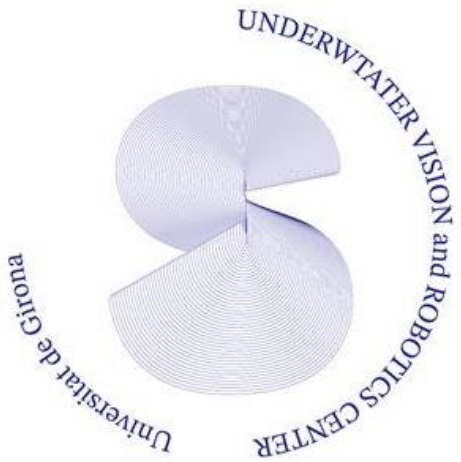


CIRS Access Protocol

Version: V0.4

Universitat de Girona
Institut de Recerca en Visió per Computador i Robòtica

Table of content

1. Scope

This document regulates the access conditions for the research and technological community from Spanish or foreign institutions, public or private, to the services and facilities of the Centre d'Investigació en Robòtica Submarina (CIRS). These access conditions facilitate the execution of R&D projects, supporting scientific and technological innovation in underwater robotics.

There are three types of access established:

a) Competitive Access:
As part of a competitive selection process, experimental access proposals are evaluated and ranked by an external Access Committee based on criteria such as scientific excellence, the technical quality of the proposal, and the expertise of the user group, ensuring an open and transparent evaluation.
At least 20% of the annual access capacity of each of CIRS's facilities will be allocated to competitive access.

b) Under requested access:
Under Request Access is not linked to any specific access call, and users are not required to undergo evaluation by an external Access Committee. Instead, users can directly contact CIRS's Director at any time to request access.

c) Access for the execution of research projects involving CIRS:
Access required for research projects where CIRS acts as partner, either fully or partially, will be managed and granted directly by the Director of CIRS, provided these projects do not fall under the two previously mentioned access modalities.

2. Eligible Access Applicants

Access is open to:

- Researchers or industrial professionals from Spanish or foreign institutions, public or private.

- Entities such as universities, research centers, and companies are encouraged to apply.

Applications must be submitted via the CIRS website's Access Portal, where detailed instructions and submission forms are provided.

3. Facilities

The Underwater Robotics Research Center (CIRS) has two different facilities where the vehicles can be operated, the water tank (in the lab) and the Sextant boat (in the harbor of a neighboring town).

3.1 Laboratory Facilities

The CIRS laboratory includes a water tank located in the University of Girona's Scientific Park, Girona, Spain (41.967350N, 2.836216E). It is equipped with a crane to move the vehicles and put structures underwater. The facilities also include an underwater room, with a window to the water tank that provides an excellent view of the vehicles that are operating. A full description of the available infrastructures that can be used can be found in Annex I, which includes:

- A fleet of state-of-the-art autonomous underwater vehicles, which includes:
    - Girona I-AUV
    - Girona 1000
    - Girona 500 AUV
    - Sparus II AUV

- Water Tank: A state-of-the-art testing pool equipped for experiments
- Hyperbaric Chamber which allows validation down to 1400 m depth of pressurized components, including AUV hulls. Essential for the development of new systems that must operate at depth.
- Sextant II: Vessel equipped with a 400 kg hydraulic crane, which allows the simultaneous operation of several underwater robots.

A list of Application Examples can be found in Annex II, section A.

3.2 Test site

Located at the harbor of Sant Feliu de Guíxols, Girona, Spain (41.777412N, 3.033381E), 31km from CIRS facilities there is the SEXTANT II boat provides access to real testing areas where the user can use it for device testing, conduct experiments such as online path planning, photomosaics, forward looking sonar (FLS) maps, bathymetry, among many others. This infrastructure is detailed in Annex I.

The infrastructure that can be used in the test site is the same as the ones that can be used at the CIRS laboratory. A list of Application Examples can be found in Annex II, section B.

