UNDERWATER ROBOTICS
CHALLENGES
MORE THAN A CHALLENGE...

Underwater Robotics Challenges

2023 Technical Guide

About UWR:

Underwater Robotics Challenges is a series of annual Underwater Robotics and Artificial Intelligence Challenges that occur in the MENA Region powered by the Underwater Robotics Research Center.

The UWR Challenges were launched to creatively address and develop innovative ideas that make a difference! With the technological development and the emergence of many problems that need to be solved by using the technology of robots, marine technology, and artificial intelligence, such as monitoring and following-up water and sea pollution. As well as entertainment and marine tourism and the pursuit of fish and coral reefs.

Underwater Robotics Challenges include a series of challenges held at the local, regional, and international levels, in each challenge we aim to encourage new features and opportunities to share your design and ideas with the ocean.

Challenges:

1. **ROV Challenge**

   Remotely Operated underwater Vehicle (ROV) Challenge is an underwater robotics challenge that aims to teach and creatively apply skills to solve real-world problems and strengthen critical thinking abilities, collaboration, entrepreneurship, and innovation in marine science by building Remotely Operated underwater Vehicles. The ROV Challenge has two main categories as follows:

   a. **Seniors Category** is for undergraduate and postgraduate students with no restrictions on age or technical and non-technical levels. In this category, ROV (Remotely Operated underwater Vehicle) is required to be built by the team members to make specified simulated tasks underwater with specific scientific and engineering concepts.

   b. **Juniors Category** is for high school students with no restrictions on age or technical and non-technical levels. In this category, ROV (Remotely Operated underwater Vehicle) is required to be built by the team members to make specified simulated tasks, with less complexity than the seniors' teams, underwater with specific scientific and engineering concepts

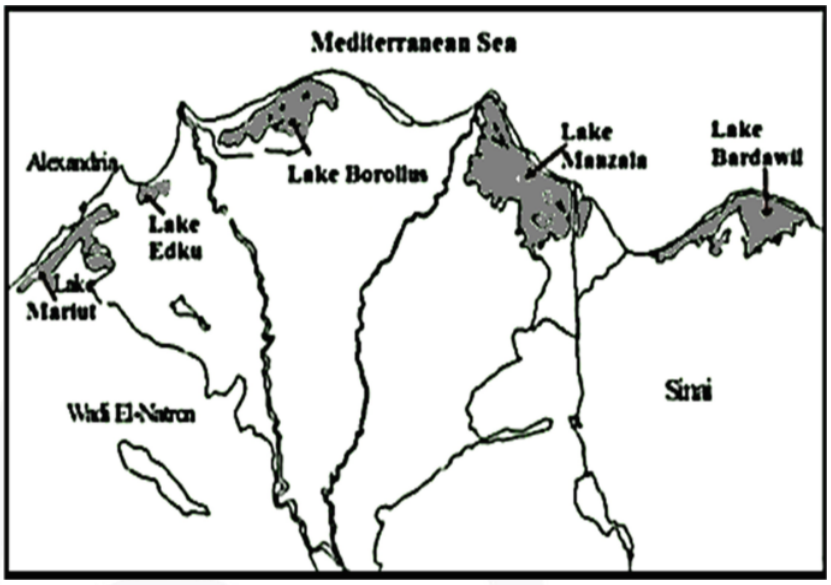
2. **AUV Challenge**

Autonomous Underwater Vehicle Challenge (AUV) is an underwater robotics challenge that aims to push the applicants towards the latest technologies and develop their skills in underwater robotics by applying them in real-life simulated missions to provide modern solutions for the marine field using Autonomous Underwater Vehicles. This challenge has one category as follows:

a. **Seniors Category** is for undergraduate and postgraduate students with no restrictions on age or technical and non-technical level. In this category, AUV (Autonomous Underwater Vehicle) is required to be built by the team members to make specified simulated tasks underwater with specific scientific and engineering concepts.

