



*5<sup>th</sup> biennial*  
**Maritime RobotX  
Challenge 2024**

November 3-10, 2024 | Nathan Benderson Park | Sarasota, FL

# Primer & Task Ideas

## Glossary:

AMS: Autonomous Maritime System

USV: Unmanned Surface Vehicle

UAV: Unmanned Aerial Vehicle

WAM-V: Wave Adaptive Modular Vessel



robotx



# Why RobotX?

- Increase technical proficiency;
- Establish valuable professional connections; and
- Enjoy learning and collaborating while competing at a world-class level.

The nominal winners are teams that score the most points. The real winners are participants who learn lasting lessons about working together to create an autonomous system to accomplish a challenging mission in a complex environment.



10 years

Multi-Domain System  
Full Autonomy  
Situational Awareness



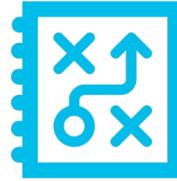
- **Objective:** Expand the community of researchers and innovators capable of substantive contributions to the emerging field of autonomous and unmanned, multi-domain vehicles.
- **Eligibility:** Teams can be from anywhere in the world and must use a WAM-V 16 to compete. Teams consist of a:
  - Majority of team members must be undergrad through post-grad students. Teams may also include high school students. Interdisciplinary teams are encouraged.
  - Combination of students, faculty, industry partners, and/or government partners.
- **Participation** in the RobotX Challenge includes:
  - Building an AMS capable of autonomously attempting challenges while operating within vehicle and safety requirements.
  - Providing a design documentation discussing the team's technical design and competition strategy.

Find out more.

Contact RoboNation at [autonomy@robonation.org](mailto:autonomy@robonation.org)



# Competition Structure



## Autonomy Challenge

Build an AMS based on a standard platform to showcase autonomous performance.



## Design Documentation

Prepare documentation showcasing AMS design and competition strategy.

### Design Documentation

- *Team Website*
- *Technical Design Report*
- *Team Intro Video*
- *Design Presentation*
- *System Assessment*



## What's next?

Continue reading through the **CHALLENGE** presented to RobotX teams this season.

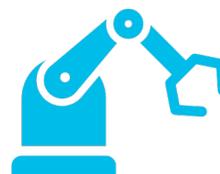
Autonomous behaviors evaluated in this year's challenge include...



Navigation



Perception



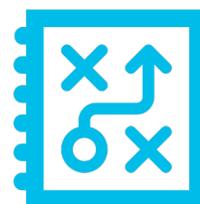
Object Delivery



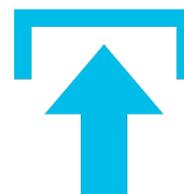
Object Avoidance



Situational Awareness



Cooperative Behaviors



Station Keeping



Inter-vehicle Cooperation

# Task Overview

## USV Demonstration



Safety  
Check



Navigation  
Demonstration

Mandatory before deploying

## UAV Demonstration



Safety  
Check

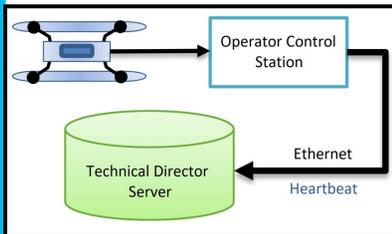


Pilot Safety  
Check + Demo

Mandatory before deploying

### Task 1

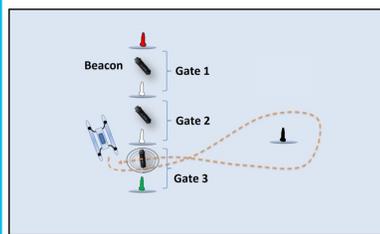
#### Situational Awareness



AMS transmits messages reporting various behaviors and data collected in course.

### Task 2

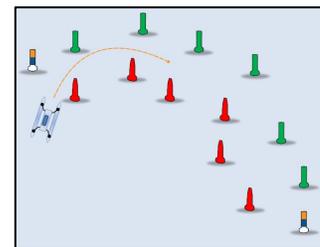
#### Entrance & Exit Gates



AMS detects active beacon and enters and exits course through corresponding gates.

### Task 3

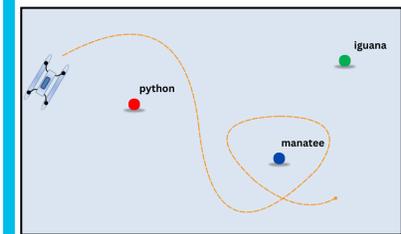
#### Follow the Path



AMS maneuvers pathway.