4. Services

The available services within CIRS are listed below:

- Boat services for scientific activities.
- Experimental water tank
- Hyperbaric chamber to carry out equipment tests up to 140 bar.
- Realization of underwater maps or bathymetry
- Rental of underwater sensory systems

These services are tailored to meet the requirements of each approved project.

5. Guide for Access Requests

5.1 Competitive Access Calls

Access calls are opened regularly to support R&D projects. Eligible proposals will be evaluated using the following criteria:

Criteria	***Weighting***
1. Scientific and technical quality of the infrastructure time proposal a. General scientific background • Is the current state of knowledge in the research area well described? • Are cited references relevant and reflect the state-of-the-art? b. Specific aims of the usage • Is the proposed topic of high scientific quality and does it provide innovative aspects?	30%

• Are the research objectives and expected deliverables/outputs of the proposal clearly stated? Are they achievable? • To which extent do the expected results lead to a progress beyond the current state-of-the-art?	
2. Quality of the work plan • Is the work plan adequate? Is it clearly described and well defined? • Can the proposed work plan be realized in the set time? • Are the scheduled tasks and methods adequate to the set objectives? Is it clearly stated which methods and equipment will be employed? • Does the proposed project maximize the use of the infrastructure? Has the proposal assessed any likely risks and are provisions for downtime/bad weather included (if applicable)?	25%
3. Scientific qualification/track record of the proposing PI and user group • Background/track record of the PI • Background/track record of the scientific team • Are the roles and responsibilities of the scientific team clearly stated? Is the combined expertise suitable to achieve the research objectives of the mission?	10%
4. Technical capability to carry out the infrastructure usage and data exploitation • Is all necessary equipment available to carry out the proposed project? • Is a clear concept presented how the gathered data will be shared with shore-based scientists, analyzed and published? • Is additional funding available to support the infrastructure usage and analysis of gathered data and samples (if applicable)? • Will data be fed into international/national data banks or models?	10%
5. Collaboration with international/national partners/industry • To what extent are new European user groups with limited access to marine infrastructure integrated? • To what extent is the proposed project embedded into larger research programmes on a national, EU or international level? • What is the potential for a long-term integration/collaboration on an international level? • Are collaborations with industry envisaged?	15%
6. Training of young scientists/public outreach • How many young scientists and students at PhD level and below will be involved? • Are dissemination activities addressing the general public planned? • Are spare berths devoted to (international) young researchers/scientists in a training role?	10%

Applicants must ensure that sufficient information is provided in the proposal to enable a thorough evaluation of all criteria.

5.2 Evaluation Phases of the Procedure

The evaluation of proposals is managed by the Facility Access Manager. The process aims to be fair and transparent and will provide constructive feedback to applicants. Evaluation is conducted in three steps, as follows:

5.2.1 Phase 1: Technical and Logistics Feasibility

Proposals are checked for compliance with the general **Eligibility Criteria**. These criteria include questions like:

- Was a complete application including the statement by the lead institution, with appropriate signatures received on time?
- Are all sections of the application form completed correctly and the requested proposal structure in Part B (scientific project description) followed?
- Is it possible to carry out the proposal in the framework of the requested access?
- Does the proposal timing match the timing of the call?
- Does the proposal comply with the conditions detailed in the specific Infrastructure Catalog?

Proposals considered to be ineligible will be returned to the applicant with a note explaining why they were considered to be not eligible or feasible. At the end of the proposal submission process (see below) a unique project identifier will be assigned to each proposal. The unique project identifier should be used in any subsequent correspondence or enquiry with the Facility Access Manager. Applicants are encouraged to consult CIRS access manager before submitting proposals.

5.2.2 Phase 2: Access Committee (AC) Evaluation

The CIRS maintains a list of expert evaluators to assist in the evaluation of all request proposals. The names of the experts assigned to individual proposals will not be made public. Evaluators will be required to read and sign a **Declaration of Confidentiality and Conflict of Interest Form**.

