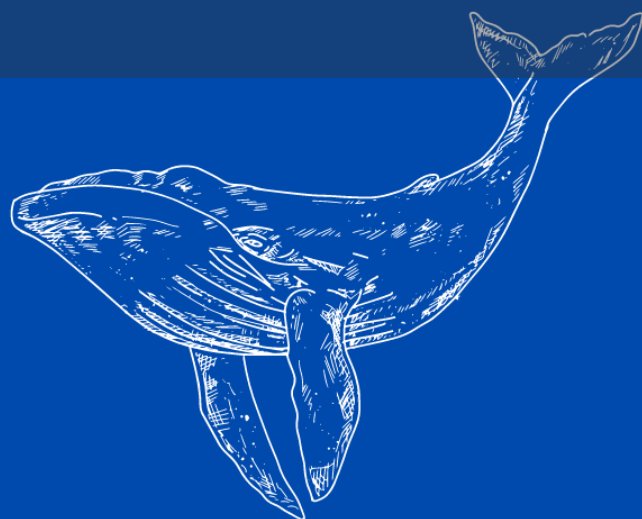


MIR Competition 2023

Underwater Autonomous Robots

Erasmus Mundus joint Master's Degree
MARINE AND MARITIME INTELLIGENT ROBOTICS
Rule Book 2023

Universitat Jaume I: CIRTESU



MIR

MARINE &
MARITIME
INTELLIGENT
ROBOTICS



UNIVERSITAT
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1

Introduction & Context

This competition is organized by CIRTESU, a research lab that is dedicated to creating advanced technology and solutions for the maritime sector, including the use of autonomous underwater vehicles such as BlueROV2.

The competition aims to solve real-world challenges faced by the maritime industry by encouraging students to develop innovative solutions using the BlueROV2 and other technologies. The competition will focus on areas such as underwater localization and mapping, object detection, and perception.

The competition is aligned with the United Nations' Sustainable Development Goals, specifically Goal 14: Life Below Water, which aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. By encouraging the development of innovative solutions for the maritime industry, this competition aims to contribute to the protection and preservation of our oceans and marine life.



2

Simulation Software

The Unity Underwater Simulator (Unity-UWSIM) for the competition environment is created using Unity 3D. This simulator includes three tasks that are explained in section 3.

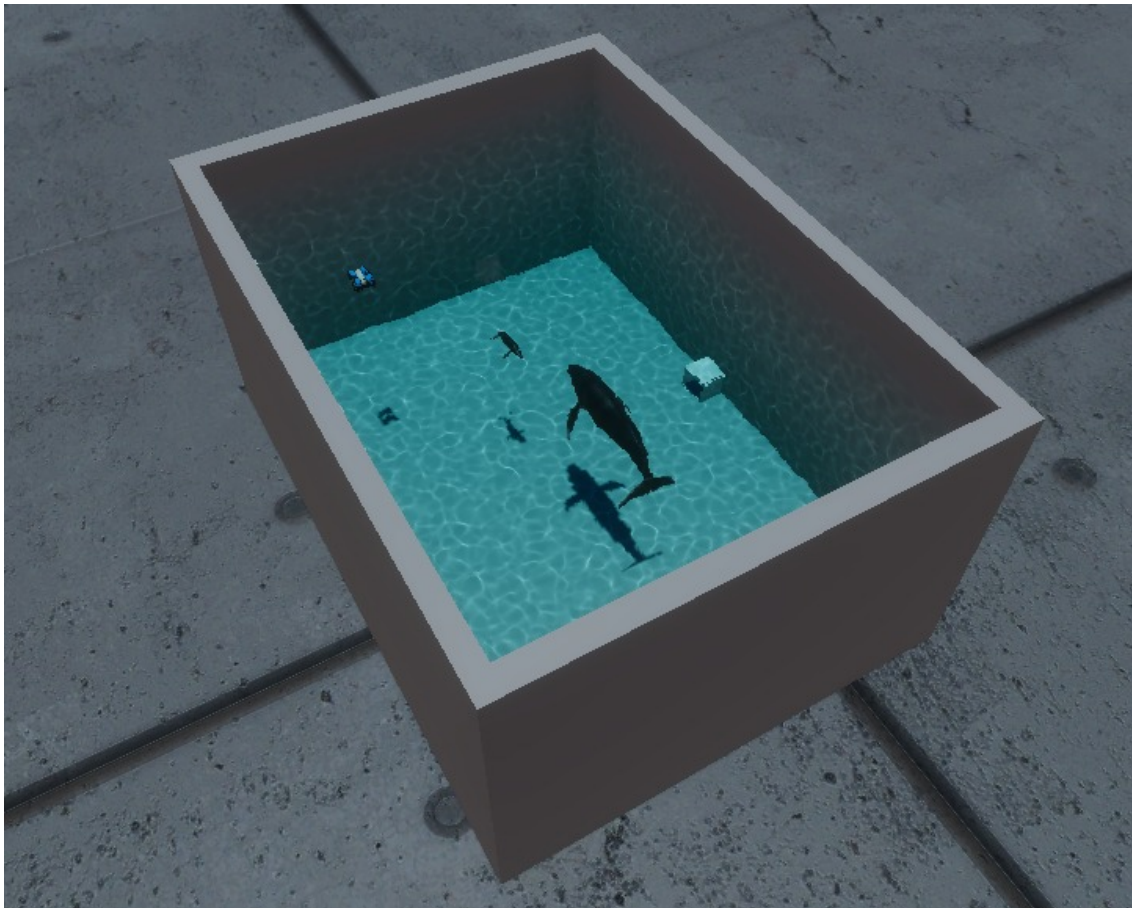


Figure 2.1: Cirtesu Pool

The How to Use the simulation is provided on this link: [How to connect ROS with the Unity Simulation](#)

3

Mission Tasks

The competition is held in CIRTESU Lab pool with dimensions (12x8x5 m). The blueROV2 robot will start from a predefined area at one of the pool's corners. The robot has to implement three tasks which after the trial is to be considered complete.

