INSTITUTE FOR SYSTEMS
AND COMPUTER ENGINEERING,
TECHNOLOGY AND SCIENCE

INESCTEC

CRAS

SCOPE AND ACTIVITY FOR 2021/22

CCI/2021-12-14

from knowledge
generation to
science-based
innovation

CENTER FOR ROBOTICS AND AUTONOMOUS SYSTEMS

*Make robotic and other autonomous systems able to operate in **complex**, **unstructured** and **dynamic environments** with increasing levels of **autonomy**, by enhancing their **perception**, **understanding**, **reasoning**, **decision**, and **interaction** capabilities.*

Motivation & Drivers

The Extension of the **Portuguese Continental Shelf**, and **the national Plan for Recovery and Resilience**.

Horizon Europe Missions

- Adaptation to Climate Change
- Restore our Ocean and Waters
- Climate-Neutral and Smart Cities

UN Sustainable Development Goals

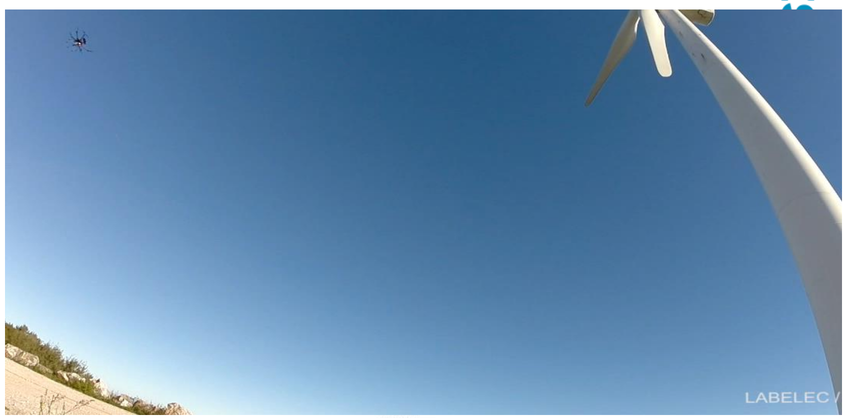
- Clean Water and Sanitation
- Climate Action
- Life Below Water

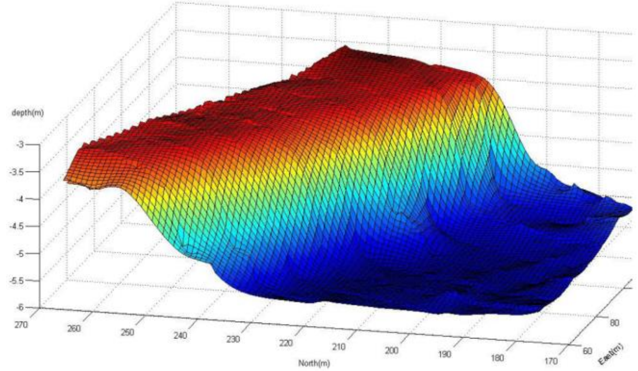
RL1 – Navigation & Control
RL2 – Interaction with Environment
RL3 – Mapping & Real Time Perception
RL4 – Platforms & Operations

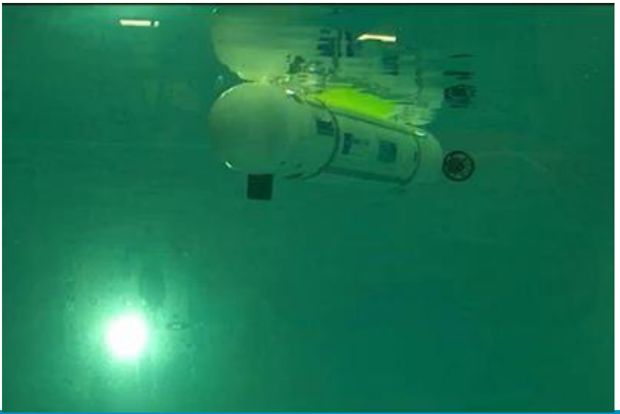
INOV1 – Robotics systems prototyping and upscaling
INOV2 – Navigation and mapping
INOV3 – Component development for robotics systems
INOV4 – Underwater acoustics for positioning, navigation and communications

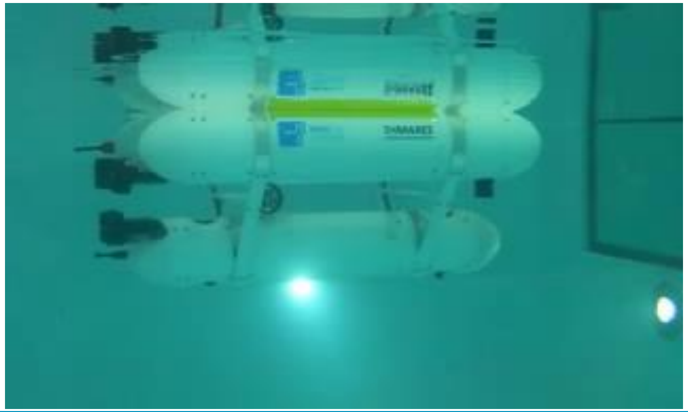
RL1 – NAVIGATION & CONTROL

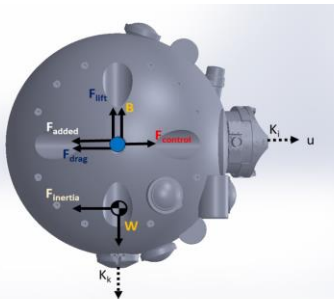
- Dynamic modelling of sensors and platforms
- Accurate estimation of position without GNSS
- Simultaneous localization and mapping
- Multi sensor data fusion
- Semantic navigation, environment aware navigation
- Control of moving platforms subject to disturbances
- Adaptive sampling

