COMPETITION MISSION ANALYSIS SAUC-E/ROBOSUB

NN

1. INTRODUCTION

This report will cover the SAUC-E and Robosub competitions and give a comprehensive description of each task in each of the competitions. The purpose of this report is to give the development of the mission control unit some background to base its decisions upon and ensure that all missions can be fulfilled with the Naiad AUV. Note that the missions presented here are for the 2013 robosub and sauc-e competitions and might not be valid for the 2014 instances of the competitions. But it will provide a baseline for the project group to work with.

2. SAUC-E MISSIONS

In the SAUC-E competition there are four missions, these are:

1: Validation gate
2: Underwater structure inspection
3: Wall inspection
4: Black box

2.1. **Validation gate.** This mission is the qualifying mission. If one is not able to complete this mission the AUV will be disqualified.The task is to traverse at a controlled depth towards the centre of the arena, make a 90 degree turn, and pass through a validation gate. The turn should be done when the AUV is directly above the structure for task 2. The gate will be constructed by two buoys on a rope two meters apart. Lights will be added to the ropes. To complete this mission the AUV has to pass through the gate without touching the gate itself.

Requirements to complete and receive all the points:

1: Pass through the gate
2: Supply a video log of the AUV passing through the gate to the judges

System requirements

1: The vision system is able to recognize the gate
2: The mission control unit is able to navigate to and through the gate without being outside of the "box"
3: The auv should recognize when it has passed the gate

Sensor requirements

1: Front and bottom Camera

2.2. **Underwater structure inspection.** In this mission the AUV has to inspect a structure located at the bottom of the arena. The structure consists of 2 concentric circles at different heights and will not move during the competition. This structure is in line with the validation gate.

Requirements to complete and receive all the points:
  1: T he AUV does a full 360 degree scan of the structure while keeping the structure in the field of view of any sensor
  2: 100% of the structure is inspected
  3: A 3D reconstruction of the structure is supplied to the judges

System requirements
  1: The AUV is able to find the structure
  2: The mission control unit in combination with the navigation is able to do a controlled strafe where the structure doesn't end up outside the sensors field of view.
  3: The AUV should recognize when it has scanned 100% of the structure
  4: The AUV should be able to produce a 3d map of the structure

Sensor requirements
  1: Front and bottom cameras
  2: Active sonar

2.3. **Wall inspection.** In this mission robot to robot communication is tested. So in this mission one needs two vehicles, one AUV that searches for the inspection point and signals an inspection robot. The inspection robot then supplies data back to the search robot. The search robot will search a wall for a point of interest and signal the inspection bot with the position of it. After that the inspection bot moves to the point of interest and supplies the search bot with information of if the point of interest is illuminated or not.

Requirements to complete and receive all the points:
  1: The search AUV follows the wall at a 2-4 m distance and finds the point of interest (buoy)
  2: The search AUV signals the inspection AUV and the inspection moves to the search AUV.
  3: The inspection AUV finds the point of interest based upon information from the search AUV
  4: The inspection AUV supplies the search AUV with data of if the point of interest is illuminated or not

System requirements
  1: The search AUV should be able to find the wall where the anomaly is
  2: The mission control unit in combination with the navigational unit should be able to keep a constant distance to the wall while preforming the search

3: The mission control unit should have a search pattern implemented
4: The vision should be able to identify the anomaly
5: Communication between the search and inspection AUV should be possible

Sensor requirements

1: Front camera
2: Acoustic modem
3: some kind of distance sensor, sonar? stereo vision?

2.4. **Black box.** The black box mission consists of three parts. The AUV should be able to map the environment. These are awarded if the vehicle surfaces within the time limit and supplies the map to the judges. In the arena there will be a stationary black box which is emitting an acoustic ping signal. The AUV should locate this black box and surface within three meters from it.

Requirements to complete and receive all the points:

1: Build a map of the environment
2: Find the stationary black box
3: Surface in the surfacing zone

System requirements

1: The AUV should be able to listen to ping signals and locate them in 2/3d space
2: The AUV should be able to move to the vicinity of the pinger
3: During the movement the AUV should be able to scan the seabed
4: When the AUV is directly above the pinger the AUV should be able to surface without drifting away from the position of the pinger

Sensor requirements

1: Passive sonar
2: Active sonar

3. Robosub

In the Robosub competition there are 7 missions these are:

1: Path
2: Traffic light
3: Parking
4: Speed trap
5: Toll booth
6: Driving
7: Pizza delivery

All of these missions except for the Driving task are also preformed in the 2010 and 2011 instance of the Robosub competition with minor changes, i.e the images in the bottom of the bins for the speed trap mission.

