6th RoboBoat Competition - Preliminary Rules

Sponsored by the AUVSI Foundation and the US Office of Naval Research

8-14 July 2013
Founders Inn and Spa, Virginia Beach, VA

Note: The goal of this preliminary mission statement is to encourage teams to submit comments and questions before the release of the final rules. Please post your feedback before Feb 1st on the RoboBoat forums.

The goal of this competition is to provide an opportunity for students to experience the challenges of and develop skills in system engineering by accomplishing realistic missions with autonomous vehicles in the maritime environment and to foster ties between young engineers and the organizations developing Autonomous Surface Vehicle (ASV) technologies.

SCHEDULE*:

Event		Due Date
Intent to Compete Form and Payment Due	Friday	1 March 2013
Hotel (Founder's Inn) reservation deadline	Wednesday	15 May 2013
T-shirt sizes	Saturday	1 June 2013
Website, Team Video, Journal Paper & Resumes	Friday	17 June 2013
Team Check-in & Orientation	Tuesday	9 July 2013 1000 hrs
Safety Inspections and In-water Practice Time	Tuesday	9 July 2013 1200 hrs
In-water Practice Time	Wednesday	10 July 2013 1200 hrs
In-water Practice Time	Thursday	11 July 2013 0800 hrs
Static Judging and In-water Practice Time	Friday	12 July 2013 0800 hrs
Qualifying Runs	Saturday	13 July 2013 0800 hrs
Qualifying Runs/Last chance and practice time	Sunday	14 July 2013 0800 hrs
Finals	Sunday	14 July 2013 1300 hrs
Awards Party (evening)	Sunday	14 July 2013 1900hrs

*subject to change.

POINTS OF CONTACT:

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1 General requirements

- **Autonomy**: the vehicle must be fully autonomous and all decisions must be taken onboard the ASV.
- **Buoyancy**: the vehicle must be positively buoyant and stay buoyant for at least 30 minutes in the water.
- **Communication**: the vehicle cannot send information or receive instruction while in autonomous mode.
- **Deployable**: the vehicle must have its own 3 or 4 points harness for crane deployment.
- **Energy source**: the vehicle must use self-contained electrical energy source. Sailboats are permitted.
- **Propulsion**: any propulsion system is fine (thruster, paddle, etc), but moving parts must have a shroud.
- **Remote-controllable**: the vehicle must be remote-controllable to be brought back to the dock.
- **Safety**: all sharp, pointy, moving, sensitive, dangerous, etc parts must be covered and clearly identified.
- **Size**: the vehicle must fit within a six-foot long, by three-foot wide, by three-foot high “box”.
- **Surface**: the vehicle must float or use ground effect of the water. Mostly submerged/flying is forbidden.
- **Towable**: the vehicle must have designated tow points and a tow harness installed at all times.
- **Waterproof**: the vehicle must be rain/splash resistant. The competition is held “rain or shine”!
- **Weight**: the vehicle must be 140 lbs or less.