### Task 4

#### Wildlife Encounter



AMS detects and scans signatures / RGB images, signaling USV to circle.

### Task 5

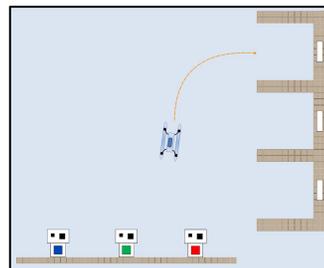
#### Scan the Code



AMS observes and reports three-light sequence display.

### Task 6

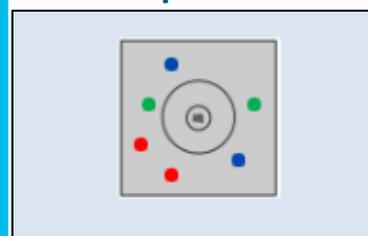
#### Dock & Deliver



AMS detects colored panels, docks in bay and delivers racquetballs.

### Task 7

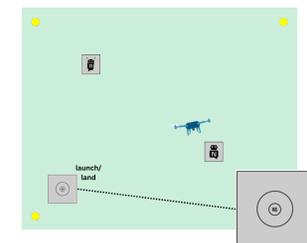
#### UAV Replenishment



AMS launches UAV, locates floating helipad, collects and delivers tin to other helipad.

### Task 8

#### UAV Search & Report



AMS launches, conducts search of field and reports location of two objects.

# USV Demonstration

## Mandatory Activity

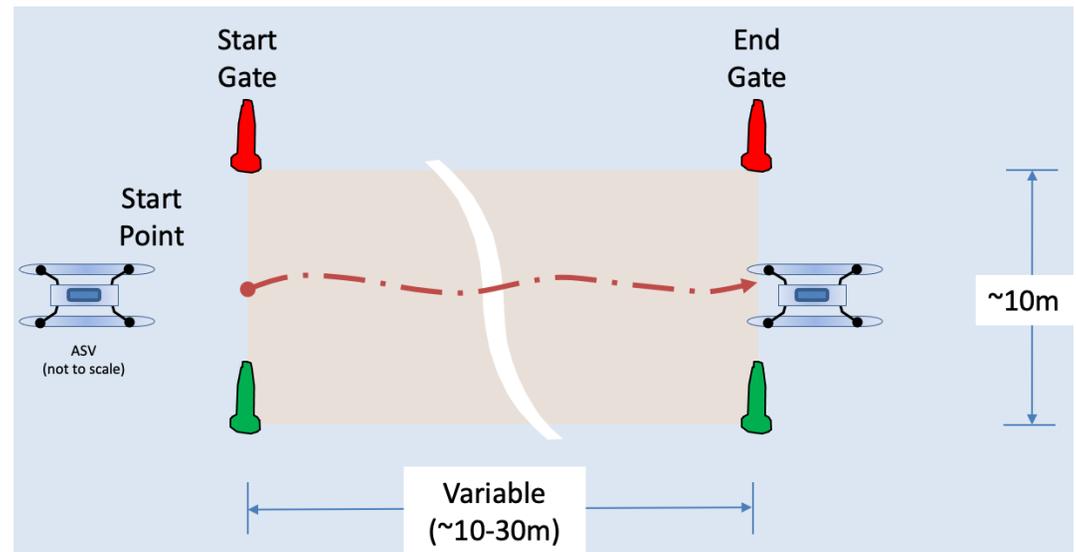
The inspection and demonstration must be successfully completed as prerequisites for entry to the practice courses.

### 1 Static Safety Inspection

- USV must meet all safety requirements:
  - Buoyancy pods
  - Emergency stop system
  - Tow points and tow line
  - Lift points are clearly marked
  - Safety requirements for propellers (and propeller guard)
  - All systems are properly secured

### 2 Dynamic Navigation Demonstration

- USV must autonomously maintain positive control, detect channel markers, and successfully navigate through two sets of gates.



# UAV Demonstration

## Mandatory Activity

### Subject To Change

Inspection details will be refined in accordance with host nation requirements.

The inspection and demonstration must be successfully completed as prerequisites for entry to the practice courses.

### 1 Static Safety Inspection

- . UAV must meet all safety requirements:
  - . Propellers
  - . Motor mounts
  - . General airframe & wiring integrity
  - . Battery security
  - . Battery capacity checks
  - . Range test(s)
  - . Integrations tests with autonomous systems

### 2 Pilot Safety Check

- . Autonomous flight control disconnected to enable manual flight control mode to demonstrate the pilot's ability to take control of the drone/aircraft and land it safely.