Proposals meeting the eligibility criteria will be evaluated based on their individual merit by three individual evaluators as a general rule. Evaluators are chosen in mutual agreement by Facility Access Manager and CIRS director. The experts examine the proposal(s) assigned to them and score and comment on each proposal under each of the **Evaluation Criteria** (see section 5) using an individual **Proposal Assessment Form**.

5.2.3 Phase 3: Consensus Evaluations

Once the individual experts to whom request proposals have been assigned have completed their individual evaluations, a **Consensus Meeting** is convened to enable joint consideration of proposals by the CIRS User Selection Panel. In preparation of the Consensus Meeting one member of the User Selection Panel will be assigned to each proposal to act as a presenter and commentator of that proposal during the Consensus Meeting.

During the Consensus Meeting the panel members will consider each proposal and agree on a final mark for each of the evaluation criteria and an overall mark (score) for the proposal. Thresholds will then be set for the following categories:

- A - Recommended for scheduling
- B - Additional proposals
- C - Not recommended

Proposals recommended for scheduling will then be ranked by infrastructure according to their overall score.

Evaluators will justify their marks with constructive and informative comments. The User Selection Panel will agree on an overall **Consensus Evaluation Report**. All applicants, whether successful or unsuccessful, will be given feedback on the outcome of the evaluation.

Successful applicants may be asked to make changes to their proposals during the negotiation phase to accommodate the comments of the evaluators and/or the comments of the User Selection Panel on infrastructure usage planning and possible integration with other projects.

5.2.4 Phase 4: Proposal Access Evaluation Notification

Results of the evaluation process are expected to be published two months after the call deadline. Information will be available on the Project Website and all applicants whether successful or not will be directly contacted. No information on the evaluation process/outcome will be made available prior to this date.

Rejected proposals include reasons for rejection and an option for resubmission with modifications. Successful applicants will be invited to enter into negotiation to conclude a contract as indicated in the chapter “Terms and Conditions”.

5.2.5 Phase 4: Access Call Resolution

A report is issued listing all received proposals and their evaluation results. This is published on the CIRS website.

6. Access Application

Access submission involves five steps, as outlined below:

Step 1: Download the applicant package. There, you will find: the Proposal Application Template that will need to be completed, the Guidelines for Applicants and the Report template (to be filled out after the completion of the use, if awarded).

Step 2: Prepare your proposal offline based on the provided template.

Step 3: Complete the online application form and upload the proposal application template.

The document must:

- be an unprotected pdf file of maximum 8 pages
- not exceed 4MB in size
- follow the given format

Step 4: The evaluation of proposals will be based upon the information provided in the completed application form, which should be correct, sufficient and adequate for this purpose, taking into consideration the evaluation criteria outlined above.

7. Terms and Conditions

When a proposal is awarded, a Contract Agreement will be signed between the institution User) and the CIRS, laying out terms and conditions of access detailing the support granted, reporting, liability and applicable safety/security regulations.

Users should note that installation and operation of any equipment that they bring to the uses is done at their own risk. The CIRS will keep the right of permitting or banning their use depending if it is considered safe to be used without damaging the infrastructure. Users will be liable for any damage to the infrastructure caused by their own equipment if it has not been explicitly approved by CIRS.

The Contract Agreement between the parties should be signed before the execution of any access.

7.1 Reporting

Following completion of the access, the User will have to submit a Report (in English) to the CIRS, within two months after completion of the use. It must explicitly follow the "Report template" provided at the Access Portal. CIRS may request further information/clarifications (or re-submission of the report) within a reasonable time-frame.

7.2 Acknowledgments

Users must acknowledge CIRS in publications or results derived from facility use. Notifications and copies of such results should be sent to the CIRS administration.

Logos for presentations can be found on the Project Website and on the Applicant package.

7.3 Access Results Data Policy

Data obtained through CIRS access adheres to open data principles unless otherwise agreed. Intellectual property and confidentiality concerns will be respected, following a policy of "as open as possible, as closed as necessary."