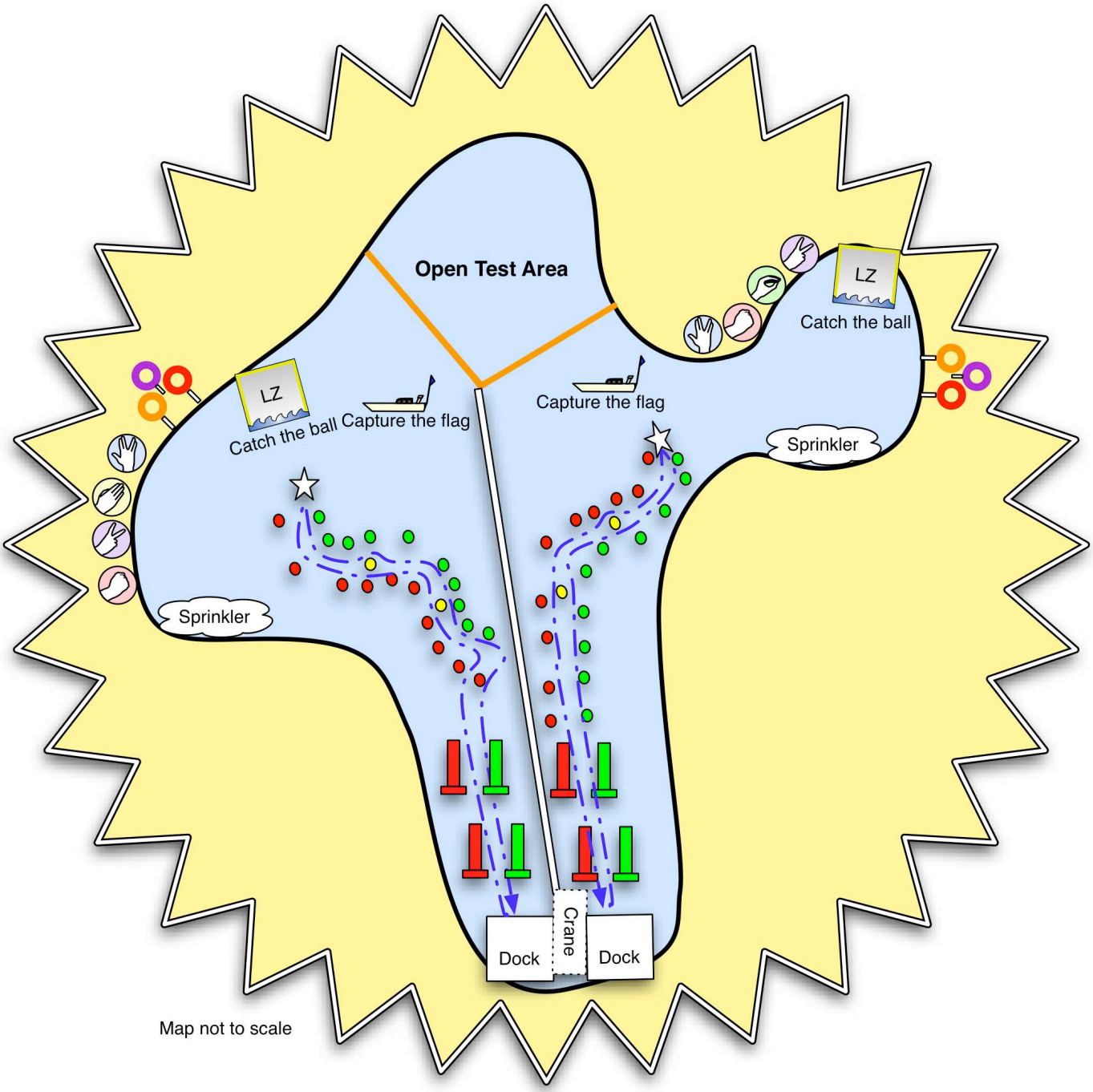
2 Notable changes from 2012

- All teams are expected to provide a digital copy of the video footage analyzed by their vehicle at the end of each time slot, the digital copy can be handed over manually (flash drive, upload to a FTP site, etc).
- The navigation challenge is now optional. However, if you go through it, your challenge station score can be doubled, tripled or quadrupled depending on how many pairs of buoys you go through.
- We will provide a GPS coordinate for each challenge station. The coordinate will be in the middle of the area where the challenge station will be.
- One of the new stations involve capturing a flag from a floating or slow moving remote controlled boat.
- Another of the new stations involves shooting a foam arrow/missile through 24in plastic hoops.

MISSION TASKS

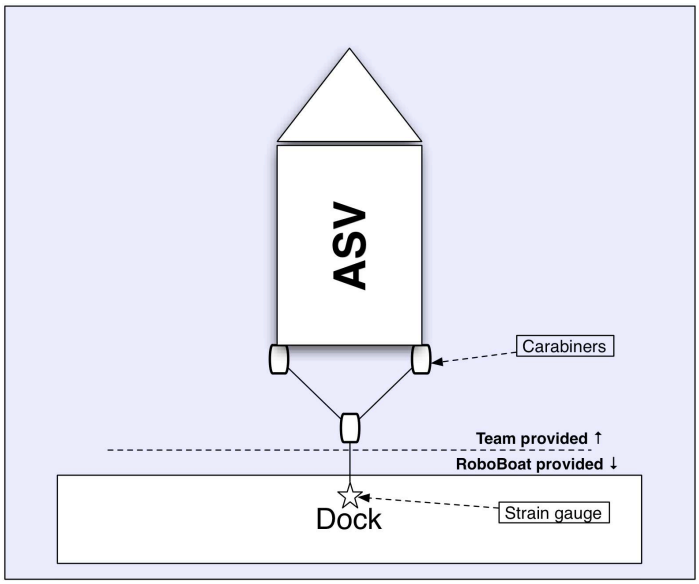
The 2013 mission is themed after a series of classic children games with a twist. Unlike previous years, completion of the navigation challenge is not required but doing it acts as a score multiplier. This means that if you go through the start and speed gate, you are free to head directly to the challenge stations.

Below is an overall competition layout. Note that the map is to scale versus the actual course and that elements may be placed differently then illustrated below. Overall, this map should be seen as a general orientation/placement idea more than an actual mapping of the elements.