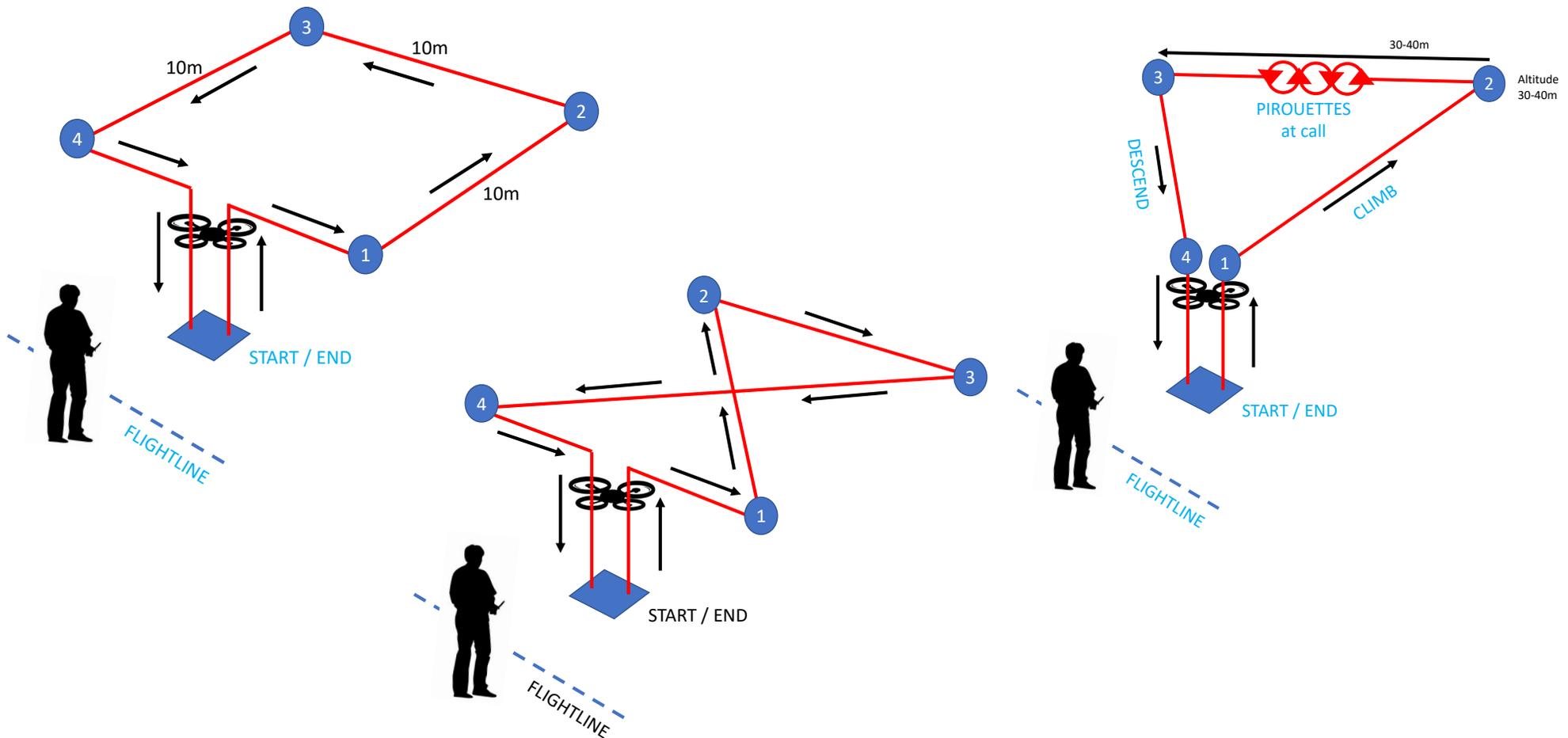
# UAV Demonstration

## Pilot Safety Check

Subject To Change

Inspection details will be refined in accordance with host nation requirements.

