Multidisciplinary Development of an Autonomous Underwater Vehicle:

Cooperative Fleet for Surveillance Mission

Society for Industrial Applied Mathematics

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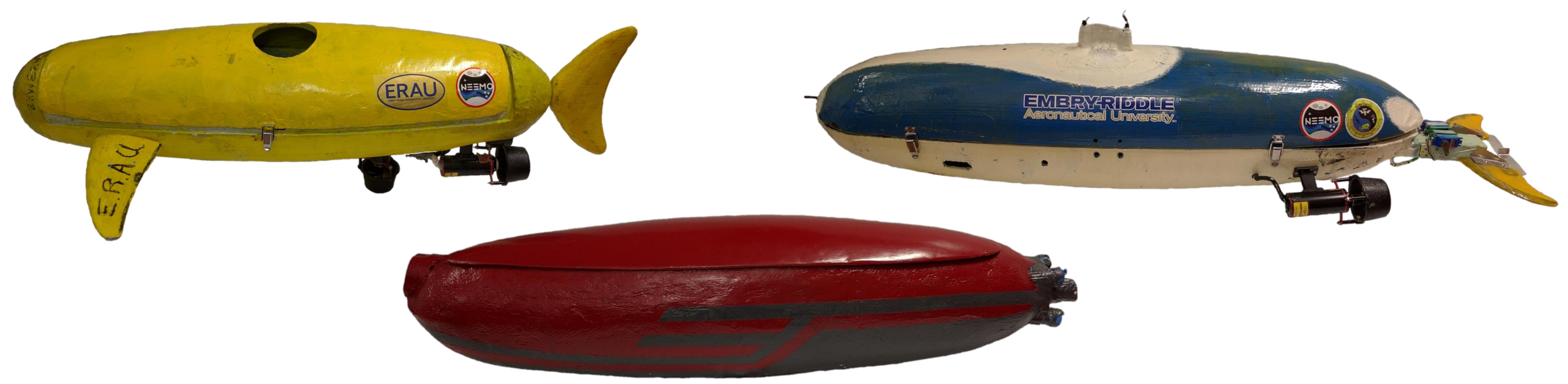
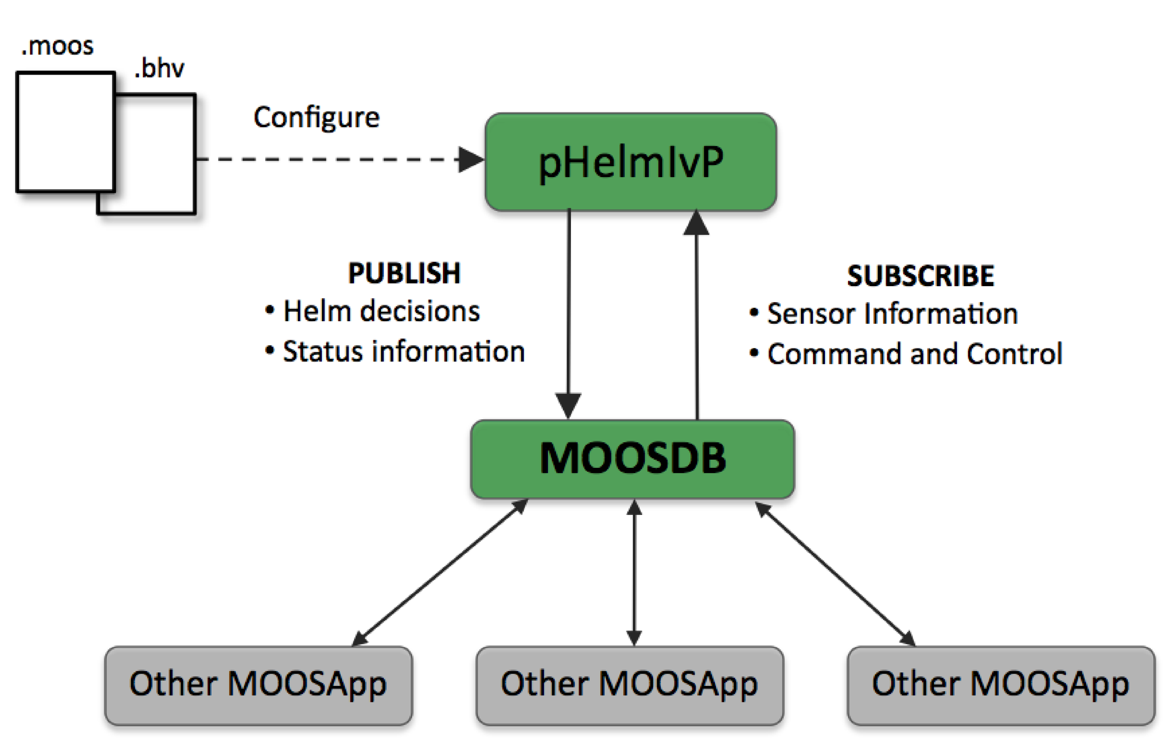
ABSTRACT: AN AUTONOMOUS UNDERWATER RESEARCH FLEET