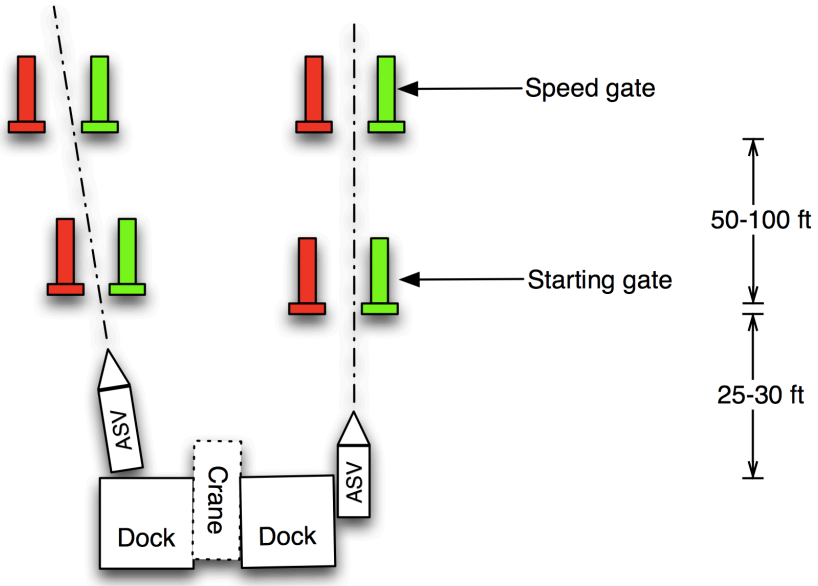
2.1 Demonstrate your strength

You will start by demonstrating the thrust of your ASV can generate by hooking up your vehicle to a thrust measurement system (see Thrust measurement harness diagram). Your vehicle will then generate as much thrust as possible in 10 seconds. This task can be accomplished in a manned manner (you can use a remote, laptop or buttons on the ASV to start/stop this task). See figure 2 in the Annex for the suggested harnessing mechanism between the strain gauge and your ASV. You must provide a harness attached to two points on your vehicle and which offers a single carabiner or loop as the strain gauge interface.



2.2 Demonstrate speed

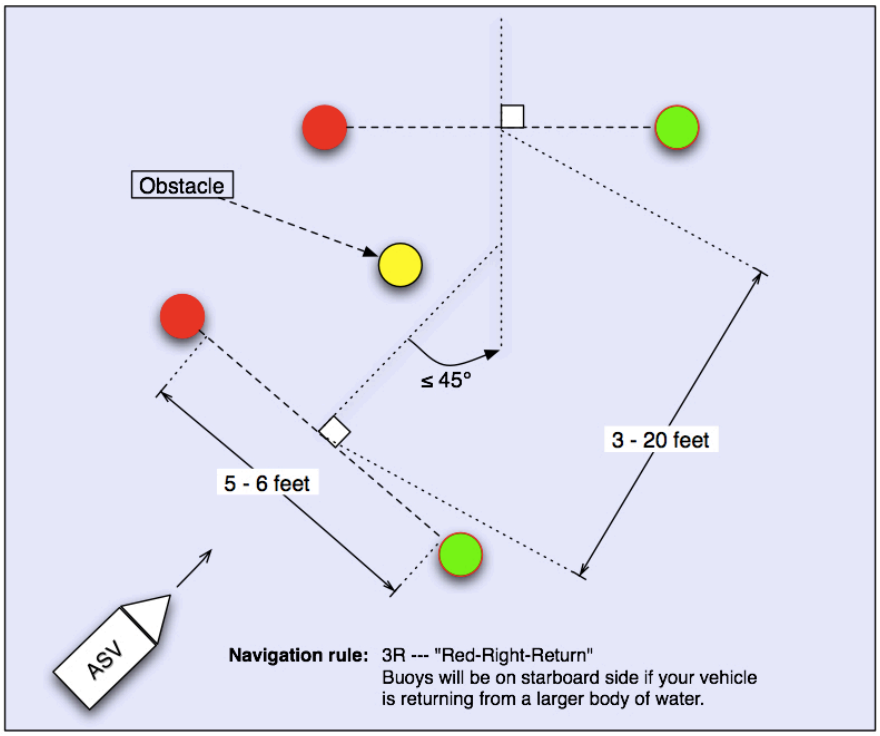
The vehicle should pass through the starting gate demonstrating the ability to steer a steady course and control speed up to a second gate, the speed gate. The starting gate will be in a fixed position with an orientation of about 25-30 feet (7.5-9 m) away from the dock throughout the competition. The speed gate will be 50-100 feet (15-30 m) away from the starting gate. A 'gate' is a set of two navigation buoys approximately 6 feet apart from each other. The buoys used will be Taylor Sur-Mark Marker buoys #950400 & #950410 (49" in tall, 10-18" in diameter). Your vehicle will be timed on how long it takes to transit between the starting gate and the speed gate. The gates will be positioned such that you can aim to pass both gates using a straight line from the dock.



2.3 Navigate the channel

The entrance of the navigation channel will be outside of the speed gate. The navigation channel is delimited by pairs of red and green navigation buoys (see Navigation channel diagram). The buoys model used will be Polyform A-0 (red and green). The buoys will be placed in such a manner that you can use the 3R navigational mantra (red-right-return). Follow the navigation channel while avoiding the yellow buoys marking obstacles (also Polyform A-0). At the end of the channel, you will find a larger blue buoy (Polyform A-2).

For 2013, the navigation channel task is optional. However, if you go through it all challenge station points will be multiplied. If you go through at least 1 pair of buoys, your challenge station points will be doubled. If you go through at least half of the buoys pairs and avoid at least 1 yellow buoy, your challenge station score will be tripled. And if you go through every single pair of buoys and avoid all yellow buoys, your score will be quadrupled. These multipliers are not additives. Only the highest challenge station score multiplier for which you qualify will be applied.



