# Autonomous Surface Vessel (ASV): Field Testing and Sensor Integration

**Ryan Monroe, UNC Charlotte Department of Mechanical Engineering & Engineering Science**
**(Faculty Advisors: Dr. Artur Wolek, Graduate Student Advisor: Alex Nikonowicz)**

**Presented at the 2024 UNC Charlotte Undergraduate Research Conference (URC)**

## Introduction

- This study evaluates the utility of deploying small, portable autonomous surface vehicles (ASVs) to collect in-water measurements such as water depth and quality
- The Hydrone ASV is evaluated through field work to determine its capability to create interpolated maps describing the spatial distribution of the water quality parameters.
- Additionally, a MATLAB/Simulink model of the Hydrone ASV was developed to predict the mission time required to follow a waypoint mission path in the presence of water currents.

## Objectives

### Water Quality Sonde Mounting

- Be able to integrate the sensor onto multiple ASV frames securely and in an easily detachable manner

### Collect Conductivity/Salinity, Dissolved Oxygen (DO), Algae, and Turbidity data

- Demonstrate multiparameter sonde's ability to collect and record water quality data onboard ASV.

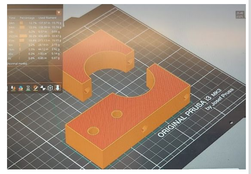
### ASV Dynamic Model in Simulink

- Control and visualize the heading of the ASV using a PID controller to optimize path motion and changes in direction

## Method

### Mount Design

- A 3D-printed, mount of two parts clamped together onto the ASV frame to secure the sonde in place.




### Data Collection

- Used Kor software to record data of conductivity, DO, algae, and turbidity via Bluetooth; used HyPack software to collect bathymetry data hardwired from echo sounder

### PID Control System in Simulink

- Thrust on the left/right motors was differentially controlled using a 20 kg mass model with 20 N max thrust

## Collected Data

### Hechenbleikner Lake

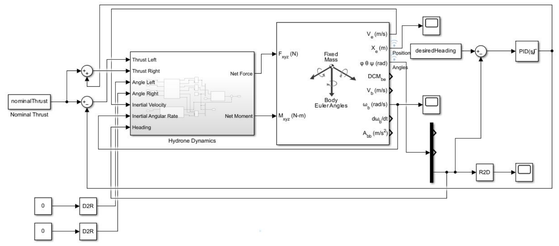
- Data from all four sensors, including Turbidity, Conductivity, Dissolved Oxygen, and Temperature were successfully collected over the course of 6 min 47s, at a speed of 2 ft/s.


### Data from ASV in Simulink

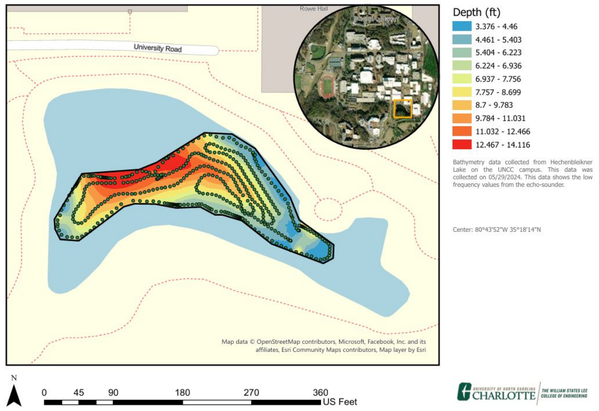
- The model was simulated executing up to 90 degree starboard/portside with constant differential thrust

## Results

### Simulink wiring diagram

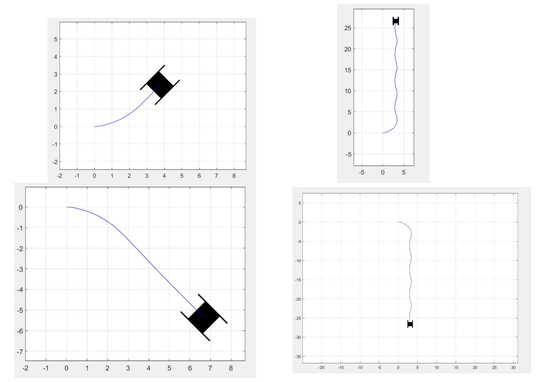



### Contour Map of Hechenbleikner Lake




*Sonde mounted onto 3 different ASVs*

*Sonde collecting data onboard ASV at Hechenbleikner Lake*



*ASV model performing a 45 and 90 degree turns in Simulink**

## Conclusions

- The results demonstrated the effectiveness of data collection utilizing ASV's navigation capability paired with a multiparameter sonde.
- The bathymetry data can be compared with the sonde data to aid in water quality assessment. A winch-deployable system, where the bathymetry data safely guides the sonde's position during data collection would enhance this effort.
- The Simulink model demonstrated efficient navigation using a PID controller. Future area may consider incorporating advanced control design to account for turbulent water currents around structures.

## References

*Credit to Alex Nikonowicz for producing the contour map from the data retreived
*Credit to Nick Kakavitsas for mentorship and assistance with final development of the code.