Society for Industrial and Applied Mathematics has been developing of a fleet of underwater research vessels shaped as dolphins for the study of ocean floors and lagoons. The name of this underwater research platform is Eco-Dolphin. They are shaped as Dolphins to avoid causing offense to the wild life. The latest Eco-Dolphin in construction, the Red Eco-Dolphin, will be using a ballast attitude control unit to be able to shift its center of gravity. This innovation will allow it to utilize the forward thrust provided by the engines to climb, descend, and maintain depth. This unit has been constructed using the latest 3D printing procedures and CATIA graphical design. The Red Eco-dolphin will communicate with the Blue and Yellow Dolphins mounting a formation at all times. SIAM will monitor the data provided through a ground station. The US Air Force has invested their time and resources on our project to help them further develop the fleet behavior needed to navigate as one entity.

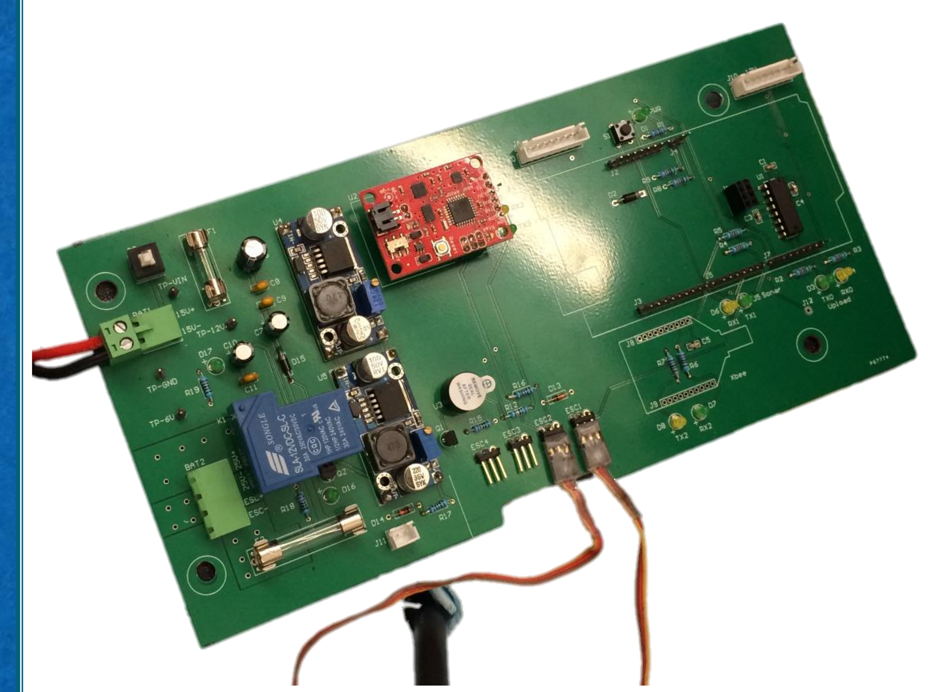


Software

The MOOS-IvP is a library of C++ modules developed by MIT's department of Mechanical Engineering and Center for Ocean Engineering for use in Interval Programing in autonomous systems. The MOOS-IvP was designed with platform independence, module independence, and nested capabilities in mind.