3 Challenge stations

The GPS coordinate for each of the challenge station will be provided for each competition stages (tests, qualifications, finals). The RoboBoat staff will do everything possible to provide as accurate as possible GPS coordinates but there will always be an error margin (based on experience at this site ~10 feet) and that different GPS unit/software may report slightly different locations for the same physical position.

3.1 Catch the ball

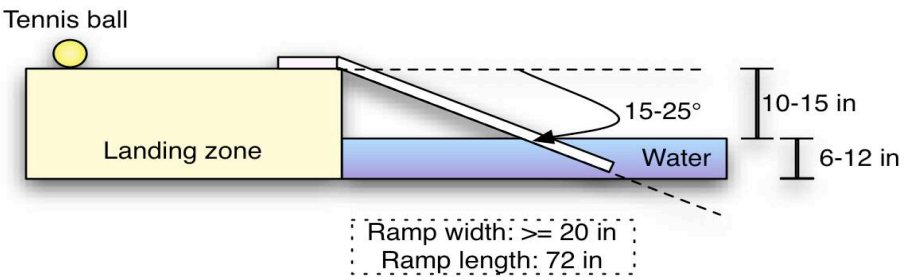
3.2 At the given GPS coordinate, your vehicle may locate a landing zone and make contact with it. From there your vehicle, or subsystems deployed by your vehicle, will have to go up the landing zone incline (20-30°) and retrieve the treasure (a tennis ball). The ramp for the landing zone will be at least 20in wide. The tennis ball is a standard yellow tennis ball. The landing zone will be 40in x 5ft and is light beige colored (EzDock section color). If you opt to deploy subsystems from your vehicle, you must retrieve every piece of material that has been deployed or you will have to forfeit all the points accrued for the amphibious landing task. Judges reserve the right to end a run if the vehicle leaves the landing zone without retrieving all the material deployed (ex: if the ASV leaves a navigation helping device on the landing zone). Read the section 4.1 Video Upload small prints

All submitted team videos must be under 3 minutes long. Your video shall be generated using the following compression options:

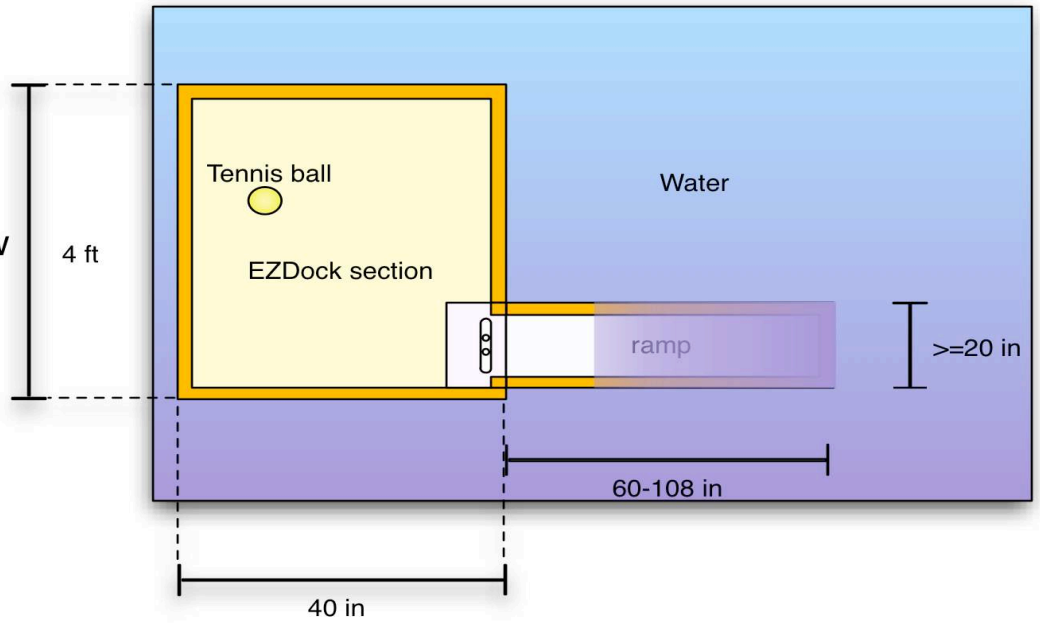
- Format: Quicktime
- Compression- H.264
- Limit Data Rate: 2200 Kbps
- Sound: MPEG-4 AAC
- Frame Size: Unscaled

The AUVSI Foundation video crew recommends that you use MPEG Streamclip to export your video in the above format. To submit your video online please visit: https://www.yousendit.com/transfer.php?action=dropbox&dropbox=500films
Amphibious landing fine print.

