TEAM PHANTOM 2 - RoboBoat 2022 TDR

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***Abstract*— Team Phantom of the Robotics Association at Embry-Riddle (RAER) has spent this competition season continuing to improve on the trimaran Phantom II platform that has been used for the last two years. Development has strongly focused on a complete overhaul of the electrical and software systems on the Autonomous Surface Vessel (ASV), with a new central computing system and all new software. This involved major physical modifications to the aft deck and outer hull structures. While COVID-19 restrictions did delay progress and testing, great progress was made, ensuring Phantom II will remain competitive for years to come.**

I. COMPETITION STRATEGY

Having performed suitably in the past two competition seasons, the Phantom II ASV design was left largely unchanged from the 2020 season. However, several significant redesigns were made to the system. The mechanical team worked towards optimising the inner layout of the vehicle. The control systems team chose to embark on a complete systems overhaul; the main programming language of the ASV was changed from NI Labview to C++-based ROS. Consequently, nearly all of the code which had already been developed in LabView needed to be re-written in ROS.

It was hoped that this development strategy would increase the capability of the Phantom II platform overall but retain many of the same strengths enjoyed by the ASV in the 2019 and 2020 competition seasons. Given the proven stability and seaworthiness of the platform, it was expected that once electrical and software overhauls were complete, the ASV would be able to retain the ability to complete many of the competition challenges that rely solely on navigation and obstacle avoidance. Specifically, the Navigation Channel, Speed Gate, Obstacle Channel, Obstacle Field, and Return to Dock challenges were expected to be the primary tasks which the ASV would aim to complete in a competition trial. These challenges were therefore almost exclusively seen as software and sensing challenges, as the ASV was already capable of meeting physical requirements of navigation on the water.

II. DESIGN CREATIVITY

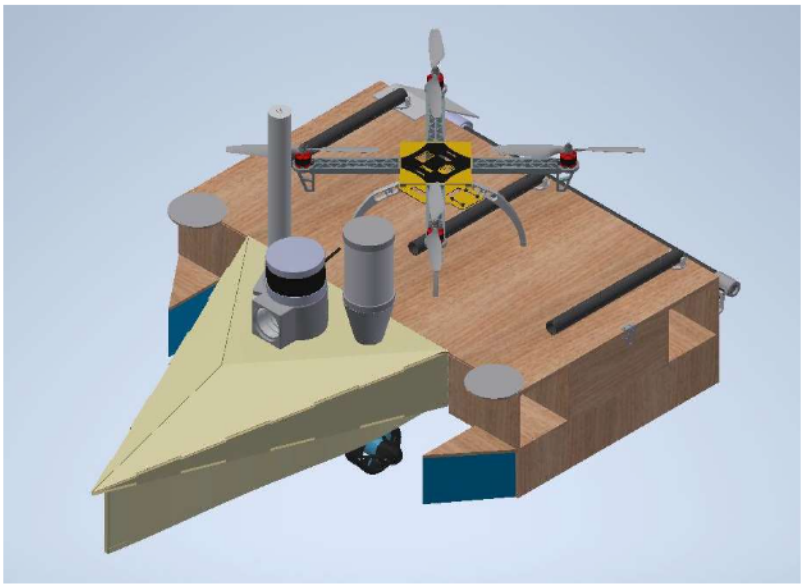

Figure 1 - CAD rendering of possible future configuration of the Phantom II

As 2019's platform was retained for competition this year, a majority of the changes to the platform revolved around modifying and fine tuning the subsystems already on the ASV. These changes revolved around performing minor repairs and remaking parts that had deteriorated over time. Development of other subsystems to tackle more competition tasks was secondary to these changes, as the software and electrical revamps were to take the entire year to complete. In other words, it was expected that the control systems subteam would be so busy with its own work, adding entirely new subsystems (namely a hydrophone for the Acoustic Docking challenge) was given less attention.