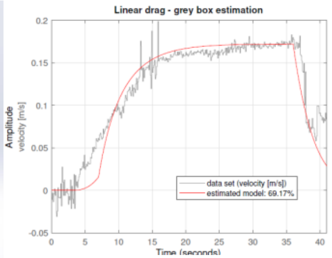






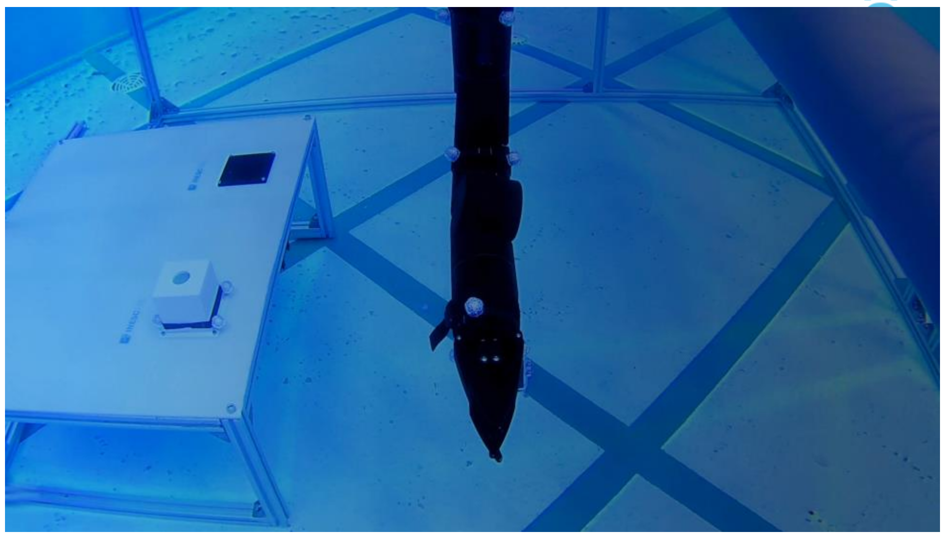


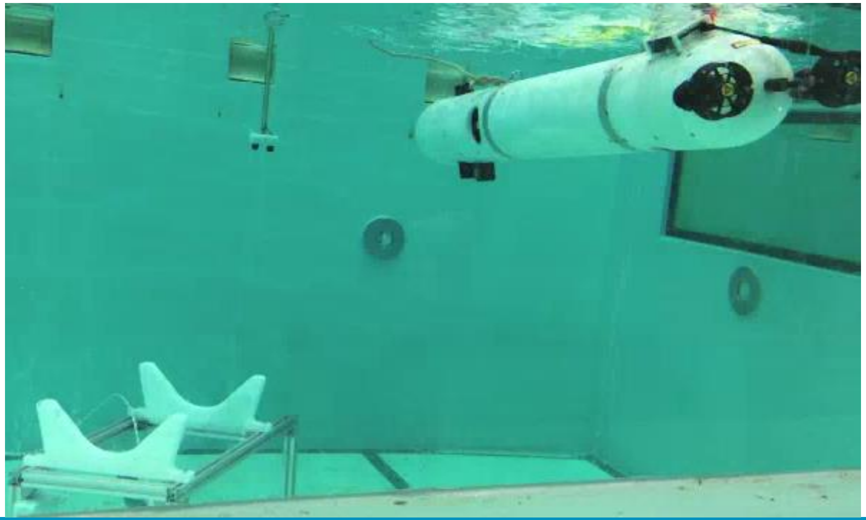




RL2 – INTERACTION WITH ENVIRONMENT

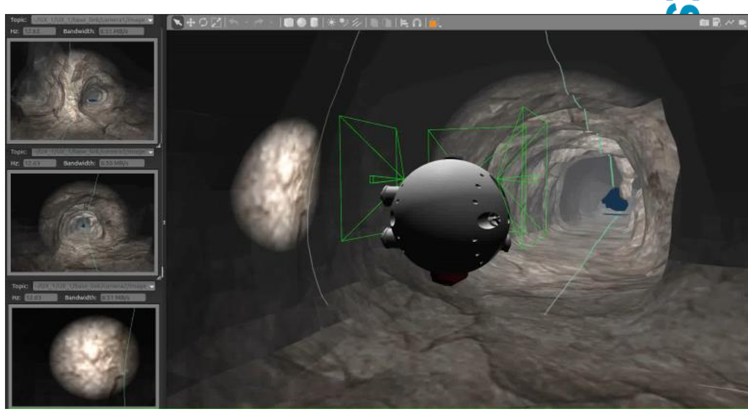
- Mobile intervention from floating platforms
- Oil spill mitigation
- Autonomous picking and placing
- Underwater homing and docking