Side View

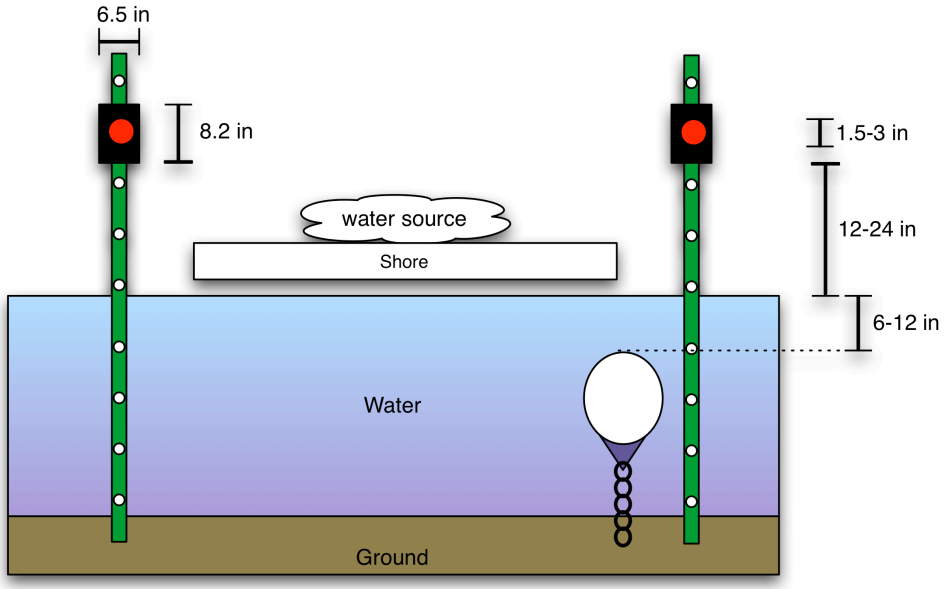


Aerial View



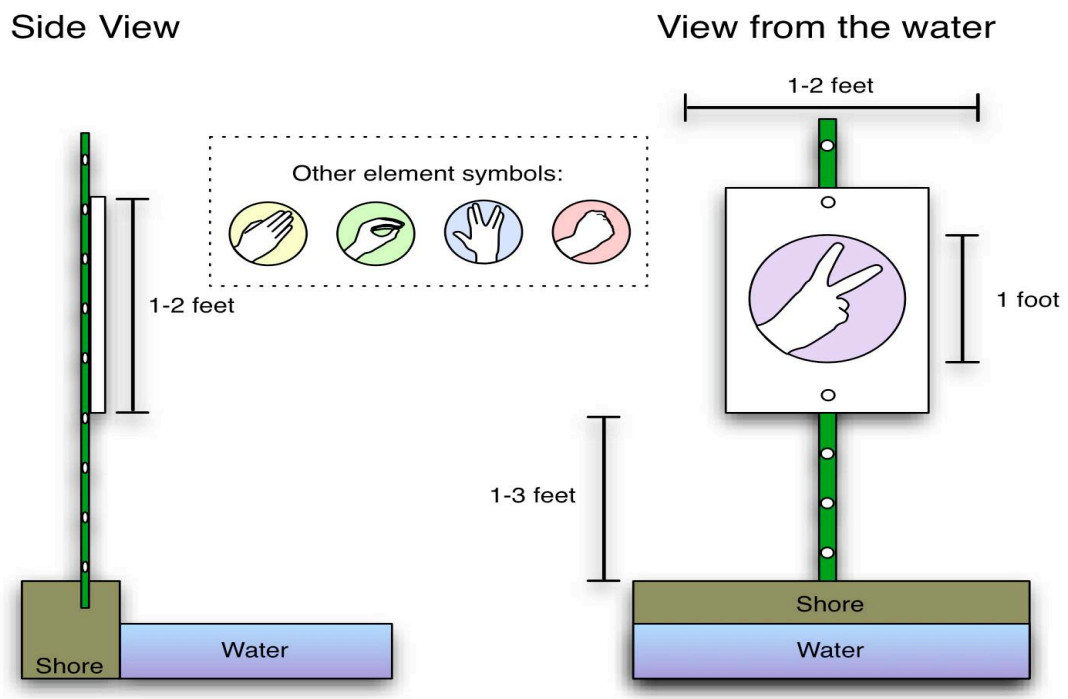
3.3 Sneaky Sprinkler

The Sneaky Sprinkler task for unmanned vehicle is all about figuring out how to turn on the sprinkler rather than be surprised by it. At the given GPS coordinate, will be two red buttons mounted on a metal pole. A white Polyform A-0 buoys will be placed fully submerged next to the pole holding the 'active' button. The button on the other pole will be considered 'inactive'. The top of the buoy will be 6-12in below the surface. The button will be position 12-24in from the water surface (directly over the water). The button will be an Emergency Stop button with a diameter 1.5-3in. The box on which the emergency button is placed is a black Pelican case 1120. To indicate when you win the sneaky sprinkler task, water fountain will be triggered as soon as the active button pressed (water debit will be limited to < 1 gallon/s).