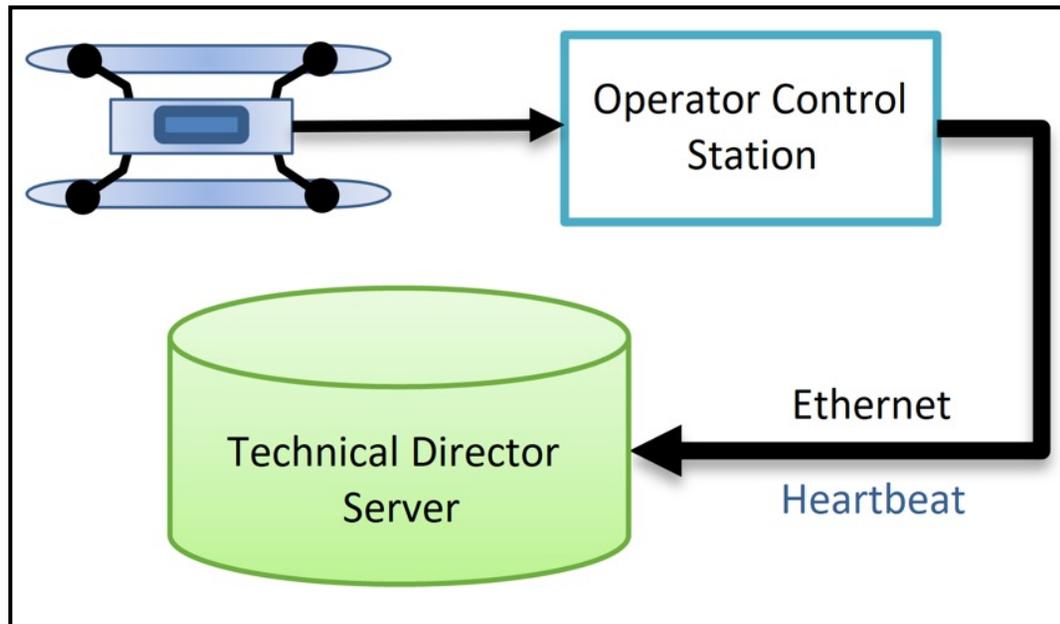
The following maneuvers are required as part of the **Pilot Safety Check**.



# Situational Awareness & Reporting

## Task 1

- The AMS transmits a heartbeat message to the Technical Director (TD) Network.
- During Semis/Finals runs, The AMS transmits specific messages reporting various activity and data collected throughout the run.
- All messages are required to follow the format outlined in the Team Handbook.

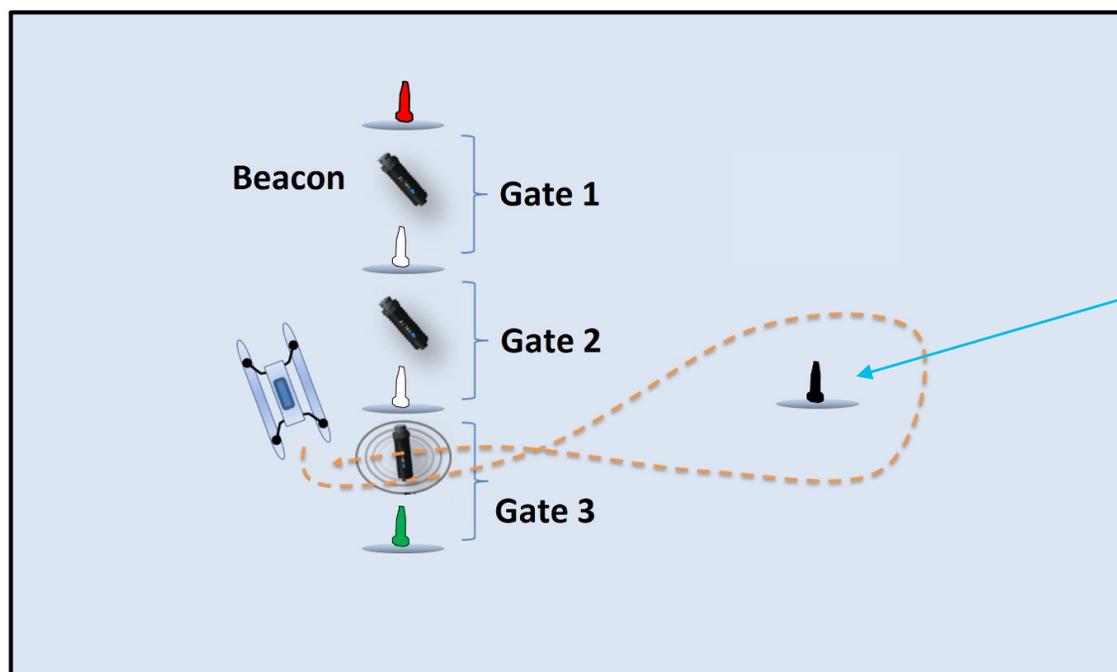


- Teams are provided a wired RJ45 connection to transmit from the team's Operator Control Station (OCS) to the TD Network, in the course operations tents along the shoreline.