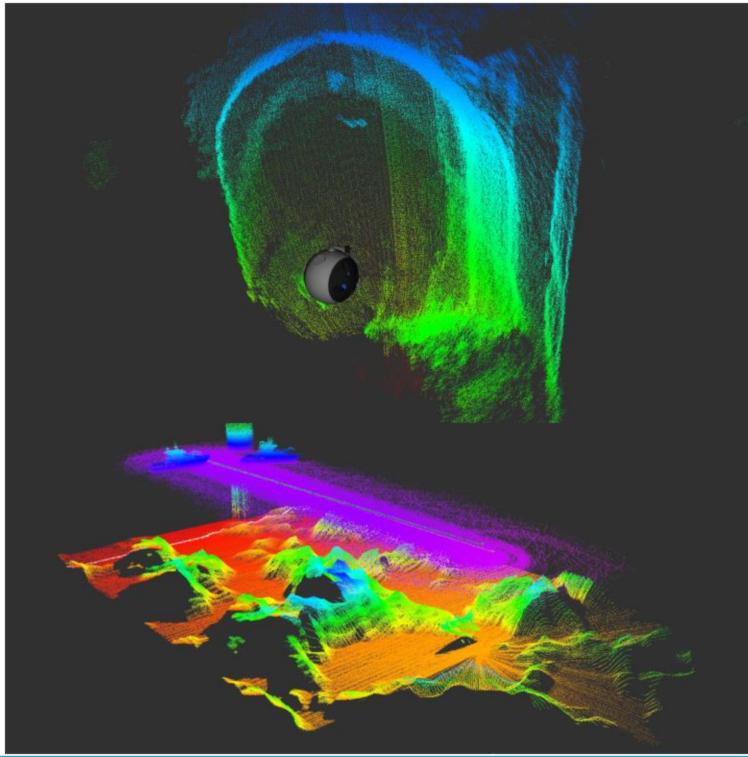


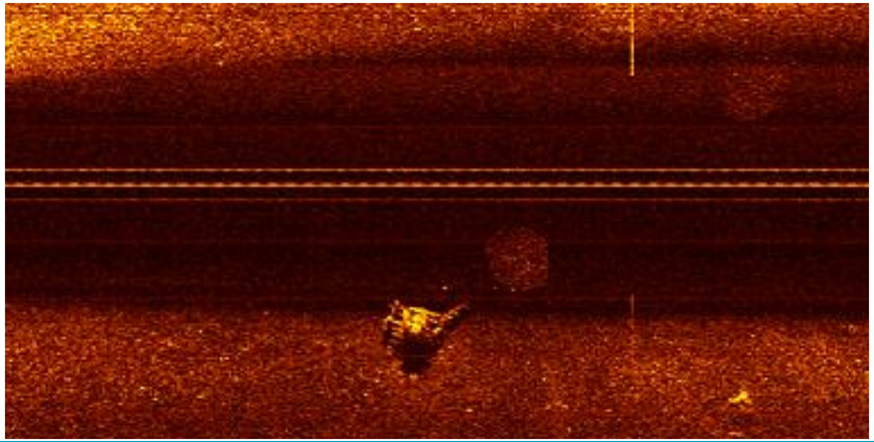


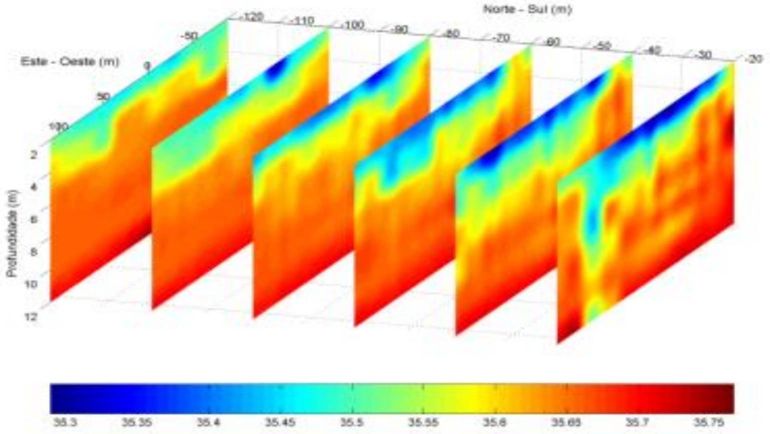
RL3 – MAPPING & REAL TIME PERCEPTION

- Underwater acoustic mapping
- Multi sensor 3D environment modelling
- Multi modal data fusion and mapping
- Hyperspectral, electro-optic, and acoustic image processing
- Distributed perception