8. Freedom of Information & Data protection

Personal information supplied to the CIRS will be stored by electronic means (e.g. database) for use only in connection with the handling of proposals. All personal data supplied shall be processed in accordance with the Belgium Data Protection Act of 1992, as modified by the law of December 11, 1998 implementing Directive 95/46/EC entering into force in 2001, on the protection of individuals regarding the processing of personal data and on the free movement of such data. You have the right to access and update the personal information about you and to ask for such information to be deleted.

All applicants who wish to query the outcome of their application and seek for clarification may contact the CIRS administration.

9. Contact details

Prof. Pere Ridao
vicorob@eia.udg.edu

Annex I – Facilities Catalogue

Access code: UdG-WT

Description:	Water tank for underwater testing. The tank is equipped with a submerged room with windows to be able to observe the interior.
AVG Capacity:	5 persons/access
Access duration:	1 day
Access modalities:	Algorithm testing / Sensor testing/ Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain

Equipment Specification

- Measurements: 16,5m x 9,5m x 5m
- Water treatment with salt
- Automatic water tank
- Illuminated with white light
- Direct view to the pool through a 5m x 1,5m x 1,5m window
- Bridge over the swimming pool
- Terrace with underwater landscape photography
- Submerged laboratory with direct view of the submerged area of the water tank
- Monorail bridge crane of 2 tons.

Access code: UdG-WT_G500

Description:	Access to use Girona500 AUV in the CIRS (cirs.udg.edu) water tank, with underground room with view to water tank. Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Water tank**
  - Size: 16,5x9,5x5 meters
  - Crane: 2 Tonnes
- **Girona500 AUV (video)**
  - Size: 1x1x1.5 meters
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, SVS, DVL, GPS, acoustic modem
  - Optional sensors:
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
    - Electric 4 DoF Arm
    - DLSR Stereo Camera
    - Artificial LED Lighting
  - Free interfaces (sensor integration)
    - 2 x Ethernet
    - 1 x RS-232
    - 24/30V supply
  - Panel with valves for free-floating manipulation

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-WT_G1000

Description:	Access to use Girona1000 AUV in the CIRS water tank, with underground room with view to water tank. Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Water tank**
  - Size: 16,5x9,5x5 meters
  - Crane: 2 Tonnes
- **Girona1000 AUV**
  - Size: 1x1x1.5 meters
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, SVS, DVL, GPS, acoustic modem
  - Optional sensors:
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
    - Electric 4 DoF Arm
    - DLSR Stereo Camera
    - Artificial LED Lighting
  - Free interfaces (sensor integration)
    - 2 x Ethernet
    - 1 x RS-232
    - 24/30V supply
  - Panel with valves for free-floating manipulation

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-WT_S2

Description:	Access to use Sparus II AUV in the CIRS water tank, with underground room with view to water tank. Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 weeks
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Water tank**
  - Size: 16,5x9,5x5 meters
  - Crane: 2 Tonnes
- **Sparus II AUV (video)**
  - Size: 1.6 meters by 460 mm diameter
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, pressure, DVL, GPS, acoustic modem
  - Optional sensors:
    - 5x Pencil Beam Echosounder
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
  - Free interfaces (sensor integration)
    - 1 x Ethernet
    - 3 x RS-232
    - 24V supply
  - Docking station

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-SEA_SS

Description:	12m long vessel equipped with a 400 kg hydraulic crane, which allows the simultaneous operation of several underwater robots. It also enables bathymetry to be carried out. It incorporates a hybrid propulsion system and can accommodate 12 researchers in the cockpit
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Sextant Boat**
  - Length: 12 meters
  - Crane: 470 Kg
  - VHF, GPS/Plotter, Radar, Autopilot
  - Breakdown: 9tn
  - Capacity: 12 persons
  - Category: Group III Class S
  - Model: Volvo 300 HP Diessel Engine
  - Speed: 12 to 15 knots
  - Cabin with small laboratory
  - Services: A/C, cold galley, wash basin, ACS
  - Pipe directly to the sea for oceanographic sensor placement from the aft deck (30 cm diameter)