# Entrance and Exit Gates

## Task 2

- The AMS detects the active beacon and navigates through the corresponding gate. Only one beacon on each course will be activated at any time.
- During Semis/Finals runs, AMS enters the course through the active gate before proceeding to other tasks and exits through the active gate at the end of the run.



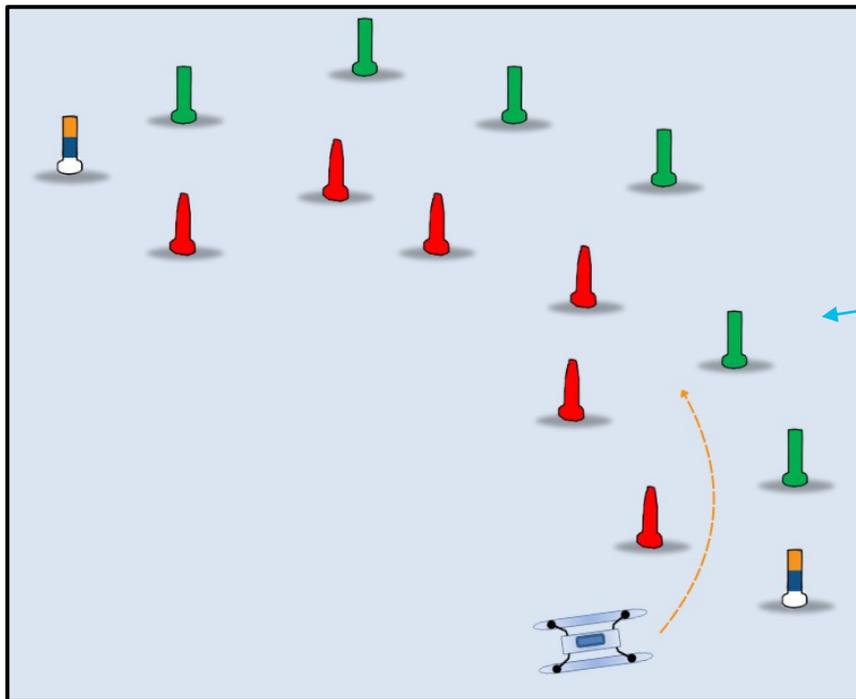
The black buoy is only present during qualifying.

 **Heartbeat Message:**  
Additional points available for reporting AMS activity.

# Follow the Path

## Task 3

- The AMS navigates through the pathway. Teams will be instructed to use pathway to either exit or return to harbor, considering the expression, "red right returning." The AMS must avoid all obstacle buoys in pathway.
  - Exit harbor: red buoys on port (left) side during navigation
  - Return to harbor: red buoys on starboard (right) side during navigation



Example:  
AMS exiting harbor.

 **Heartbeat Message:**  
Additional points available  
for reporting AMS activity.

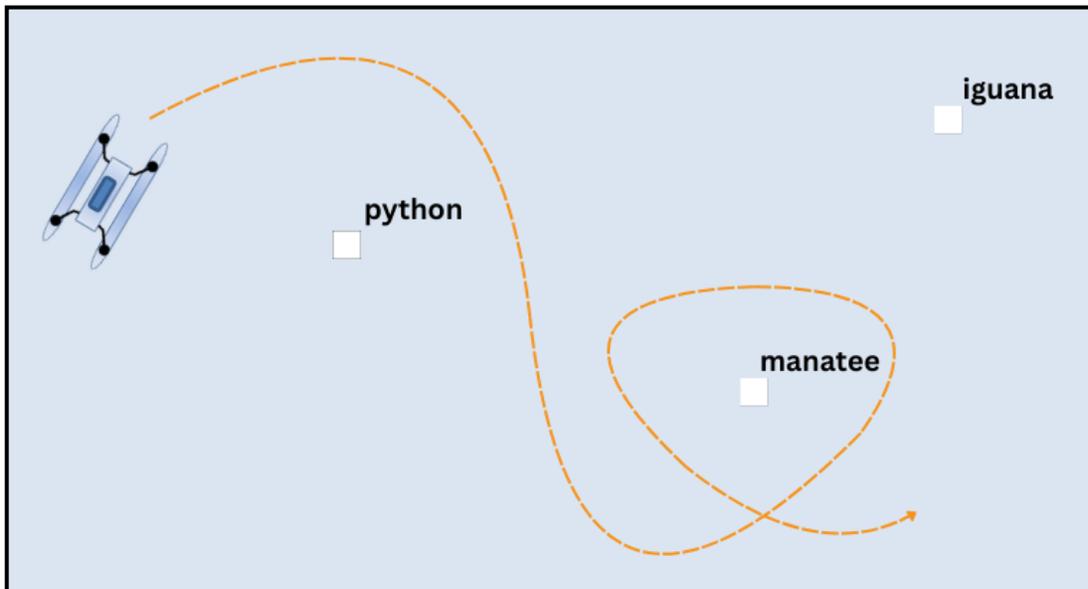
# Wildlife Encounter

## Task 4

### Hyperspectral Imaging

RoboNation is working to acquire the hyperspectral paint for this task. There is an alternative task approach on the next page.