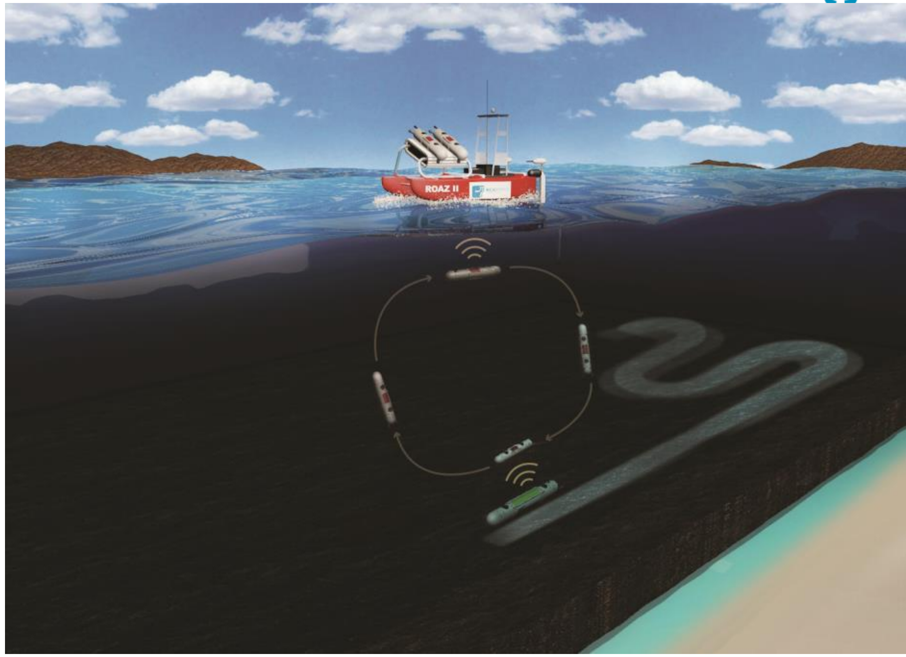


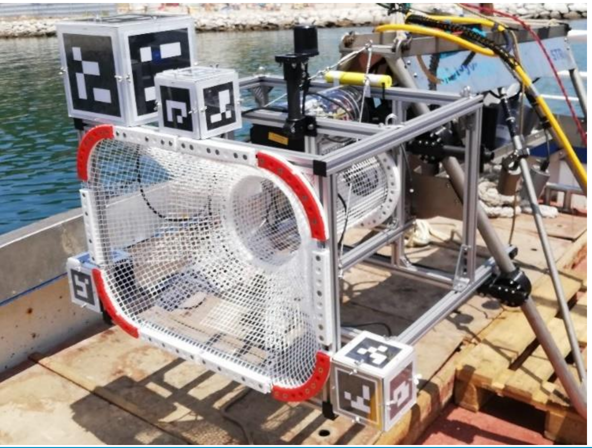




RL4 – PLATFORMS & OPERATIONS

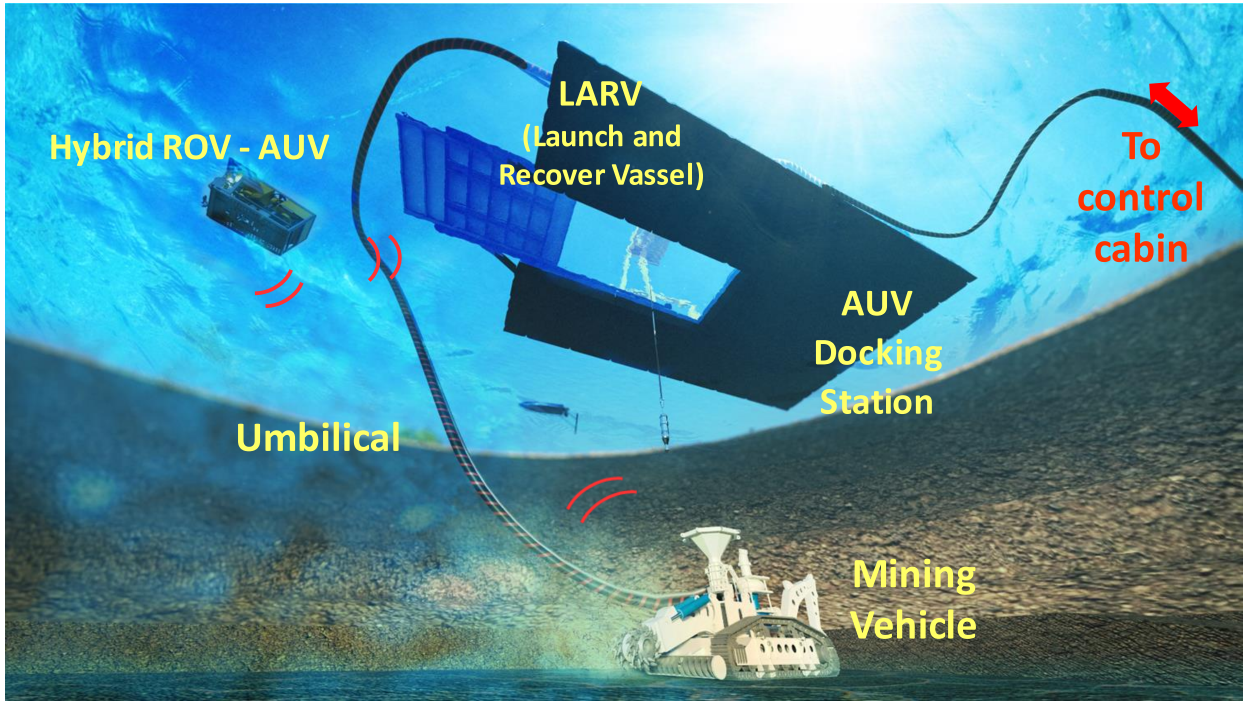
- Innovative robotic solutions
- Persistent robotics for oceans exploration
- Heterogeneous robotic teams
- Underwater docking stations
- Underwater data and energy mules





FROM RESEARCH TO INNOVATION

VAMOS SYSTEM OVERVIEW



Command and Control
VR based interface

Hybrid ROV / AUV

Remoted operated Mining Machine

Support Vessel

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INNOVATION ACTIVITIES/MAIN MARKETS AND APPLICATION AREAS

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	TEC4AGRO	TEC4ENERGY	TEC4HEALTH	TEC4 INDUSTRY	TEC4SEA	Other
INOV1. Robotics systems prototyping and upscaling	FeedFirst	Automon Grifo-X EVA AUV		Activity	Automon; UX1-Neo/UGR Grifo-X Turtle 4k IRIS/NetTag eDNAuto Nessie Dock NoduleMiner6k	
INOV2. Navigation and mapping	Activity	SantoAntonio EVA AUV Grifo-X		Activity	Santo Antonio UX1-Neo/UGR ESAPlastics UWNav Fusion stack	
INOV3. Component development for robotics systems	Activity				SLS Unexup / Vamos MARESYE LIBS inSite	
INOV4. Underwater acoustics for positioning, navigation and communications					IRIS/NetTag	