Access code: UdG-SEA_G500

Description:	Access to use Girona500 AUV at Sea with the support of the Sextant Boat. Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Sextant Boat**
  - Length: 12 meters
  - Crane: 470 Kg
  - VHF, GPS/Plotter, Radar, Autopilot
- **Girona500 AUV**
  - Size: 1x1x1.5 meters
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, SVS, DVL, GPS, acoustic modem
  - Optional sensors:
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
    - Electric 4 DoF Arm
    - DLSR Stereo Camera
    - Artificial LED Lighting
  - Free interfaces (sensor integration)
    - 2 x Ethernet
    - 1 x RS-232
    - 24/30V supply

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-SEA_G1000

Description:	Access to use Girona1000 AUV at Sea with the support of the Sextant Boat. Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Sextant Boat**
  - Length: 12 meters
  - Crane: 470 Kg
  - VHF, GPS/Plotter, Radar, Autopilot
- **Girona500 AUV**
  - Size: 1x1x1.5 meters
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, SVS, DVL, GPS, acoustic modem
  - Optional sensors:
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
    - Electric 4 DoF Arm
    - DLSR Stereo Camera
    - Artificial LED Lighting
  - Free interfaces (sensor integration)
    - 2 x Ethernet
    - 1 x RS-232
    - 24/30V supply

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-SEA_S2

Description:	Access to use Sparus II AUV at sea with Sextant boat near Sant Feliu de Guixols harbor (open to other locations, previous discussion with UdG). Access to test algorithms on the AUV or to test new sensors (we can operate the vehicle).
AVG Capacity:	5 persons/access
Access duration:	1 week
Access modalities:	Algorithm testing / Sensor integration / Data acquisition
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain (open to other locations, previous discussion with UdG)

Equipment Specification

- **Sextant Boat**
  - Length: 12 meters
  - Crane: 470 Kg
  - VHF, GPS/Plotter, Radar, Autopilot

- **Sparus II AUV (video)**
  - Size: 1.6 meters by 460 mm diameter
  - Autonomy: 8-10 hours
  - Basic sensors: AHRS, pressure, DVL, GPS, acoustic modem
  - Optional sensors:
    - 5x Pencil Beam Echosounder
    - Soundmetrics ARIS FLS
    - Imagenex DeltaT Multibeam
    - Tritech Seaking Profiler Sonar
    - Tritech Micron Imaging Sonar
    - HD Color Camera
  - Free interfaces (sensor integration)
    - 1 x Ethernet
    - 3xRS-232
    - 24V supply

Training requirements:

- Algorithms testing: basic ROS training + simulations submitted and validated by CIRS team before trials
- Sensors: follow connection specifications and provide models to CIRS team before access use
- Data acquisition: learn to teleoperate the robot and/or use our interface

Access code: UdG-HCH_WT

Description:	Access to use hyperbaric chamber in the CIRS. Allows validation down to 1400 m depth of pressurized components, including AUV hulls. Essential for the development of new systems that must operate at depth.
Access modalities:	na
Dates:	To be agreed with the host, subject to availability
Location:	Girona, Spain

Equipment Specification

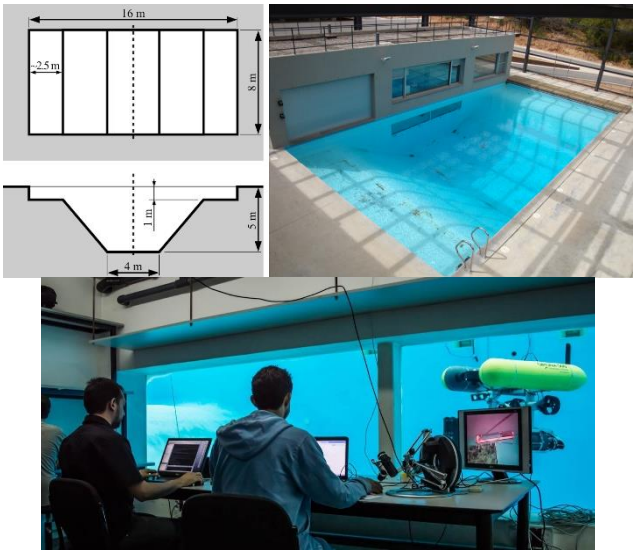
- Hyperbaric chamber
    - Fresh water is offered for testing equipment up to 140 bars.
    - Internal measurement: 550mm diameter and 1600mm high
    - A metal structure is available to introduce large equipment.