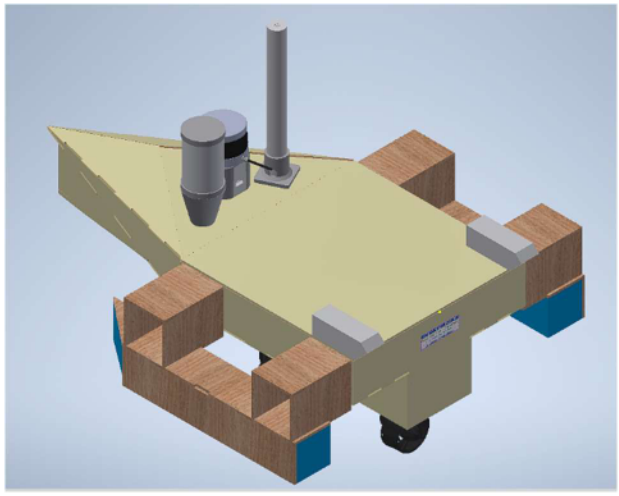

Figure 2 - Current boat configuration

In this year's competition we brought in a new team that has begun to learn about the previous team's work. There is continued work on the current model boat and work being implemented on the move to new C based ROS code. With this we will start from the ground up and be attempting task one and task three. In our design for the boat, we were able to keep the slim design of the hull and pontoons on the side allowing for quick travel and precision in movement. The use of our LiDAR system would observe obstacles in the front field of view of 180 degrees giving reason for the antenna and lights on the back port and starboard sides of the puck. In each of the tasks we use the front and back motors in order to allow quick maneuverability in the water and ease in the docking process. Within the trials the system would look for objects within a 2 meter radius and use that information to decide a route around said object. This will be the main factor used for object avoidance using the point cloud system obtained from the LiDAR. With initial runs of the course the boat will then scout for waypoints around the water to set a course.

IV. ACKNOWLEDGEMENTS

The Embry-Riddle RoboBoat 2020 team would like to acknowledge all of our advisors and faculty, in particular: Dr. Eric J. Coyle, Dr. Christopher J. Hockley, Mr. Bill Russo, Dr. Charles Reinholtz, Dr. Patrick Currier, and David J Thompson, who were each able to share endless amounts of time, guidance, knowledge, and support to our team. We would also like to acknowledge ThunderPower, which has provided the Robotics Association at Embry-Riddle with its LiPo batteries for many years. Finally, we would like to acknowledge and thank VectorNAV for their extraordinary donation of a new VN-300 for us to use.

V. REFERENCES

[1] Roboboat 2021 Rules and Tasks Description, Robonation RoboBoat

APPENDIX A:

Component	Vendor	Model/Type	Specs	Cost (If New)
ASV Hull	Developed	N/A	Sealed and laser-cut plywood	Inherited
Amas	Developed	N/A	Sealed and laser-cut plywood, insulation foam	
Fiberglass Exterior	Fiberglass Plus	Marine Gel Coat	http://www.fiberglassplusinc.com/gelcoats.html	Inherited
Waterproof Connectors	N/A	N/A	None, waterproof connections were hand made with silicone sealant	N/A
Propulsion	Blue Robotics	T200 Thruster	https://bluerobotics.com/store/thrusters/t100-t200-thrusters/t200-thruster/	Inherited
Power systems	Thunder-Power	6S LiPO	5000mAh	Inherited
Motor controls	RC Electric	30A ESC	https://www.amazon.com/RC-Brushless-Electric-Controller-bullet/	Inherited
CPU	NVIDIA	Jetson Xavier AGX	https://www.spektrumrc.com/Products/Default.aspx?ProdId=SPM6600	$216
Teleoperation	Spektrum	DX6i	https://www.amazon.com/FrSky-Taranis-Channels-Transmitter-Controller/dp/B072559WH9	Inherited
LIDAR	Velodyne	Puck	https://velodynelidar.com/products/puck/	Inherited
IMU and GPS	VectorNav	VN-300 Dual Antenna GNSS/INS	https://www.vectornav.com/products/vn-300/specifications	Inherited
Camera	Point grey Research	Blackfly USB3 w/ 1920x1200 fixed focus lens	https://www.flir.com/products/blackfly-usb3?model=BFLY-U3-23S6C-C	Inherited
Software				
Programming Languages	Robot Operating System (ROS), C++			
Vision	TensorFlow			
Inter-vehicle communication	Ubiquiti	Bullet M2	https://store.ui.com/collections/wireless/products/bullet2	Inherited
3D Modelling and Drafting	Autodesk Inventor			