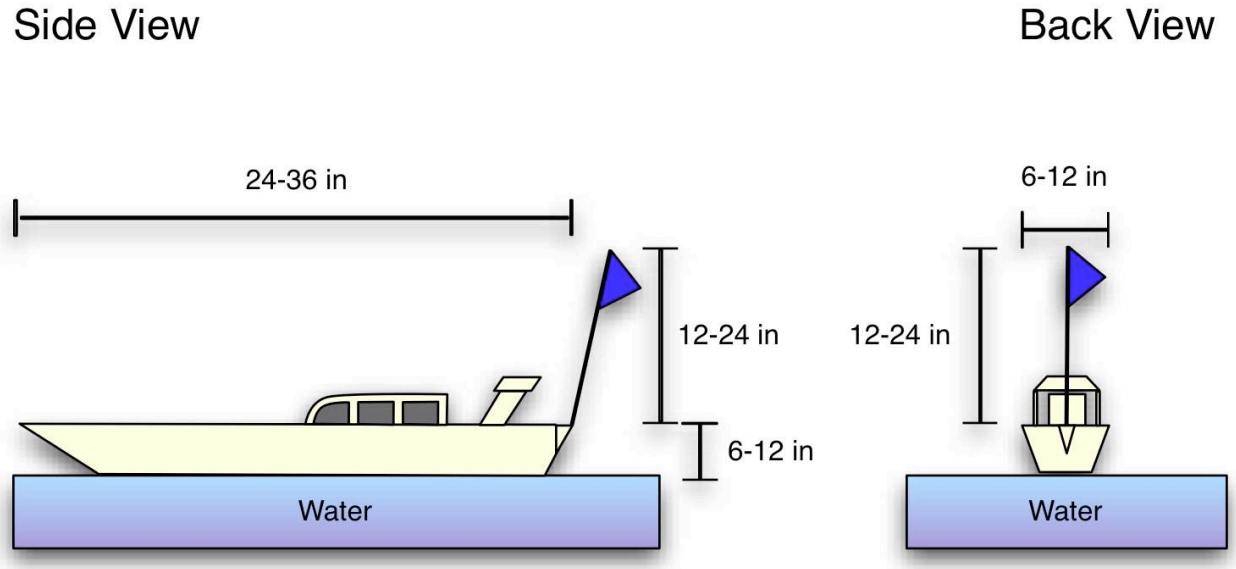
3.4 The 'Rock, Paper, Scissor, Lizard, Spock' station

At the given GPS coordinate, your vehicle may locate a set of four signs (similar to stop sign but with a custom color) between two (2) feet and five (5) feet above the water level. Each target will be marked with one of the five symbols from Rock, Paper, Scissor, Lizard, Spock (randomly chosen). The sign will be printed on ~1/8in thick aluminum metal plate. Each target will be 2-12 feet away from the next one. One of the targets will be 'hot' (20C+ degrees warmer than the other ones). The targets will be directly facing the water and will be ground based (on the edge of the shore). Report the name of a symbol that would beat the one that is warm along with the GPS position of the warm symbol sign. The competition organization will provide an 802.11g 2.4Ghz wireless network for reporting the hot target. This network is expected to be used solely for reporting 'Rock, Paper, Scissor, Lizard, Spock' challenge and not for other purposes (incl. telemetry, remote control, etc). The exact IP of the reporting server will be posted on the information whiteboard at the competition sit.



