



MBZIRC Maritime Grand Challenge
EXTENDING HUMAN CAPABILITY

ABOUT MBZIRC

The **Mohamed Bin Zayed International Robotics Challenge (MBZIRC)** aims to be one of the world's largest and most prestigious international robotics competitions.

Held every two years in Abu Dhabi as a real-world challenge for universities, research centres, companies and individual innovators from all over the world, we inspire the development of solutions in autonomous robotic aerial and surface vehicle technologies.

At the forefront of exploration and experimentation, we set out to find novel technological successes that are resilient in an ever-changing market, reinforcing the UAE's role as an emerging hub for advanced technology innovations.

MBZIRC is run by **ASPIRE**, the programme management pillar of Abu Dhabi's **Advanced Technology Research Council**, which oversees technology research in the Emirate.



▶ THE PRIZE PURSE

First Prize:
US \$2,000,000

Second Prize:
US \$500,000

Third Prize:
US \$250,000

→ At the end of the simulation phase, a prize of **US \$500,000** will be split among the teams progressing to the demonstration phase.

▶ MARITIME GRAND CHALLENGE - THE TIMELINE

The MBZIRC Maritime Grand Challenge will be held over three phases:



2021 — **White Paper Phase**
01 Oct 2021 - 31 Jan 2022

Simulation Phase — **2022**
August 2022



2023
Demonstration Phase - For Five Finalists
June 2023

ADVANCED ROBOTICS. AGAINST THE BEST. AGAINST THE CLOCK.

The **MBZIRC Maritime Grand Challenge** is a unique, real-world competition designed to inspire the creation of ground-breaking solutions in autonomous robotics, in the air and out at sea - stimulating ideas, encouraging collaboration, and pushing boundaries.

In 2023, the MBZIRC Maritime Grand Challenge will deploy autonomous robotic technologies to address the global problems of illegal fishing, piracy, smuggling, and coastline security - and is open to teams from universities, research centres, companies and individual innovators from all over the world.

This highly complex, multi-layered task involves autonomous aerial and surface vehicles working together in a GNSS-denied environment off the coast of Abu Dhabi, to identify a target vessel and offload goods from it in the shortest possible time.



THE BIG PICTURE

Bridging the gap between the lab and the real world

Robots and other autonomous systems are increasingly being adopted in diverse fields - from health care and security to transport and manufacturing - as they become cheaper and smarter.

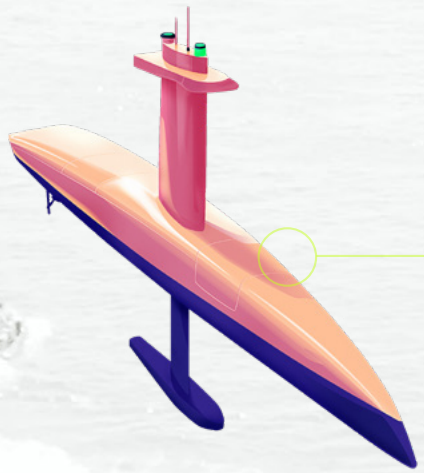
However, a significant gap exists between the current reality of robotic capabilities and real-world requirements. Through the MBZIRC Maritime Grand Challenge, we at ASPIRE are looking to bridge the gap by pushing technological boundaries and enabling robots to work more autonomously in dynamic, unstructured environments, while interacting and collaborating with us - and with one another.

DEFINING THE CHALLENGE


ASPIRE invites universities, research centres, companies and individual innovators to participate in the Mohamed Bin Zayed International Robotics Challenge (MBZIRC). This challenge is focused on a new generations of unmanned systems operating in an infrastructure-less, integrated maritime aerial-surveillance environment.

SYSTEM COMPONENTS

MBZIRC Maritime Grand Challenge teams will utilise a heterogeneous unmanned system comprising:



1 autonomous Unmanned Surface Vehicle (USV) Base Station with a manipulation arm



A swarm of 5 -20 Unmanned Aerial Vehicles (UAVs). UAVs may land on, take off from and recharge on the USV.

COMMUNICATION

The entire “unmanned system swarm” must work in a GNSS denied environment.

No extra-system communications are allowed (except those provided by the challenge organisers for security and safety purposes). However, intra-system communication is permitted. For example, the USV could hold a base station (such as a femtocell) to augment the capabilities of the UAV swarm.

No other device or equipment is allowed besides the ‘USV+UAV swarm’ system.