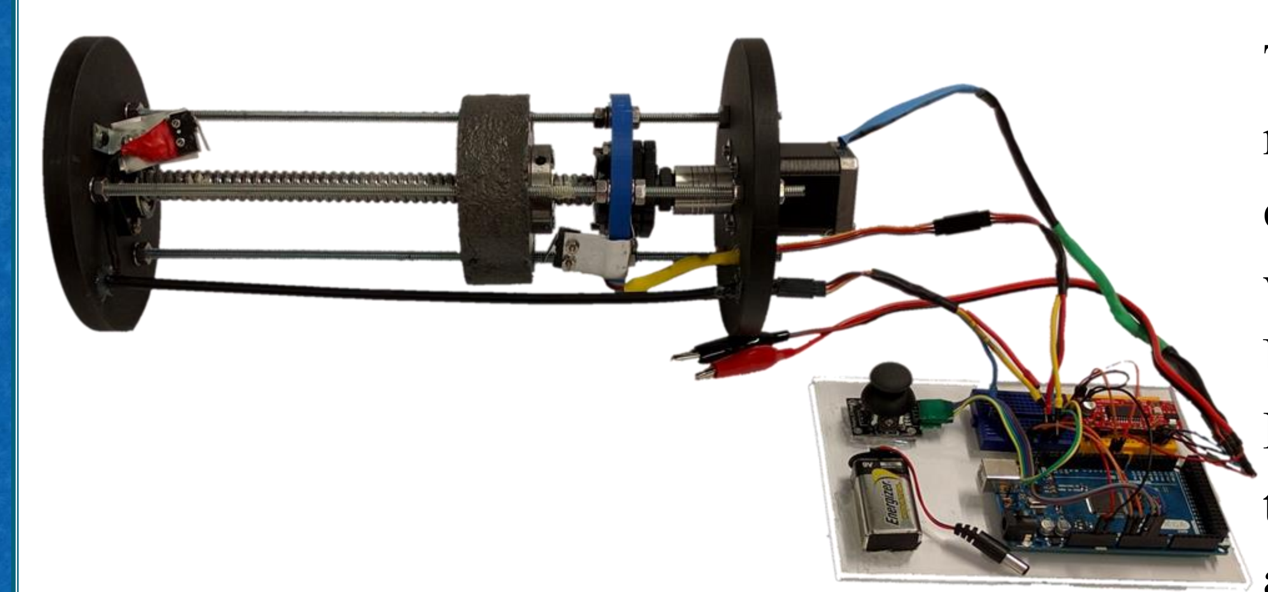


Electrical Systems



All electrical components that must be kept dry have to fit within the confined space of an airtight cylinder. The cylinder must fit an Arduino, a raspberry pi, and various other electronic components. The electronic components must be designed to run off a limited power supply without overheating. The electronic team's solution has been meticulously designed PCBs with strict space and power constraints.

Mechanical Systems



The Eco-Dolphin Ballast Control Unit is designed to move a lead disk within the Red Dolphin to change the center of gravity, making the dolphin capable of thrust vectoring by controlling its pitch. The Ballast Control Unit is controlled by an Arduino Mega and a Stepper Motor Control Board. The Nema 17 stepper motor turns the torque screw that the lead block is attached to allowing the lead cylinder to move along the length of the dolphin. There are two limit switches located at the top and the bottom of the torque screw that are connected directly to the Arduino Mega to prevent the dolphin from overturning. The Ballast Control Unit is currently ready for installation.

Conclusion

Eco-Dolphin has been a successful project so far because of the close collaboration of the three teams necessary for the design and production of such a complicated endeavor. SIAM at Embry-Riddle hopes to perfect the three dolphins and their fleet navigation software, and continue using what we learn to tackle difficult problems.

Reference

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