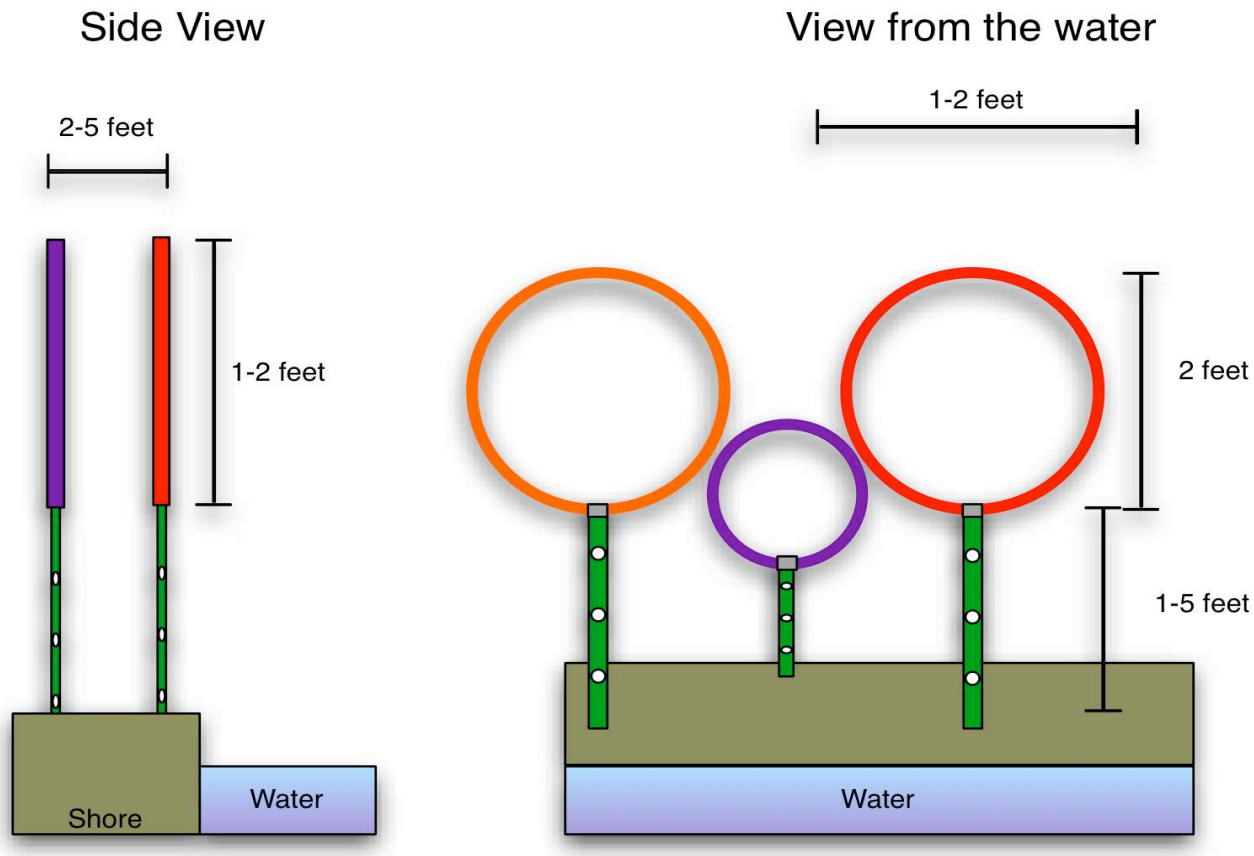
3.5 Capture the flag

Your vehicle may locate a floating or slow moving boat around the given GPS coordinate. Note that since the boat will be floating or moving, the given GPS coordinate will be approximate and you will need to explored a radius of up to 150 feet around this coordinate. The boat will carry a small blue flag on a 12-24in flexible plastic pole. You must approach the boat and steal the flag. The flag will require less than 3lbs of force to be released from the boat. Note: your vehicle will be considerably larger/sturdier than this floating boat. Please avoid making contact with the boat to prevent damaging it.



3.6 Shoot through the hoops

At the given GPS coordinate, you will find 3 colored hoops mounted a pole. There will be an orange, a red and a purple hoop. The orange and red ones will be by the water while the purple one will be 2 to 5 feet further from the shore. The hoops will made of 24" Pull Buoy Inc Deluxe Hoops (http://www.amazon.com/dp/B002NL0OUK/). To complete this challenge task, you must shoot a foam arrow/missile through the hoops. The arrow/missile must be shot using compressed air (cannot be self-powered or using any type of combustible materials). The arrow/missile must be entirely made of foam (no wood, metal, ceramic, hard plastic, etc). We strongly recommend using Nerf arrows/missiles or similar toys (ex: http://www.hasbrotoyshop.com/nerf-big-bad-bow-arrow-refill?BR=582&ST=SO&PG=1). Additional points will be given for shooting through the purple hoops that is installed further from the shore.



3.7 Return to the dock to cash in

If you have reached the challenge station and attempted at least 3 stations, you qualify for a bonus task! The bonus task is to return to the dock in autonomous mode going through the navigation channel passing through at least 3 sets of buoys and navigating in the general direction of the navigation channel. Note that the 3R Navigation mantra still applies, but since you will be returning, the red buoys will be on the starboard side of your vehicle

4 Rules

4.1 Video Upload small prints

All submitted team videos must be under 3 minutes long. Your video shall be generated using the following compression options:

- Format: Quicktime
- Compression- H.264
- Limit Data Rate: 2200 Kbps
- Sound: MPEG-4 AAC
- Frame Size: Unscaled

The AUVSI Foundation video crew recommends that you use MPEG Streamclip to export your video in the above format. To submit your video online please visit: https://www.yousendit.com/transfer.php?action=dropbox&dropbox=500films

4.2 Amphibious landing fine print

In order to earn points for the amphibious landing stations, the tennis ball is retrieved and stays onboard your vehicle until the end of the run. In addition you vehicle must either (a) entirely leaves the water to retrieve the tennis ball, (b) stays in the water, but deploys a self-propelled aerial or ground vehicle to retrieve the tennis ball. Any other mechanism to retrieve the tennis ball that involve a vehicle still in the water without deploying a self-propelled vehicle will not be granted any points (such as crane, telescopic arm, robotic arm, etc). For the duration of the attempt at this station, the "surface" general requirement is lifted (it will be strictly enforced once again as soon as you leave this station). The '*competition area*' rules will also be relaxed during the duration of the amphibious landing task to let you deploy subsystems into the landing zone as long as all these subsystems are retrieved by your vehicle before leaving the landing zone. Finally, for the duration of the amphibious landing the '*autonomous control requirements*' rules will be also relaxed if you choose to deploy subsystems in the landing zone by letting you remote control these subsystems from the "mothership" (they can either be autonomous or remote controlled by commands originating from the "mothership" but not by outside computers or team members) as long as all the parts are retrieved before leaving the landing zone.