The chamber is located under a bridge crane to aid in the introduction and extraction of the equipment to be tested.

Annex II – Application Examples

A) CIRS Facilities

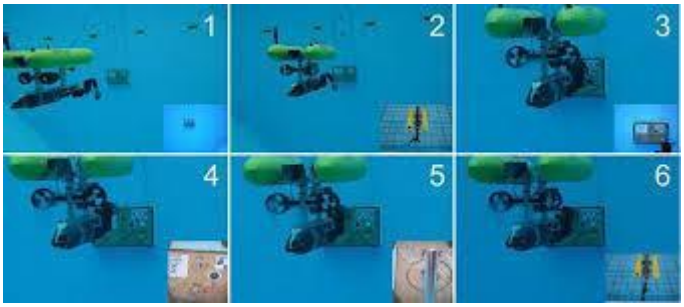
The CIRS water tank located at in the University of Girona's Scientific Park, Girona, Spain (41.967350N, 2.836216E) inside the CIRS lab building. It is equipped with a crane to move the vehicles and put structures underwater. The facilities also include an underwater room, with a window to the water tank that provides an excellent view of the vehicles that are operating.



Example applications:

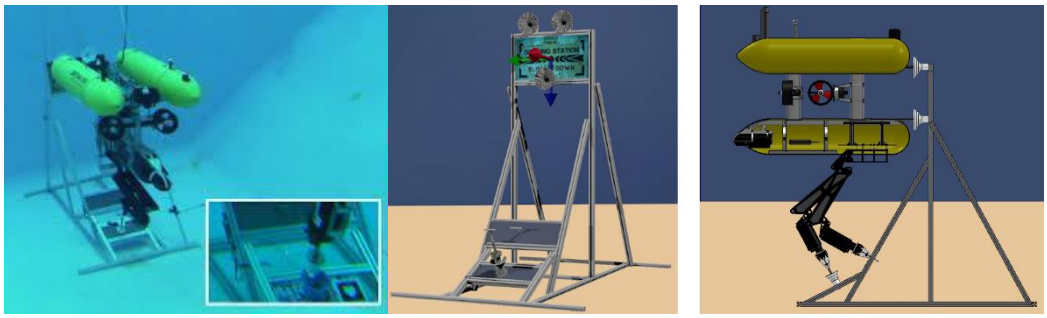
- ***Free-floating manipulation***

A textured panel with valves can be hanged in the walls of the water tank for free-floating manipulation algorithm testing. Absolute positioning updates can be provided when the panel is in the field of view of the forward-looking camera.



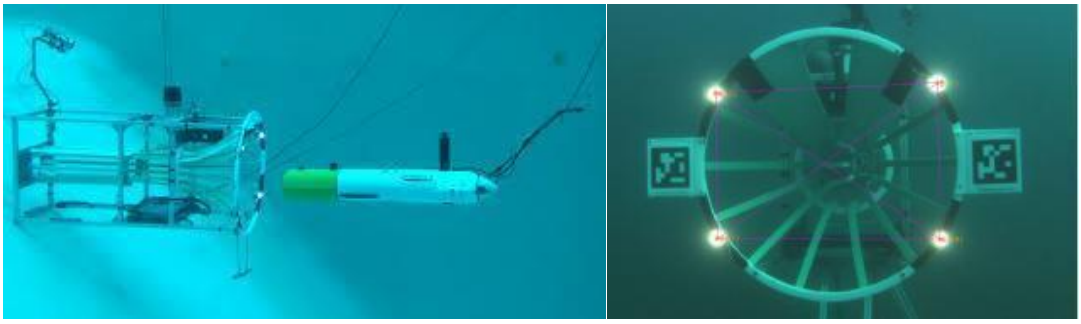
- **Docked manipulation**

A big docking station for Girona500 AUV is available for docking and manipulation purposes. Docking is achieved by inserting three bars in front of the AUV into the three funnel-shaped holes on the docking station. Once the vehicle is docked, a valve can be turned and a connector can be plugged/unplugged.