Context:

The Mediterranean basin in northern Egypt comprises five northern lakes arranged from west to east as Mariout, Idku, Burlus, Manzla, and Bardawil. These lakes represent great economic importance as their production of fish is more than 75% of Egypt's total production. However, they suffer major problems, such as degradation; habitat loss; pollution as they receive great amounts of industrial, municipal, and agricultural wastewater without treatment; and the spread of aquatic plants.



The development of the Egyptian lakes is one of the national projects that complement the process of economic development. In May 2017, the national project for the development of natural lakes was launched at a cost of 100 billion pounds, with the aim of clearing lakes and removing encroachments to develop the northern lakes and increase Egypt's production of fish. This project helped increase fish production, bringing the total fish production to 171.5 thousand tons in 2015, and the increase continued to reach 220,7 thousand tons in 2019.

Theme:

In this year's version of the UWR Challenges, underwater robots will be tasked with assisting in the development, monitoring, and maintenance of Egypt's northern lakes. Utilizing marine technology in similar projects can result in achieving better outcomes with higher efficiency by relying on more accurate data and direct access to these water bodies.

As per the growing demand for qualified scientists and engineers, UWR Challenges are developed to provide the new engineering generation with new challenges with this class of underwater technology and innovation for the science, inspection, and research world. Aligning these challenges with national problems is intended to create further opportunities and result in actual development for the marine technology sector in Egypt.

Mission Background:

Each team will be required to use their robot to perform an Underwater Mission consisting of several tasks that mimic different operations needed to develop, maintain, or monitor the Egyptian Northern Lakes. These tasks are built to address the following areas.

1. Pollution

The water quality and ecosystems in the Egyptian Northern lakes are continuously declining as a result of the massive amounts of agricultural drainage, municipal sewage, and industrial wastewater which enrich with many pollutants, particularly heavy metals. The final destination for both natural and anthropogenic elements produced or derived from the environment is lake sediments, causing a considerable negative ecological impact. Atomic Absorption Spectroscopy is used to evaluate the heavy metal concentrations of the collected water and sediment samples. The distribution and transportation of heavy metals in connection to aquacultural health have been the focus of numerous projects. In this task, underwater robots will be used for dynamic and continuous monitoring of these pollution levels across the lakes.

2. Marine life

Overfishing has been identified as the most widespread local threat to fisheries in northern lakes. It is a process that occurs when fishing activities lead to lower levels of fish stocks below the acceptable level. This process ultimately depletes fish resources and potentially extinct a number of fish varieties exposed to this process. The dramatic changes in ecosystems resulting from the overfishing process lead to a loss of ecosystem balance and the emergence of other species of marine organisms, which may prevent the target species in the fishing process from re-emerging, known as the ecosystem transformation process. In this task, underwater robots will be used to monitor and report changes in fish populations in the lakes.

3. Mapping

Mapping of lakes reveals a wealth of data for lake management and planning requirements. Geographic information systems (GIS) have emerged as a pivotal technology in the scientific study and management of renewable natural resources. GIS can help with extrapolation from point and line transect surveys to whole lake estimates of total biomass or production. GIS can also be effective in organizing multispatial data sets to enable modeling and visualization of spatial trends. In this task, underwater robots will be used to install, inspect, and maintain underwater lake sensing equipment.

Main Technical Design Aspects:

1. For the Seniors Category, vehicles are restricted to 90 cm in diameter and 35 kg in weight, vehicles above these limits will not be allowed to compete in the Underwater Mission.
2. For Juniors Category, vehicles are restricted to 80 cm in diameter and to 30 kg in weight, vehicles above these limits will not be allowed to compete in the Underwater Mission.
3. Any modifications on the vehicles after the size and weight measurements are not allowed.
4. Pneumatics and hydraulics are permitted.
5. Lasers are permitted.
6. A camera is required in the main vehicle.
7. It is not allowed to use multiple vehicles, but it is allowed to use any additional device to help the vehicle in performing the mission.
8. The tether of additional devices should be hardly attached to the tether of the main vehicle.
9. The additional devices and the tether will be considered in the size and weight check.
10. Each team will be required to submit design documents for the main vehicle, additional devices, and their SIDs.