4.3 Scoring

Each of the tasks has a point value associated with it. The tasks must be completed in order. Additional points will be awarded if you can get back to the dock early (complete task within 20 min). At any point in time, a team can terminate its run. If there is time remaining, they can opt to start a new run. Please note that all points allocated for a run will be lost if a new one is started. Thrust test points can be carried over during a phase of the competition (test, qualifications or final) if no noticeable changes to the propulsion or battery system occurred unless the team decides to do a new thrust test.

4.4 Interference

Vehicles that interfere with competition elements may be disqualified at the judges' discretion. "Interference" does not include cases where, in the opinion of the judges, a vehicle is attempting to complete one of the tasks. If a vehicle becomes entangled on a

competition element, the run will be declared complete. Teams may keep the points earned on that run, or may have the vehicle untangled to return it to the dock and start another new run. If a new run is begun, all points from the previous run are lost.

4.5 Communications during the run

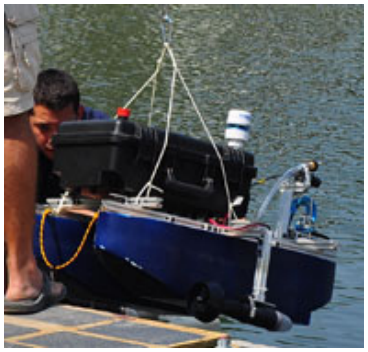
Communication with the vehicle during the run is strictly forbidden except for the messages to report the Rock, Paper, Scissor, Lizard, Spock messages. Any running laptop/computerized device connected (wired or wireless) to the vehicle must be left on the dock table. The remote control (for bringing the vehicle back) must be handed over to the designated RoboBoat official during the run. The official will follow the team leader and will hand over the remote if asked to do so. Handing over of the remote control will terminate the run.

4.6 Logistic of putting vehicles in the water

In order to make it possible to deploy your vehicle at the RoboBoat competition, your team has to provide both a wheeled cart/trailer and a 3 or 4 points harness.

4.6.1 3 or 4 points harness

4-points harness is preferred over 3-points harness. For your vehicle to be deployed with a crane, your team has to provide a harness custom design for your vehicle. Your vehicle design should include 3 or 4 hook points that are fixed to the vehicle structure. We recommend using ½ in of diameter (or thicker) nylon rope for the harness. We recommend terminating each end of the harness by a carabiner for quick installation/removal of the harness. To attach the harness to the crane, an additional loop should be created in the middle/upper part of the harness to avoid slipping during deployment. Below are few examples of harnesses used to deploy vehicles in 2011 (from left to right: harness on U of Michigan's vehicle, harness on US Naval Academy's vehicle and preeminent hook points on VT's vehicle.




4.6.2 Wheeled cart/trailer with hard-linked handle

All team are expected to provide their own trailer (Suggestions: garden cart, golf cart, dump cart, etc). Trailers will be moved by hand on site (no motor vehicle allowed). A handle system that is connected to the trailer by a solid link (no rope/chain as it cannot be use to back up nor to align the trailer) that exceeds the length of the ASV by 2-4 feet is required in order to move the trailer on the ramp. All trailers must be negatively buoyant (sink when put in the water). Below are some examples of wheeled cart/trailer.



4.7 Time considerations

Once time is started at the beginning on the run, it will not be stopped (even while the vehicle is returning to the dock). The only exception is if course obstacles are damaged by a natural cause (wind, wave, rain, etc), time might be stopped and a run might be restarted (time adjusted) at judges' discretion.

4.8 Size and weight limits

The vehicles for RoboBoat must fit within a six-foot long, by three-foot wide, by three-foot high “box” (1.83 m x 0.91 m x 0.91 m). Table 1 shows the bonuses and penalties associated with a vehicle’s weight in air.

5 Diagrams and illustrations

5.1 Maximum size and weight table

	Bonus	Penalty
ASV Weight > 140 lbs (ASV Weight > 63.5 kg)	N/A	**Disqualified!!!**
140 lbs ≥ ASV Weight > 110 (63.5 kg ≥ ASV Weight > 50 kg)	N/A	**Loss of** 250 + 5 (lb – 110) 250 + 11(kg – 50)
110 lbs ≥ ASV Weight > 70 (50 kg ≥ ASV Weight > 32 kg)	**Bonus of** 2(110 – lb) 4.4(50 – kg)	N/A
ASV Weight ≤ 70 lbs (ASV Weight ≤ 32 kg)	**Bonus of** 80 + (70 – lb) 80 + 2.2(32 – kg)	N/A
ASV Dimensions greater than - Width: 3ft (0.91m) - Height: 3ft (0.91m) - Length: 6ft (1.83m)		**Disqualified!!!**