INNOVATION ACTIVITIES/MAIN MARKETS AND APPLICATION AREAS

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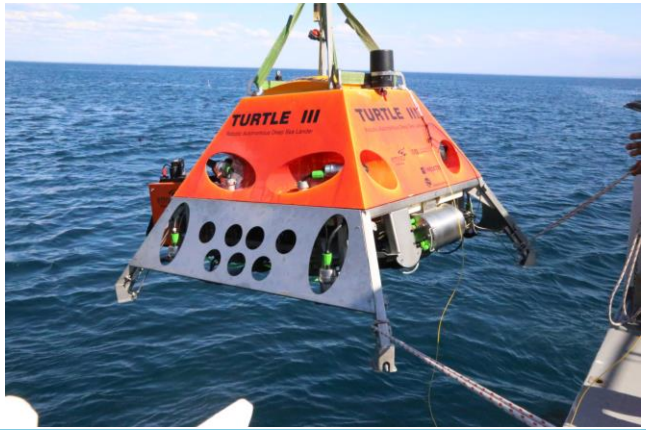
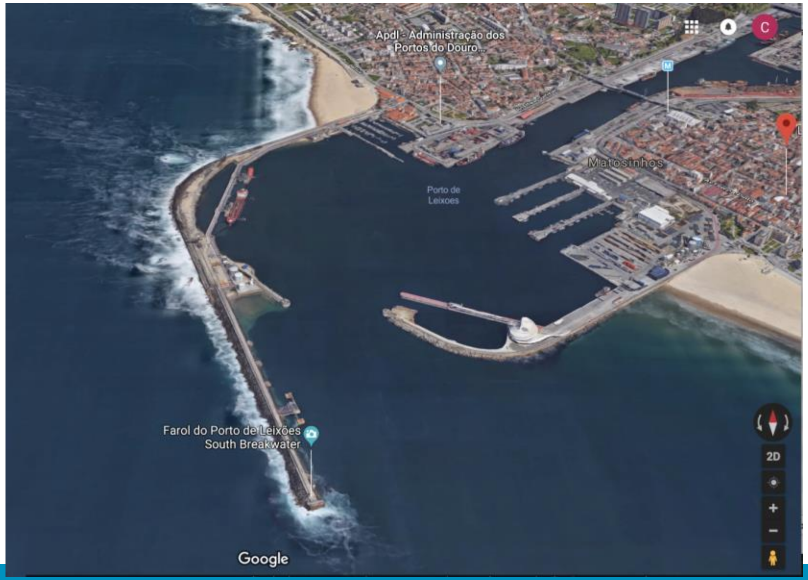
- Santo Antonio – Inspection of Dam shaft and Sediment mapping
- Automon – Water sampling collection for evaluation of suspended sediment
- eDNAuto – Water Sample device for Niva
- Turtle 3 – Third version for 4000m
- NoduleMiner6K – Concept Design of a Nodule Mining System for 6000m