- The AMS detects and scans each spectral signature, signaling the USV to circle each marine creature as specified. For example:
  - Circle the python in clockwise direction.
  - Circle the manatee in anti-clockwise direction.
  - Circle the iguana in any direction.



### Graphic Display:

Additional points available for developing graphic display.



### Heartbeat Message:

Additional points available for reporting AMS activity.

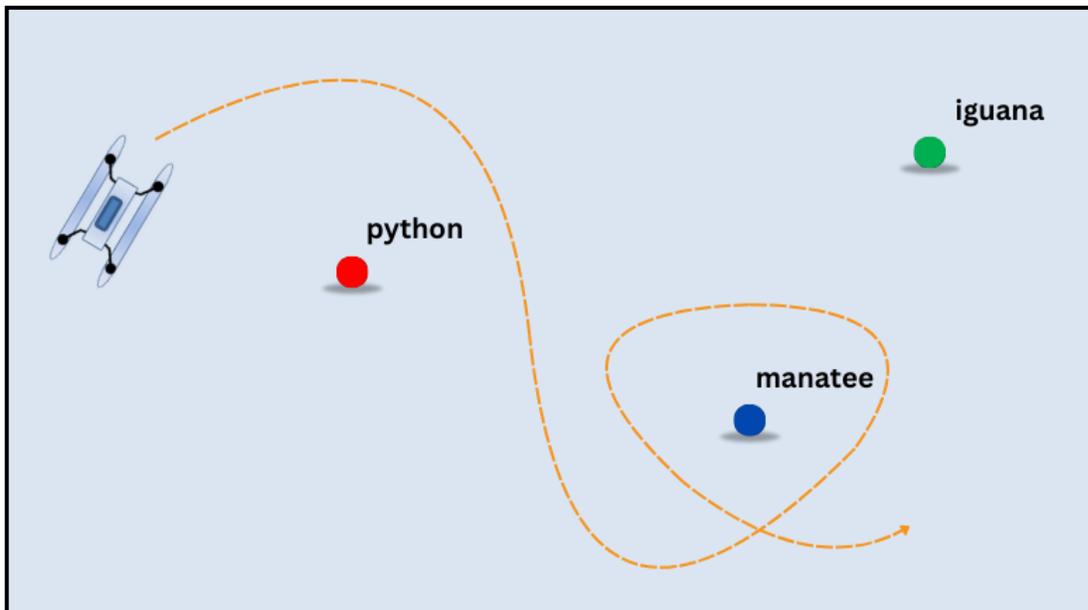
# Wildlife Encounter

## Task 4

### No Hyperspectral Imaging

As a backup plan for not acquiring the hyperspectral paint for this task, this is an alternative approach to this task.

- The AMS must detect and scan each colored buoy, signaling the USV to circle each marine creature as specified. For example:
  - Circle the python (red buoy) in clockwise direction.
  - Circle the manatee (blue buoy) in anti-clockwise direction.
  - Circle the iguana (green buoy) in any direction.



### Graphic Display:

Additional points available for developing graphic display.



### Heartbeat Message:

Additional points available for reporting AMS activity.

# Scan the Code

## Task 5

- The AMS observes the three-light sequence display and reports the RGB colors observed in the sequence they appeared.
- This light sequence informs the AMS of the correct information to complete other tasks in the Semi-Finals and Finals Rounds.



### Graphic Display:

Teams must develop a graphic display of light sequence captured by AMS.