3.1. **Path.** In this task the AUV should follow a predefined path and it will take you through the whole course, starting with the traffic lights and ending with the pizza delivery.

The path consists of aluminium sheets placed on the bottom of the pool.

Requirements to complete and receive all the points:
  1: Follow the path and complete all missions along the way

System requirements:
  1: The vision system is able to recognize and localize the "path"
  2: The mission control unit is able to choose the correct path to follow

Sensor requirements
  1: Bottom camera

3.2. **Traffic light.** In this mission the AUV has to bump two buoys at the right time. The buoys are lit with high power RGB lights and each of the buoys should get a predefined color at the end of the mission. The light inside of each buoy cycles through red green and blue with a 5 sec interval. The required colour is supplied to the teams at the start of the day.

Requirements to complete and receive all the points:
  1: The two buoys should be lit with the correct colour

System requirements
  1: The vision system should be able to detect the current colour of the buoys
  2: The mission control unit should be able to calculate when to hit the buoys so they stay at the correct colour
  3: The mission control unit should be able to recognize when the buoys have the correct colour so it knows when to move on

Sensor requirements
  1: Front camera

3.3. **Parking.**

3.4. **Speed trap.** In this mission the AUV should drop its markers inside two specific bins. In this years instance of the Robosub competition numbers are placed inside the bins and the bins that should receive a marker is supplied to the teams at the beginning of the day.

Requirements to complete and receive all the points:
  1: The AUV drops one marker in each of the selected bins

System requirements
  1: The AUV is able to recognize the indicators on the bottom of the bins
  2: The AUV is able to navigate above the selected bins at an appropriate height

    3: The AUV is able to drop markers
    4: The mission control unit is able to decide the right time for a marker drop

Sensor requirements
    1: Bottom camera

Actuator requirements
    1: Marker droppers

3.5. **Toll booth.** In this mission, the AUV should fire its torpedoes into octagon shaped holes. These holes are positioned on a board divided into four quadrants. Each quadrant has its own colour and two holes. On the mission day two specified quadrants are selected, one primary and one secondary. The AUV receives more points for hitting the primary target than the secondary one.

Requirements to complete and receive all the points:
    1: One torpedo is fired into the small octagon of the primary quadrant
    2: One torpedo is fired into the small octagon of the secondary quadrant

System requirements
    1: The vision system is able to divide the target into its quadrants
    2: The vision system is able to find the correct quadrants
    3: The vision system is able to differentiate between small and big octagons
    4: The mission control in combination with the navigational unit is able to aim the torpedoes so it can hit its target
    5: The mission control is able to actuate the torpedoes

Sensor requirements
    1: Front camera

Actuator requirements
    1: Torpedo shooter

3.6. **Driving.** This is a manipulation task where the AUV should turn a steering wheel and shift a lever.

Requirements to complete and receive all the points:
    1: Turn the steering wheel 1 revolution
    2: Shift the lever to the other position

System requirements
    1: The front gripper is able to grip both the steering wheel and the shifter
    2: The vision system is able to identify whether the shifter is up or down

3: The mission control is able to navigate in small circles to be able to turn the steering wheel

4: The mission control is able to recognize when the AUV has made a full 360 degree turn of the wheel

5: The mission control unit is able to shift the lever without loosing its grip of it, so very precise movements are needed

Sensor requirements

1: Front camera

Actuator requirements

1: Front gripper

3.7. **Pizza delivery.** In the pizza delivery mission the AUV should locate a pinger on the bottom of the arena. On top of the pinger there is a "pizza box" made of pvc pipe, the AUV should be able to grip and lift that pizza box. When the AUV has securely gripped the tube the AUV should surface within a octagon above the pinger.

Requirements to complete and receive all the points:

1: Locate the pinger

2: Lift the pizza box from its stand

3: Surface within the octagon above

System requirements

1: The AUV should be able to listen to ping signals and locate them in 2/3d space

2: The AUV should be able to move to the vicinity of the pinger

3: The AUV should be able to grip the pizza box

4: The auv should be able to to a controlled climb to the surface

Sensor requirements

1: Passive sonar

2: Bottom camera

Actuator requirements

1: Bottom gripper

4. SIMILARITIES

In both competitions the qualifying mission is a validation gate so these two missions can be treated the same. The only difference is that in the SAUC-E competition you will have to search for the gate in another way.

In both competitions there is a mission that includes a pinger. The only difference is that the task in the Robosub competition includes gripping and lifting and object. Also in the Robosub competition there is two pingers but only one will be used at a time, so one cant only use vision to find the stand for the pizza box since the one in the field of view might be the wrong one.