Caleb Flaim | 09/09/2023 | OCN 443 two thesis ideas

I am interested in building a microcontroller-based AUV that works on similar buoyancy and navigational principles as an Argo Float or a seaglider (any of the various brands). Sasha Seroy has agreed to mentor my project, which means that Rick Keil will be my faculty mentor within the thesis class. This project aims to quantify the spatial variability around an Orca buoy at different times in the year (e.g., early winter, mid-winter, late winter) to determine if the single-point sampling scheme accurately describes the variability seen in Puget Sound at different times in the year by building a DIY AUV.

The building and testing of the AUV will occur in three main phases. Phase 1: build a surface drifter that logs the desired variables (e.g., temperature, salinity, light concentration, imagery, etc.), GPS position, and relay information via LoRa (long-range radio) on the 915mHz ISM (Industrial, Scientific, and medical) band. This will be deployed in Puget Sound near a known data source for validation. The drifter will have the hull and most of the components of the glider, but they will not be powered or coded. Phase 2: modify the surface drifter to be a float by adding a VBD (variable-buoyancy drive) and then deploy near a known data source for validation. Phase 3: modify the float to be a glider by adding “wings” and powering and programming the components that allow the mass-shifter to move. Each phase of this project has been designed to work as a stand-alone project that can collect viable data for my thesis in the event that progress to meet the next phase is not met. The end goal for data collection is to deploy the DIY glider alongside a Student Seaglider Center glider near an Orca buoy for double validation of the data. Each phase will address roughly the same science question (minus a variable or two, depending on the electronics).

Techniques for analyzing the data are likely to be standard statistical tests to quantify the difference between the various data sources.

Lyman et al. 2020 discuss the build and validation of an Arduino-based wave height logger that can be cheaply built and deployed. Busquets et al. 2012 discuss the build and use of an Arduino-based AUV that can be built cheaply and deployed in a fleet. Both of these topics are important in that they achieve similar end goals to much more expensive commercial and proprietary equipment options. This enables researchers to either more cheaply study a region or more thoroughly study a region since they can purchase more instruments for the same cost. Open-source equipment and science also allow for research communities (both academic and public) to improve upon or alter the instrument's design and function to better measure the desired variables. It also allows the science to be more easily reproducible since there may no longer be a quarter-million dollar price tag associated with the equipment.

References

Lyman, T. P., Elsmore, K., Gaylord, B., Byrnes, J. E., & Miller, L. P. (2020). Open Wave Height Logger: An open source pressure sensor data logger for wave measurement. Limnology and Oceanography: Methods, 18(7), 335-345.

Busquets, J., Busquets, J. V., Tudela, D., Pérez, F., Busquets-Carbonell, J., Barberá, A., ... & Gilabert, J. (2012). Low-cost AUV based on Arduino open source microcontroller board for oceanographic research applications in a collaborative long term deployment missions and suitable for combining with an USV as autonomous automatic recharging platform. 2012 IEEE/OES Autonomous Underwater Vehicles (AUV), 1-10.