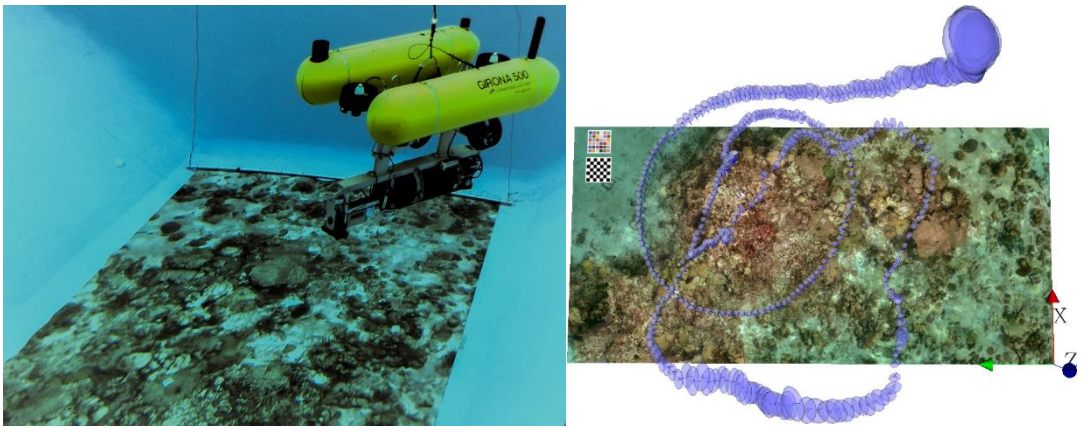
- **Docking with Sparus II AUV**

A funnel-shaped docking station with 4 frontal blinking LEDs and two ARUCO markers is available to test Sparus II AUV docking strategies.



- **Absolute positioning using photomosaic**

A poster of an underwater photomosaic can be placed at the bottom of the water tank to provide ground truth positioning of a vehicle with a down-looking camera. This positioning is very useful to compare with your trajectories (i.e. SLAM algorithms) and obtain error measurements.

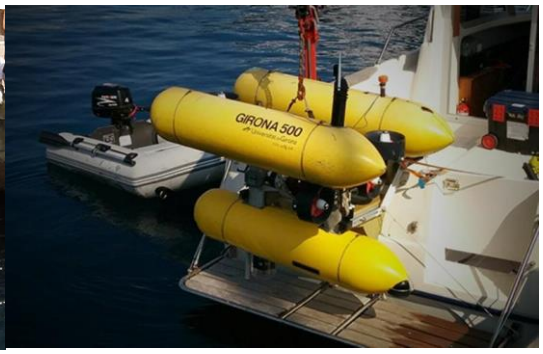


- **Anything that you propose**

Each of the vehicles has a big sensor suite that can be used for any experiment you propose. Each TNA lists all the sensors available for each vehicle and location. Use them wisely and do not hesitate to contact us if questions arise.

B) Test Site

The Sextant boat is located at the harbor of Sant Feliu de Guíxols, Girona, Spain (41.777412N, 3.033381E). It is a 30 minutes drive by car from the CIRS laboratory. The boat contains a crane that can carry Girona500 AUV and Sparus II AUV, allowing to deploy/recover the vehicles on the harbor itself or on the open sea. The boat is equipped with GPS and USBL to track the vehicles. If necessary and operating at low depths, the vehicles can be cabled to a surface buoy to have continuous wifi access to the vehicles and be able to properly debug them.