TASKS

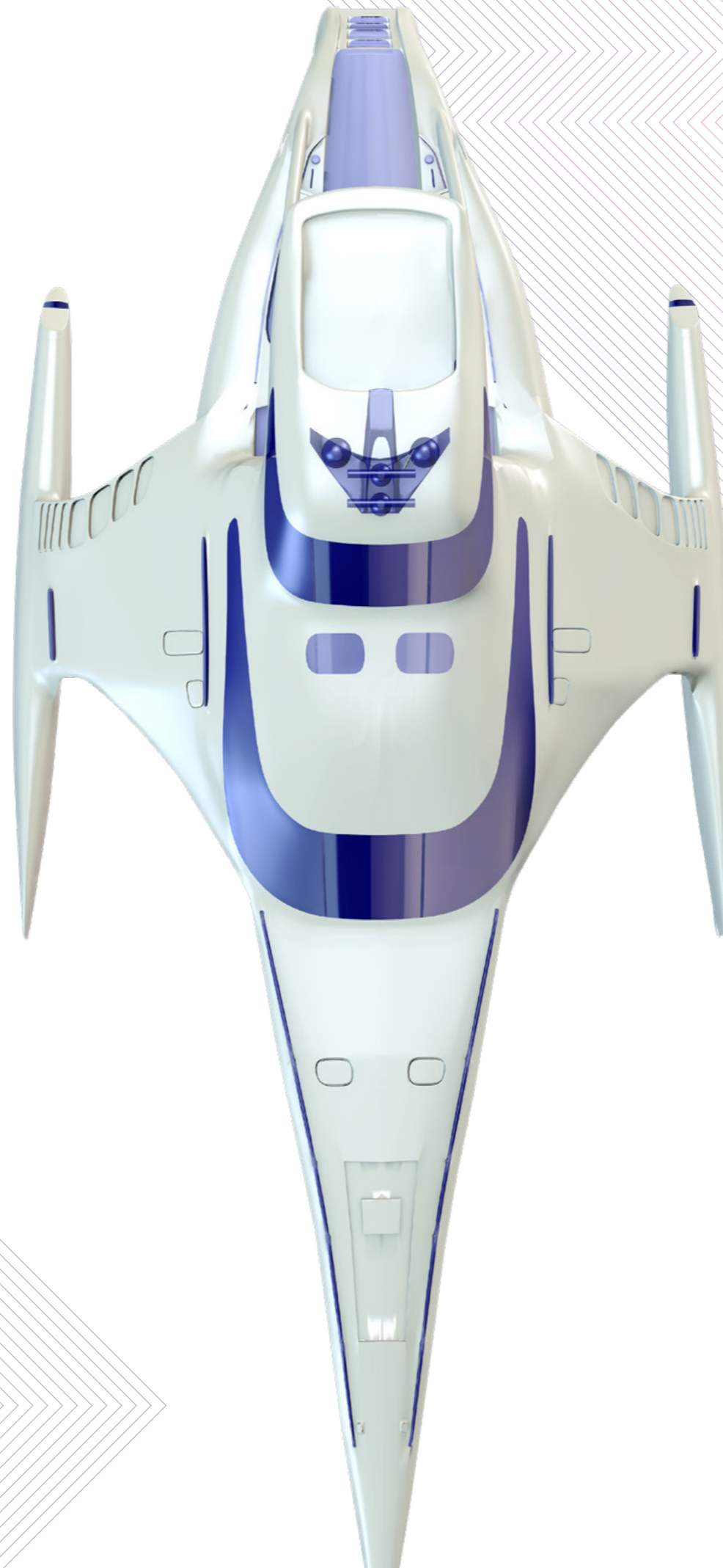
The MBZIRC Maritime Grand Challenge has two principal tasks: **Inspection** and **Intervention**.

THE INSPECTION TASK

The UAV swarm is used to monitor a large surface area of water to identify vessels that are in motion. Out of the total number of vessels present, there will be a subset of “target” vessels. Once a vessel is identified, the UAV swarm deploys to determine whether or not it is a target by scanning the vessel.

The following outcomes should be transmitted to the USV:

- ◆ A 3D model of the vessel to match with a reference model.
- ◆ In the case of a possible target vessel, a Boolean “suspected”/“not suspected” signal is transmitted to the rest of the swarm through intra-swarm communication for collective decision making.
- ◆ Once a target vessel is confirmed by the operator, the “USV+UAV swarm” system proceeds to the intervention task.