The tasks are organized into the following

1. Task 1: Autonomous Docking
2. Task2: Swimming with whales
3. Task3: Companion robot

Task 1 - Autonomous Docking:

Scheme:

A submerged station on the pool's ground is considered the recharge station for the robot. The robot has to locate and find this station. Afterwards the robot is to stay inside completely for 30 seconds without bumping the walls.

The docking station as depicted in figure 3.1, 4 Aruco markers are fixed (dimensions 0.1x0.1m) in each of the station corner. A single aruco marker with dimensions of (0.15x0.15m) is fixed in the back middle of the docking station as shown in figure 3.2.



Figure 3.1: Docking station - Dimensions: 1x1x1 m

Task 2 - Swimming with whales | (whale watching):

Scheme:

Marine scientists need to watch Humpback whales and study their behaviour [1]. Scientist require the data in order for the scientists to study their behaviour. Robots can swim with whales safely and provide useful data to help preserve this breathtaking creatures in the north sea.



Figure 3.2: Docking station in Unity simulation

The blueROV has to avoid hitting the whales in the pool and navigate safely, where the whales are deployed as virtual objects using Augmented reality as virtual objects in the environment. To ease this task, the whale objects are static.

Figure 3.3 shows how the environment will be. The location of the whales are randomized.



Figure 3.3: Humpback whales randomly swimming in the pool

Task 3 - Companion robot:

Scheme:

A ship has been sunken in the ocean and it is very important to detect crucial items on the seabed. As some of them are a treasure and the other are hazardous items which may affect the marine life. The recovery of these items is a complex task that requires a combination of maritime expertise and a cutting-edge technology.

The blueROV has to go and listen to the operator for further instructions. The blueROV will search for a panel near the surface as shown in figure 3.4.

Instructions will be sent to the blueROV2 using acoustic communication link from the control panel. The task at hand is to locate a single specific item on the seabed, which is one of three items that have been identified in the area.

The three items are:

1. Red butane cylinder (figure 3.5a)



Figure 3.4: Control panel near to the surface of the pool

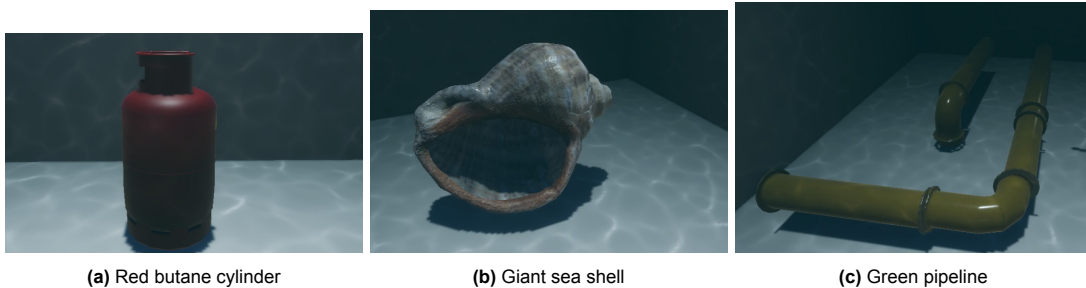


Figure 3.5: Lost items in the sea bed to be detected

2. Giant sea shell (figure 3.5b)
3. Green pipes (figure 3.5c)

After receiving the instructions, the robot has to go and search for this lost object, if found, the robot maintain a near position to it and a bounding box to be drawn around the object with a label identifying the lost object.

4

Presentation & Technical Report

Technical Report - Deadline: 31/05/2023

A presentation to be given in front of a panel of judges to explain each team methodology. Technical report to be handed out before the Deadline 31/5/2023 - 23:59 - Madrid Time

Technical Report Rules

Presentation

An 15 minutes oral presentation to be done in front of panel of judges at the same time for the competition.

Presentation Rules

1. Max. number of slides: 20 slides
2. Time period: 20 minutes

5

Scoring & Time

Score

Total points are 100.

Table 5.1 shows the scoring system. The score with "+" sign is bonus mark and not included in the total 100 points.

Task	Criteria	Points	Notes
1- Autonomous Docking	Successful docking	20	
	Docking within time limit (5 min)	+5	
2- Finding Lost Object	Successful object retrieval	20	
	Object found within time limit	+5	
3- Whale watching	Successful navigation	20	
	No obstacles hit	+5	
4- Presentation	Quality of presentation	10	
	Clarity of explanation	5	
	Use of visual aids	5	
5- Technical Report	Quality of report	10	
	Clarity and organization	5	
	Relevance to competition tasks	5	
Total		100	

Table 5.1: Scoring System for Underwater Robotics Competition

Time

The time for the trial is 30 minutes. Each team has two trials.

References

- [1] *Humpback Whales*, National Geographic. URL: <https://www.nationalgeographic.com/animals/mammals/facts/humpback-whale>.