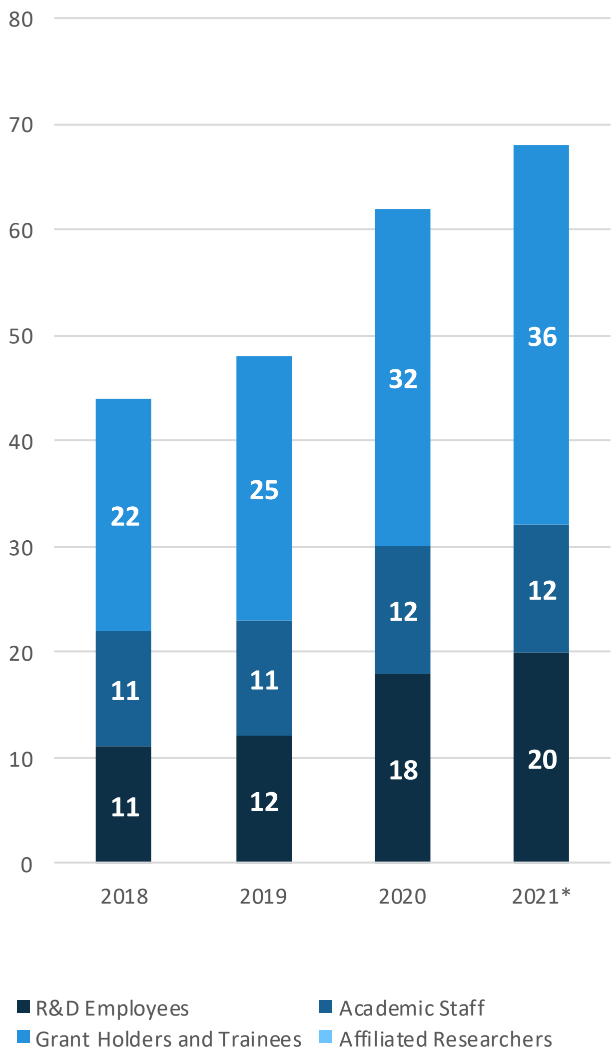


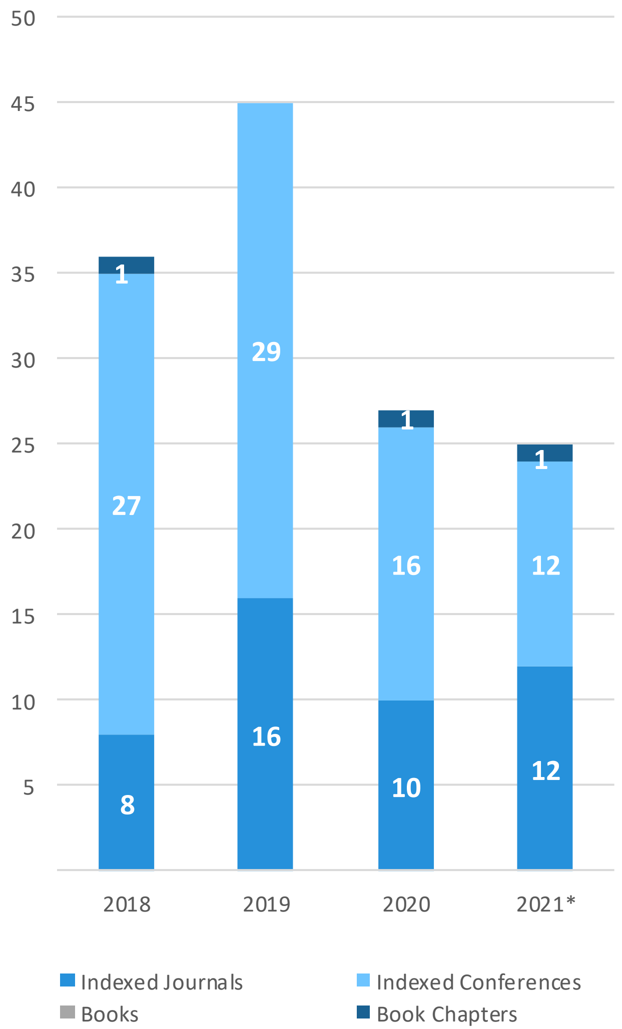
CRAS FACILITIES

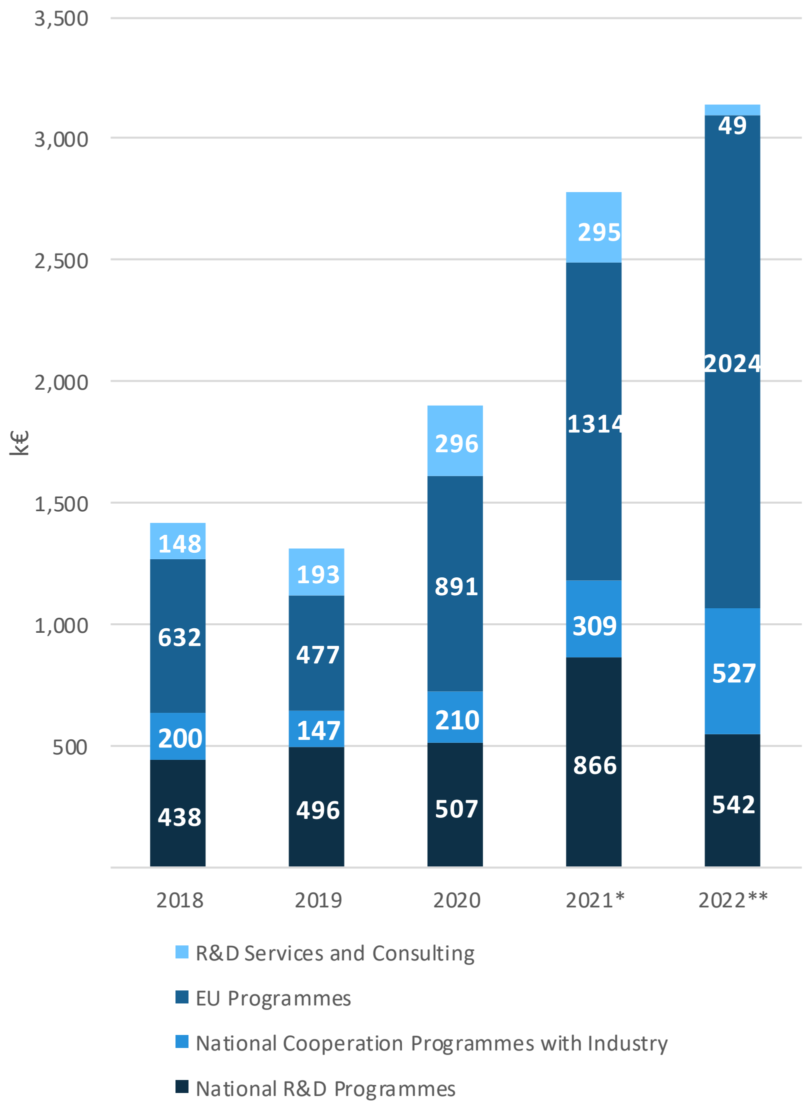
- >1000m2 lab space, in 2 locations
- 2 test tanks (largest: 10x6x5 m3), with underwater tracking system
- Pressure chamber (400 bar)
- Harbor facilities and vessels



CRAS - TEAM AND ACTIVITY







OBJECTIVES AND THEIR ACHIEVEMENT IN 2021

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OBJ1. Scientific publications -

- Increase the number of papers published in first quartile journals.

OBJ2. Partnerships.

- Strengthen already established partnerships with CAP and CTM and promote joint research initiatives with other INESC TEC centres.
- Deepen scientific cooperation with top research groups in CRAS core areas and relationships with industrial partners in order to promote the transfer of high TRL technologies developed by CRAS.

OBJ3. Leadership and visibility.

- Participate in international technological exhibitions, by the organization of international events (such as special sessions in relevant international conferences) and by the organization of summer schools on robotics.
- Promote short term exchanges of researchers with partner institutions.
- Promote the participation in international forums INESC TEC researchers are involved with: Kick-Raw Materials, EU ROBOTICS, Air Centre, EMSO ERIC.
- Increase the participation of CRAS researchers as journal editors.