THE INTERVENTION TASK

For each vessel that is potentially classified as a target:

- ◆ Video(s) streaming is activated between the UAVs and the USV.
- ◆ The operator watches the video and confirms the nature of the vessel.
- ◆ If the operator does not confirm the suspected target because the UAVs have made an incorrect collective decision, the team will be penalised by increasing the mission completion time by a pre-defined number of minutes. The swarm will then resume searching.


When a vessel is identified as a target, the operator selects items to be retrieved from that vessel.

- ◆ The items must be picked up from the vessel and transported by the UAVs to the USV, either collectively or via individual transport.
- ◆ One of the target vessels will have items that are too large to be collected by the UAVs. UAVs will collectively attach to those larger objects and move them closer to the edges of the vessel.
- ◆ Once the vessel is close to the USV, the large object will be picked up by the USV directly using its manipulation arm.
- ◆ This will require coordinated USV locomotion and manipulation, and must account for potentially adverse sea conditions. The large objects collected by the manipulation arm are to be deposited on the deck of the USV.
- ◆ After all items have been collected from the target vessel, the swarm will resume exploring and decide whether all target vessels have been found.

The mission is considered completed after a pre-defined finish time or the moment when the “USV+UAV swarm” system has determined that there are no more target vessels in the area and has landed back on the USV, whichever is earlier.

SCORING

Teams will be scored based on the time taken to complete the tasks. Errors, such as missed vessels, lost items, or exceeding search-area boundaries, will incur time penalties.



THE JOURNEY TO ABU DHABI

Now till June 2023, the **MBZIRC Maritime Grand Challenge** will stretch the collective intelligence and creativity of teams from universities, research centres, companies and individual innovators from all over the world. The journey to the final in Abu Dhabi will challenge robotics pioneers to collaborate, innovate, and generate new technical solutions that meet the demands of the modern world.



2021

WHITE PAPER PHASE

01 Oct - 31 Jan 2022

Each participating team is required to register at www.mbzirc.com, then later submit a white paper describing the team, its background in swarm robotics, computer vision, simultaneous localisation and mapping, marine vehicles, and communications, along with its proposed technical approach.

The format and content requirements of the white paper will be announced on the MBZIRC Maritime Grand Challenge website at www.mbzirc.com.

Registration are now open. White papers can be submitted from 01 Oct 2021. White papers must be received by 31 Jan 2022, 6pm GST*.

Submissions after the above mentioned date will not be accepted.



2022

SIMULATION PHASE

August 2022*

Short listed semi-finalist teams will be selected to complete the inspection and intervention tasks via simulation, during an on-site visit by the judging committee in August 2022. Proof-of-concept of the system components should also be demonstrated to show the feasibility of the approach.

The demonstration should cover the following elements of the challenge:

- Multi-UAV search and inspection of large representative structures;
- Intra-swarm communication and collective decision-making; and
- Collective lift and transportation of larger objects to a home location.



2023

DEMONSTRATION PHASE

June 2023*

The final live demonstration will be held over several days in June 2023 in a specially designated maritime area off the coast of Abu Dhabi, when five finalist teams will put their systems to the test.

Judging will be against the clock, with total time to complete the Inspection and Intervention tasks (plus penalties) determining the winner. There will be a maximum qualification time: failure to complete the tasks within that time will not be considered successful. If conditions allow, teams will be given multiple opportunities to complete the tasks.

***Please note** that this is an initial timeline, which maybe subject to change. Any changes to the timeline will be announced on the website at www.mbzirc.com

➤ SHARING THE BENEFITS OF INNOVATION

At MBZIRC, we believe that partnership and collaboration will drive future advances in robotics. To enable the benefits of innovation to be shared, any team accepting an MBZIRC prize will share non-exclusive, perpetual and royalty-free IP with ASPIRE, including rights to sublicense to third parties.



ARE YOU READY FOR THE CHALLENGE?

REGISTER AND COMPETE

Registration for the MBZIRC Maritime Grand Challenge is now open and White Papers may be submitted from 01 Oct 2021. Any team with skills, resources and knowledge - from universities, research centres, companies and individual innovator - is welcome to participate and compete with the world's leading innovators in autonomous robotics.

Register at www.mbzirc.com

IMPORTANT DATE

The deadline for registration and receipt of White Papers is **31 Jan 2022, 6pm GST***

Mohamed Bin Zayed International Robotics Challenge

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