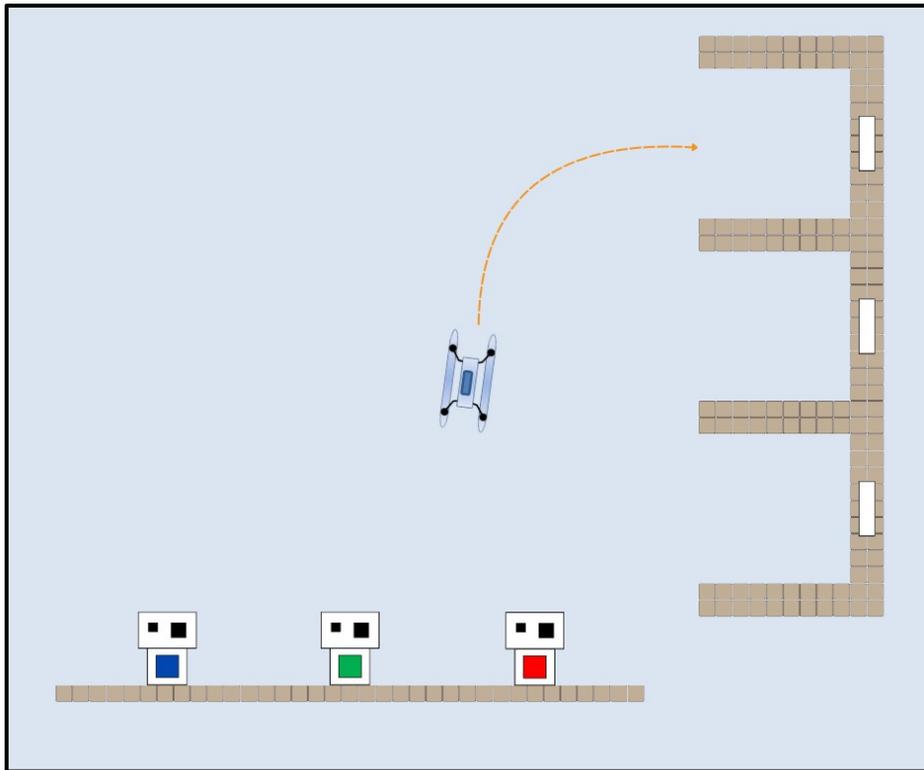
### Heartbeat Message:

Additional points available for reporting AMS activity.

# Dock and Deliver

## Task 6

- The AMS detects different colored panels (red, green, or blue) and docks in the corresponding bay.
- Each panel has a colored square and two square holes. Once the AMS has found the designated color and docked, the system flings racquetballs into either of the two holes.



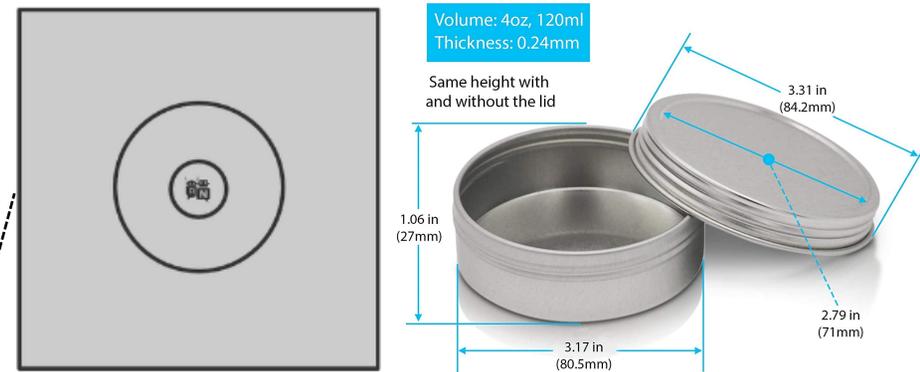
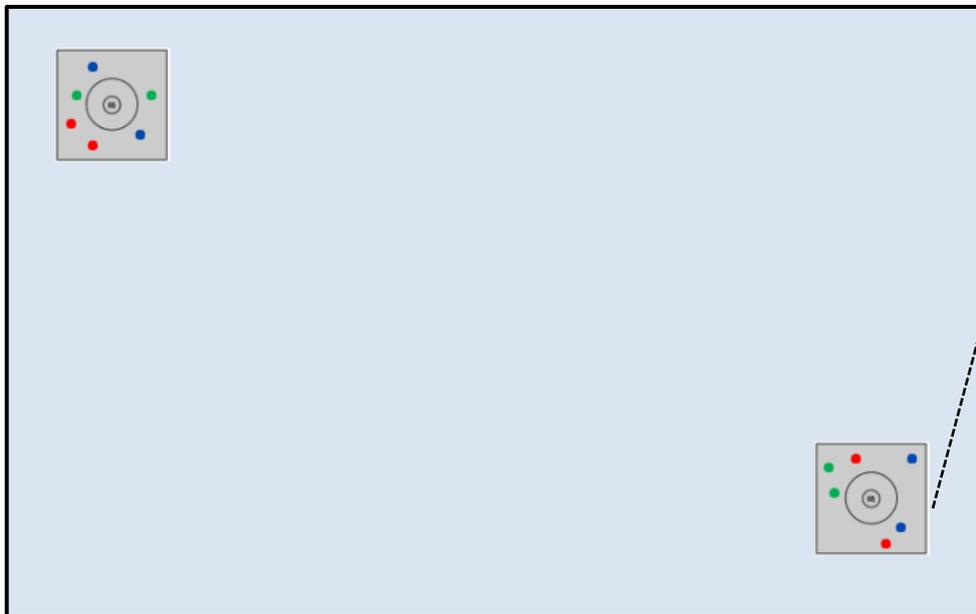
 **Heartbeat Message:**  
Additional points available  
for reporting AMS activity.