OBJ4. Human resources.

- Increase the number of MSc and PhD students in CRAS. Promote joint supervision of PhD students with researchers from other INESC TEC centres.
- Allow younger senior CRAS researchers to enrol in training activities related to project management, proposal preparation, and team management.

OBJ5. Laboratory infrastructure.

- Continue the implementation of the two research infrastructures – TEC4SEA and EMSO-PT.
- Continue the establishment of a top-quality laboratory infrastructure with distinctive and unique capabilities.

OBJECTIVES AND THEIR ACHIEVEMENT IN 2021

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EMSO-PT

Postponed to April'22

EMSO-PT OBJ1 - Deployment of a Turtle node with an EGIM system – The EGIM system assembled at INESC TEC will be integrated on a Turtle lander that will be deployed off the northern Portuguese coast.

EGIM deployment Period 8 days, +800m deep, Unicornio Seamount –with IMPA

EMSO-PT OBJ2 - Deployment of a glider network – two operational gliders equipped with payload sensors will be deployed in cooperation with EMSO-PT partners to conduct several experiments.

Glider deployment Period 12 days @ REPMUS

TEC4SEA

Postponed to April'22

TEC4SEA OBJ1 - Conclude the first investment phase – current investment plan and deadlines are very challenging. Concluding this plan within the timeline will enable the infrastructure to become active and start offering differentiated services to the stakeholders.

TEC4SEA OBJ2 - Validation of services – the definition of services is being finalized and a series of validation tests will be conducted before these services are offered to the community.

TEC4SEA OBJ3 - Present itself to the world – to end of the 1st implementation phase shall be commemorated with a special event. Different stakeholders shall be invited, and the infrastructure resources presented and visited.

MAIN EXTERNAL PARTNERS AND COLLABORATIONS WITH OTHER CENTRES - RESEARCH

Research

Inovation

Internal

CAP	CTM	CSIG	CPES
TEC4SEA INSITE ESAPLASTICS	TEC4SEA GROW	SAIL NEWSAT	EU-SCORES
INSITE			

External

ASM	CIIMAR	MARINHA	IPMA
Nessie Hipersie	Biorem Connect2Ocean eDNAuto	Sail REPMUS	EMSo-PT Grow Hipersea
MIT	**KRISO**	**UGR**	**PTSpace**
K2D	Joint Research	UNEXUP	MoU

ESA – ESAPlatics; TORI – MoU; APDL & CompositeSolution - Marimar

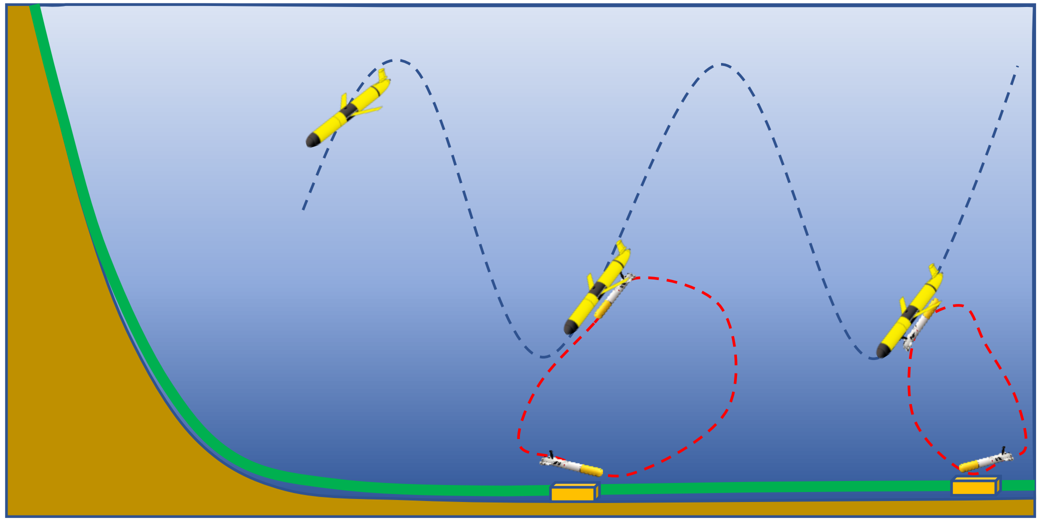
K2D (MIT/PORTUGAL, 2020-2023)

Knowledge and Data from the Deep to Space

CTEC

Take advantage of existing undersea cables to develop a network for continuous, real-time sensing of oceans vital signals

- Use a synergistic set of devices, from electronic components to autonomous underwater vehicles
- Collect complex data from the oceans: physical, chemical, biological and environmental variables
- Develop a new repeater for submarine cables to monitor the water column and surroundings
- Integrate autonomous underwater vehicles in the monitoring system in order to complement the data collected by the fixed nodes



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ATLANTIS (H2020, 2020-2023)

