Autonomous Surface Vehicle (ASV)

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In collaboration with the UNH Remotely Operated Vehicle (ROV) project

Special Thanks to Dr. Martin Renken, John Ahern, Scott Campbell, Laura Gustafson, Sheri Milllette & Tate Ellinwood (Saint Paul High School)

CONTROLS AND AUTONOMY

- Updated controller from a bang-bang controller to PID controls
  - Reduces overshoot and decreases settling time of heading control
- Developed autonomy:
  - Grid of points, to collect data, in a lawnmower pattern
  - GPS to track current position of vessel and determine heading and speed
  - Sends commands the controller in order to follow the lawnmower pattern

SHORE TO VEHICLE COMMUNICATIONS

- Shore station equipment stored in a water/dust proof box for safe & efficient transportation
- WiFi signal used for telemetry and control
- ROS communicates across multiple machines to pass data and commands
  - ASV laptop is vehicle control
  - Shore station laptop is operator station
  - Sonar readings and GPS location communicated to shore station
  - Vehicle system parameters can be monitored (Propulsion, UUV Deployment)
- XBees are used for failsafe heartbeat

```
Time:  20:09:12
Latitude:  43.13574166666667
Longitude:  -70.93888666666666
Speed (knots):  0.01
Heading : 0.0
```

UNDERWATER GPS DEPLOYMENT

- Uses a Waterlinked® Underwater GPS© System
  - 4 submersible transducers (on ASV), 1 receiver (on ROV), and an Electronics dry box (on ASV deck)
- Employs a low-power linear conveyor to deploy the transducers
- System stabilizes the transducers for precise location monitoring
- Detachable for transportation of ASV

2018-19 Version

2019-20 Version

Waterlinked® Components

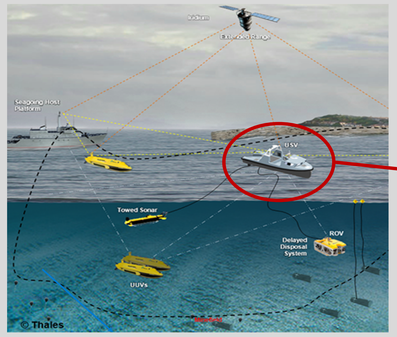
Fully Retracted UGPS Arm

Fully Deployed UGPS Arm

MISSION

The ultimate goal of this project is to have autonomous ASV and ROV deployment, which is also able to behave as a swarm with other ASV and ROV pairings. The intended application of this system is autonomous sea floor mapping.

Future goals include improving the autonomy of the system, and communication between multiple vehicles. The system would be able to serve as a testbed for evaluating the effectiveness of autonomous naval assets.



Le Guevel, Sonia. "Thales Wins French-UK Mine Countermeasures Contract." *Thales Group*, 2019 Thales Group, 27 Mar. 2015, www.thalesgroup.com/en/worldwide/press-release/thales-wins french-uk-mine-countermeasures-contract.

ASV OVERVIEW

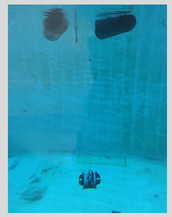
- **Catamaran-style Design**
- Length: 7' 9"
- Beam: 5' 6"
- **Twin Electric Motors**
- 4 arms for deploying UGPS sensors
- Trapdoor for deploying Unmanned Underwater Vehicle (UUV)
- "Penthouse" platform to keep electronics far from waterline
- **Built by 2017-2018 ASV Team**
- Many improvements and modifications have been added

TETHER MANAGEMENT

- New pulley system added to better handle tether between ASV and UUV, and helps prevent tether slipping.
- Rotary encoder added to allow for deployment/retrieval of tether based on distance, rather than time.

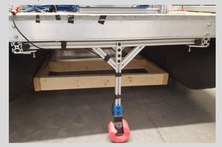
UUV INTEROPERABILITY

- Designed to operate with the UNH ROV team's vehicles
  - Blue Robotics ROV2 Heavy
- Modified automotive winch
- Trapdoor system for smooth UUV deployment



SENSOR OVERVIEW

- Positioning: GPS + GLONASS Receiver
- Water Depth Measurement: Blue Robotics Echosounder
- Heading & Tilt: Inertial Measurement Unit (IMU)
- Tether Deployment Length: Rotary Encoder



TUPPS (TESTING UNMANNED PERFORMANCE PLATFORMS)

Purpose: A small-scale version of the ASV for indoor testing in a tank.

- Cost-effective, modular construction
- Arduino, Raspberry Pi, and other open-source components
- Inertial Measurement Unit for heading control
  - PID heading control in testing
- Blue Robotics thrusters