# UAV Replenishment

Feedback Request:  
What weight do you want the tins?

## Task 7

- This task is designed to be accomplished by a UAV.
- The UAV launches from the USV, locates a floating helipad, and collects a small colored tin (red, green, or blue).
- The UAV delivers the tin to the circular target area on another floating helipad, then returns to the UAV.
- This task will be available on land for practice.



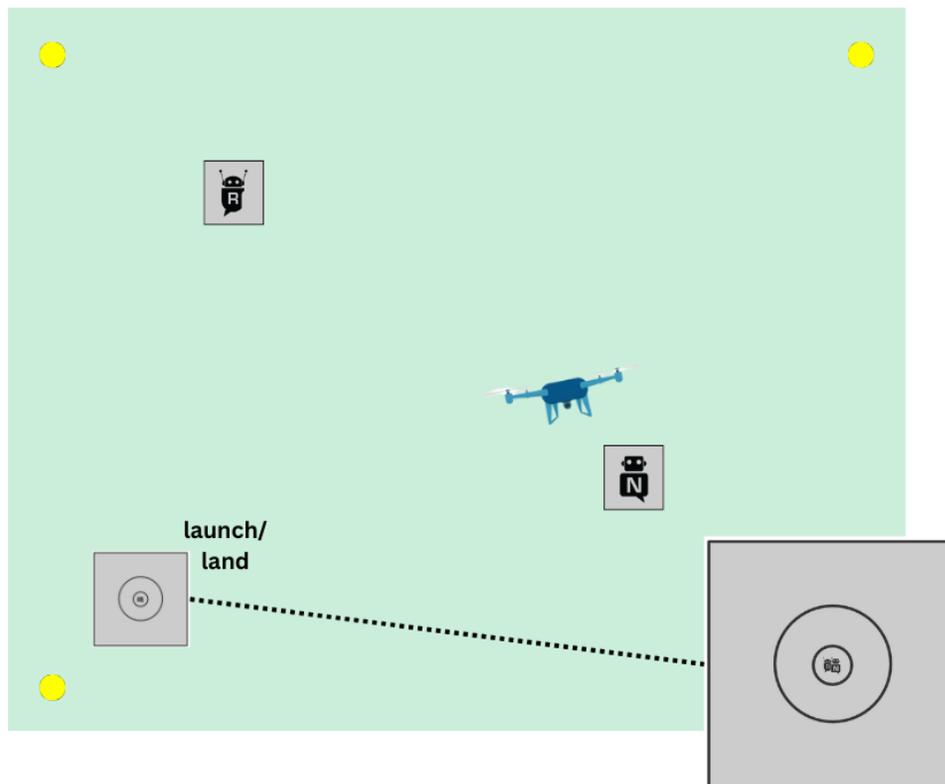
 **Heartbeat Message:**  
Additional points available  
for reporting AMS activity.

# UAV Search and Report

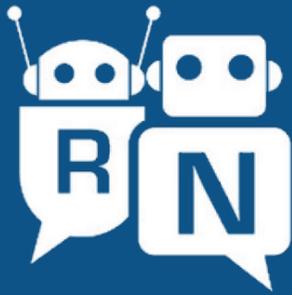
Task available both on water and on land.

## Task 8

- The UAV launches from designated start point (or directly from USV), conducts a search of a field marked by four orange markers, detects and determines the location of two distinct objects.
- This task will also be available on water as an official Semis/Finals task.



 **Heartbeat Message:**  
Additional points available  
for reporting AMS activity.



# robonation



seaperch



seaglide



gosense



roboBoat



roboSub



robotX



RoboNation is a 501c3 nonprofit organization whose mission is to provide a pathway of hands-on educational experiences that empower students to find innovative solutions to global challenges. Working together with the industry, research and educators, we have grown to include over nine student competitions and programs and engage more than 250,000 students per year.

For more information contact [autonomy@robonation.org](mailto:autonomy@robonation.org)