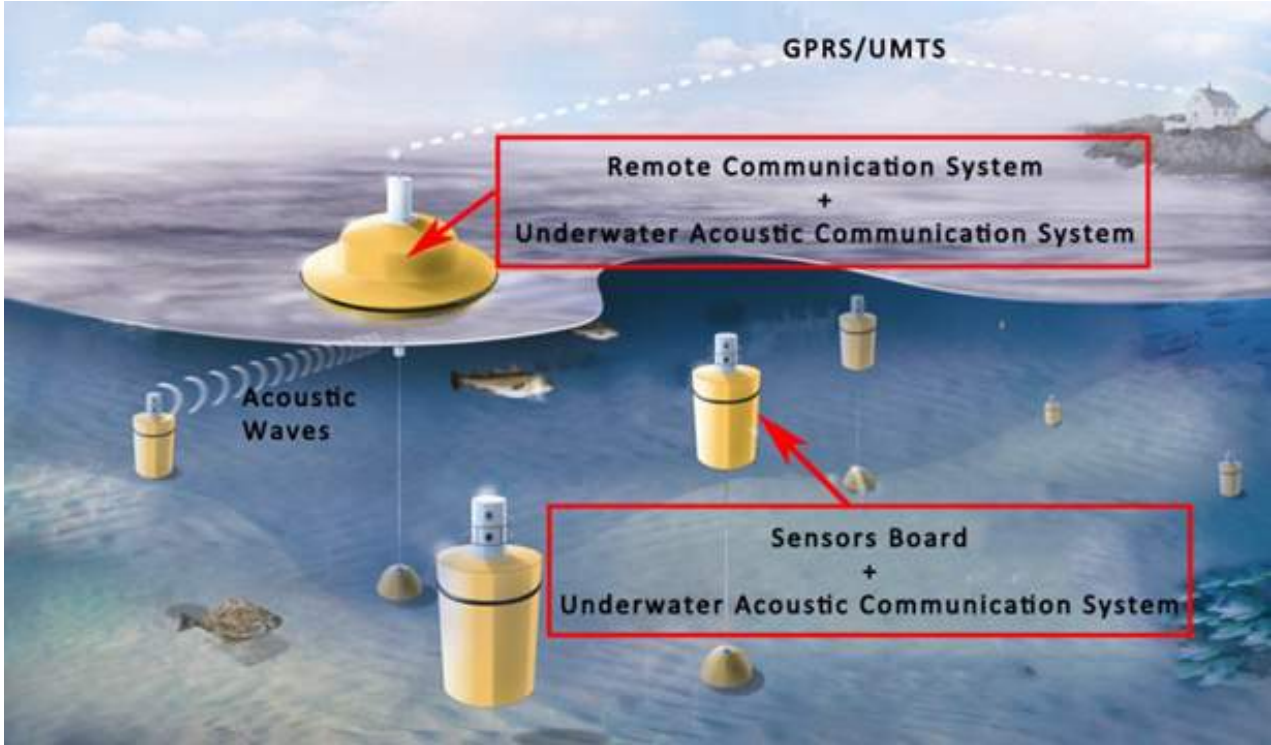
UW communications



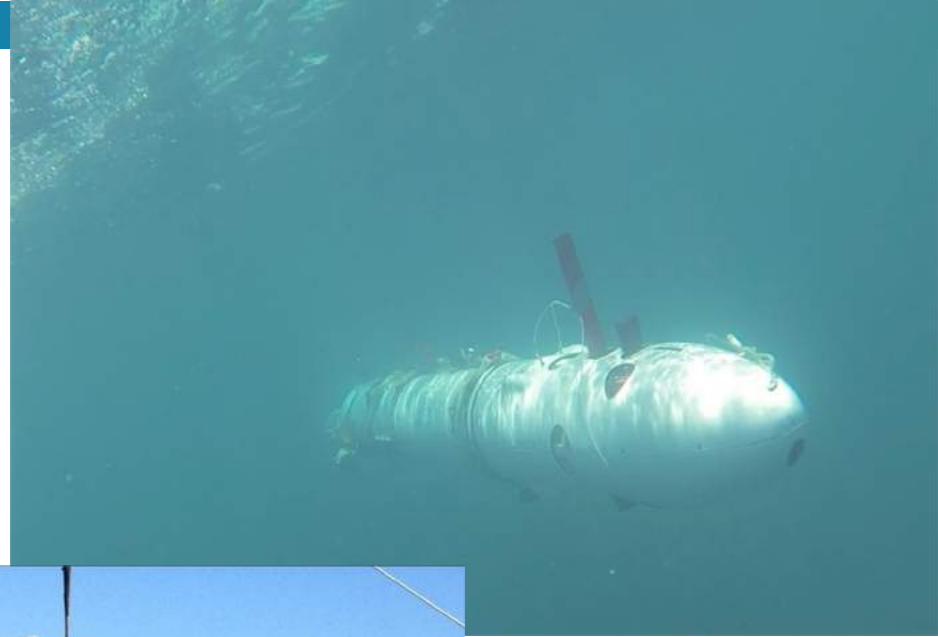
Andrea Caiti
ISME node of Pisa



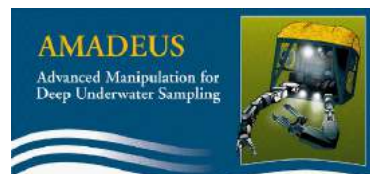
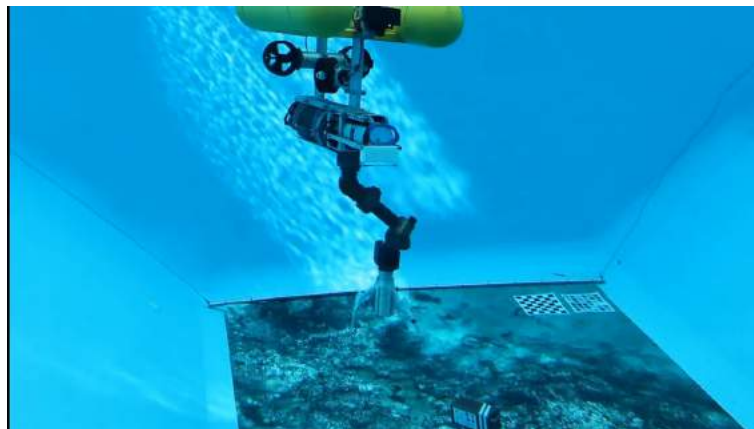
Chiara Petrioli
ISME node of Roma



Single agent autonomy



ISME works on an intervention since before its birth (1997)

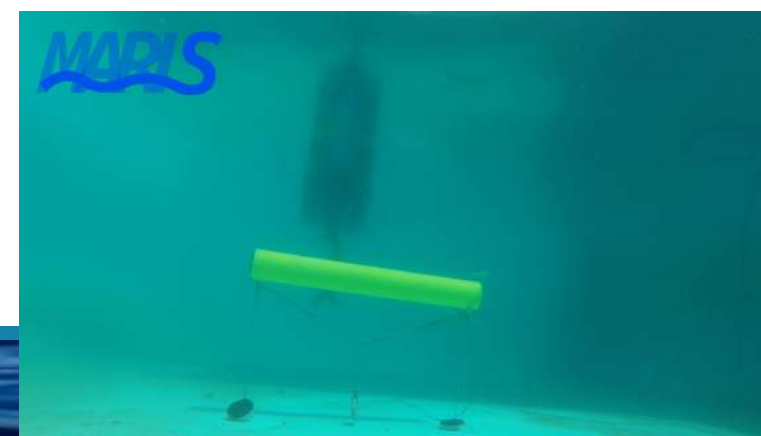


1997

2000

2010

2020





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

- Master Students
- Ph.D.
- Navy Officers
- Applied Industrial Researchers
- Academic Researchers and Prof.

Dottorato Nazionale di Robotica (capofila UNIGE)





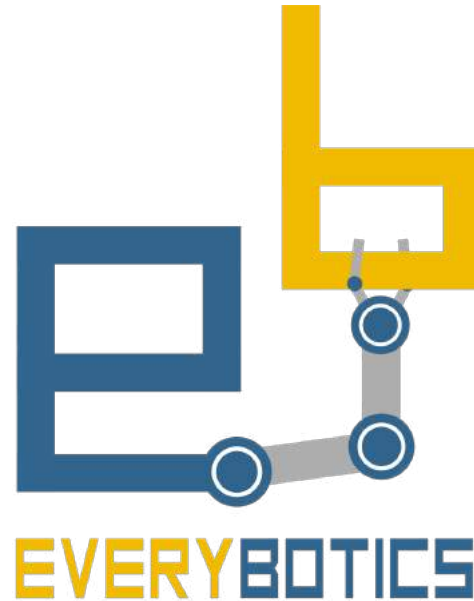
MASTER EAS

MASTER UNIVERSITARIO DI II LIVELLO IN ELETTROACUSTICA SUBACQUEA E SUE APPLICAZIONI

Il Master è gestito dal Dipartimento di Ingegneria dell'Informazione dell'Università di Pisa,
nell'ambito di una Convenzione con l'Accademia Navale di Livorno

< >

Spin Offs (and alike)





ISME Youtube channel

Director

Giovanni Indiveri - giovanni.indiveri@unige.it

Associated Universities and Departments with point of contacts

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University of Calabria – Alessandro Casavola - a.casavola@dimes.unical.it

University of Roma “La Sapienza” – Chiara Petrioli - petrioli@di.uniroma1.it

University of Bologna – Claudio Melchiorri - claudio.melchiorri@unibo.it

An underwater scene with a blue color palette. In the center, two bright light sources create a circular glow, surrounded by a school of small fish. The foreground shows a sandy seabed with some rocks and coral. The overall atmosphere is serene and deep.

Thank you !