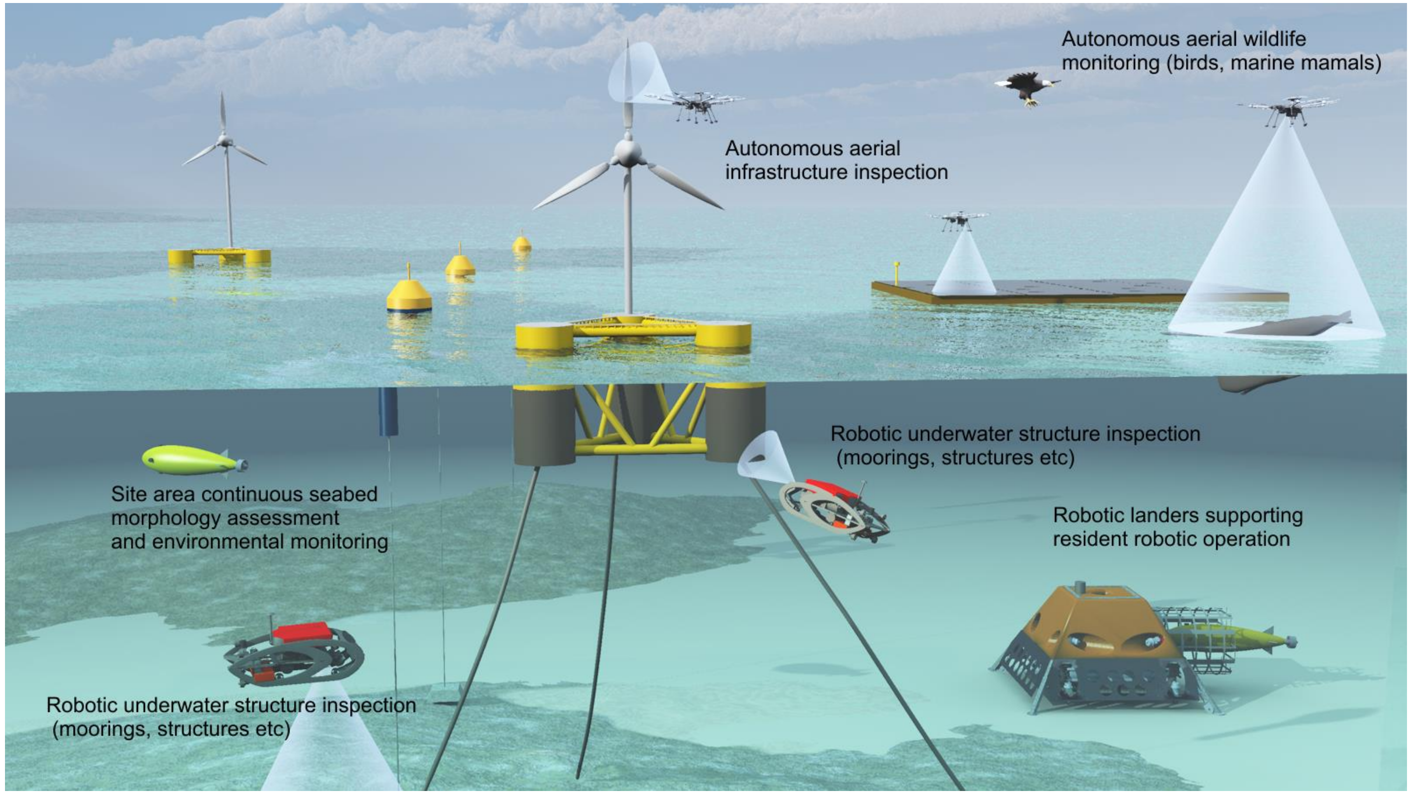
The Atlantic Testing Platform for Maritime Robotics

Pioneer pilot infrastructure capable of demonstrating robotic technologies for inspection and maintenance of offshore wind farms

- Provide early access by medium-sized enterprises, R&D institutions and energy operators to a pilot infrastructure for validating innovative and technological solutions
- Use of heterogeneous robotic platforms for inspection and maintenance, below and above water
- Reduced life-cycle costs with increased efficiency in the use of robotics for inspection and maintenance

EU-SCORES-(HEU, 2021-2024)

EUROPEAN - SCALABLE AND COMPLEMENTARY OFFSHORE RENEWABLE ENERGY SOURCE



CPES – Electrical infrastructure design, energy management, provision of system services, electricity market design and simulation

CRAS – Marine robots & sensor integration for environmental and condition monitoring

CEGI – Development of O&M tools for multi-technology offshore power plants

CAP – Sensors for environmental monitoring

2.2 M€ budget [INESC TEC]

Offshore wind + floating PV:
Belgium DEMO

Offshore wind + wave:
Portuguese DEMO

UNEXMIN (H2020,2016-2019) UNEXUP (EIT RM,2020-2022)

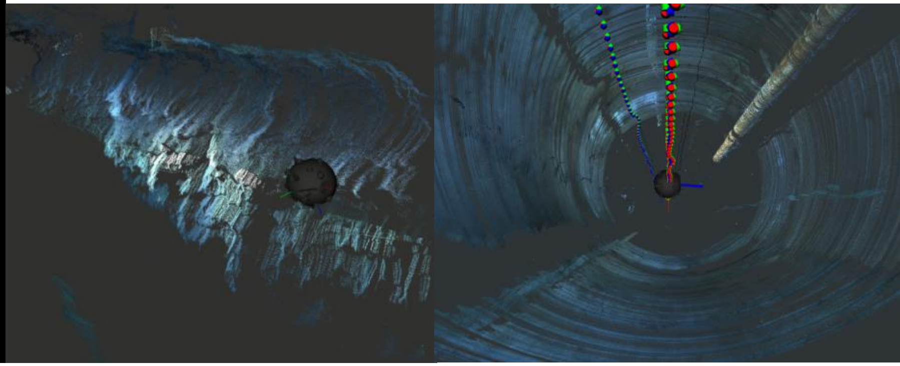
Robotic exploration of flooded mines

UGR - Spinoff for UNEXMIN results exploitation

UNEXMIN technology upscaling

Second generation robotic explorer

Modular robot with extended capabilities



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YOU ARE INVITED TO COME AND VISIT OUR LABS!

Thank you!

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