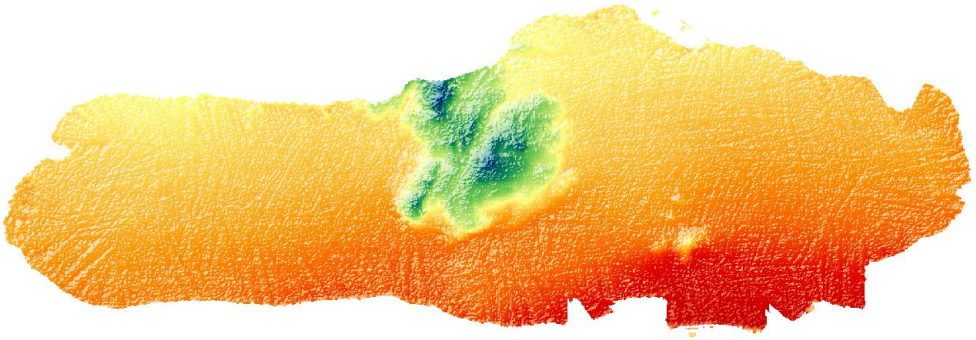


Example applications:

- **Bathymetry**

Bathymetric maps can be obtained with the use of the Imagenex DeltaT multibeam echosounder.

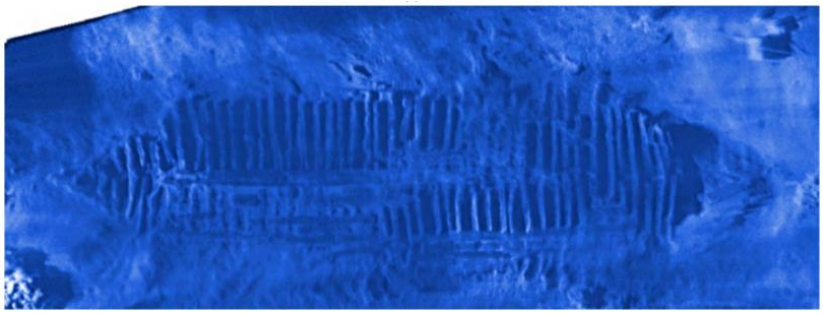
(example: 650 x 280 m bathymetry up to 50 m depth).



- **Forward Looking Sonar (FLS) maps**

FLS mosaics can be obtained by using the Soundmetrics ARIS FLS.

(example: sunken iberian ship)

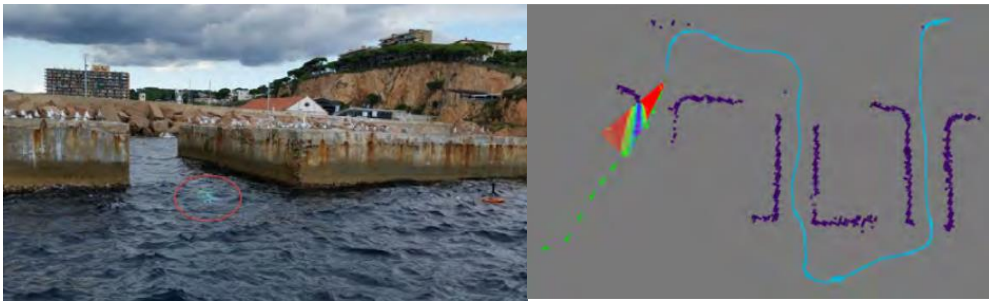


- **Photomosaics**

Photomosaics can be obtained by stitching images gathered from a single bottom-looking camera, stereo camera, ... (example: sunken iberian ship)

- **Online path planning**

A combination of sonar sensors such as MSIS, profiler, multibeam… can be used to detect the environment and adapt the planning based on the observations.



- **Anything that you propose**

Each of the vehicles has a big sensor suite that can be used for any experiment you propose. Each TNA lists all the sensors available for each vehicle and location. Use them wisely and do not hesitate to contact us if questions arise.