Design and Testing of Navigation Software for a Small Autonomous Surface Vessel

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Abstract: In 2017, Kremers designed and built a small, open-source Autonomous Surface Vessel (ASV) to serve as a platform for future thesis work. This thesis develops a new navigational software package for the Webb ASV. Software development has focused on creating reliable, maintainable code for future projects with the ASV. The navigational software is designed around simple modular pieces which can be easily changed or replaced based around well-defined interfaces. Alongside the software upgrade, new hardware controllers are developed. A custom printed circuit board (PCB) is designed to replace old prototyped electronics. Some testing has been conducted but much more will be required to prove mission readiness.
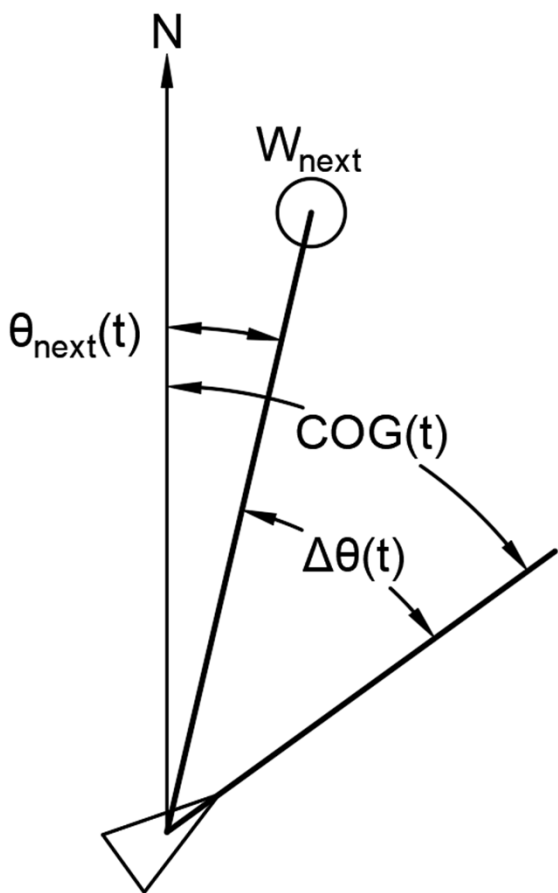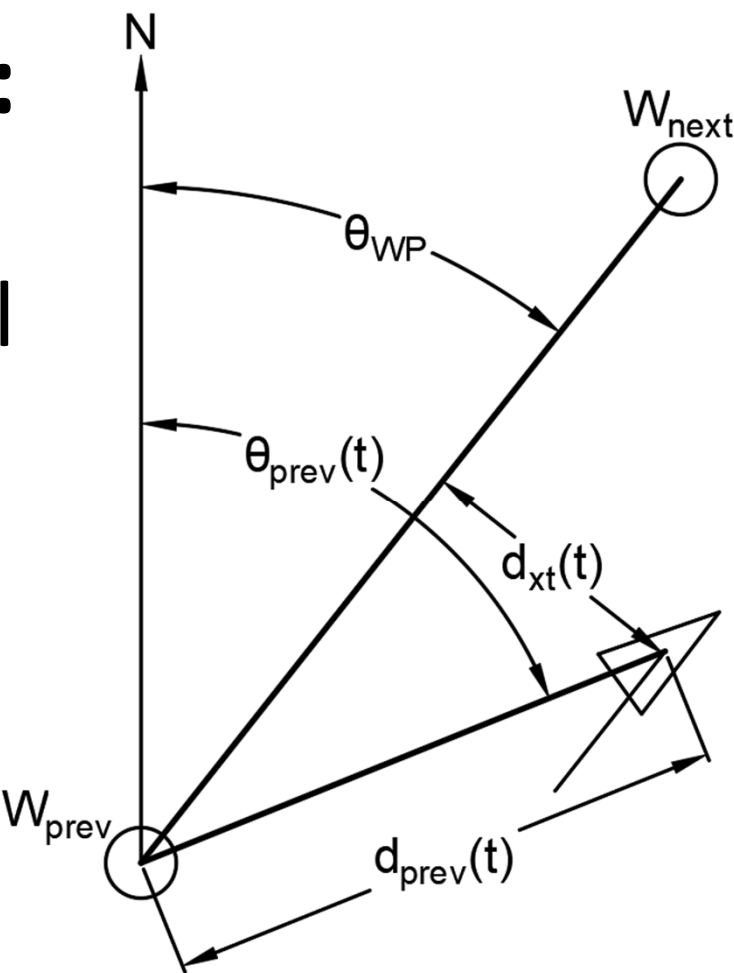
OBJECTIVES

- Design and test new navigation software for the Webb ASV
- Demonstrate basic maneuvering capabilities
- Prepare documentation for future work

NAVIGATIONAL PRINCIPLES

Cross-Track Distance (d_{xt}):
Orthogonal distance between the ASV position and the ideal great-circle path between the current two waypoints

Heading Error ($\Delta\theta$):
Difference between Course Over Ground (COG) and bearing to next waypoint (θ_{next})
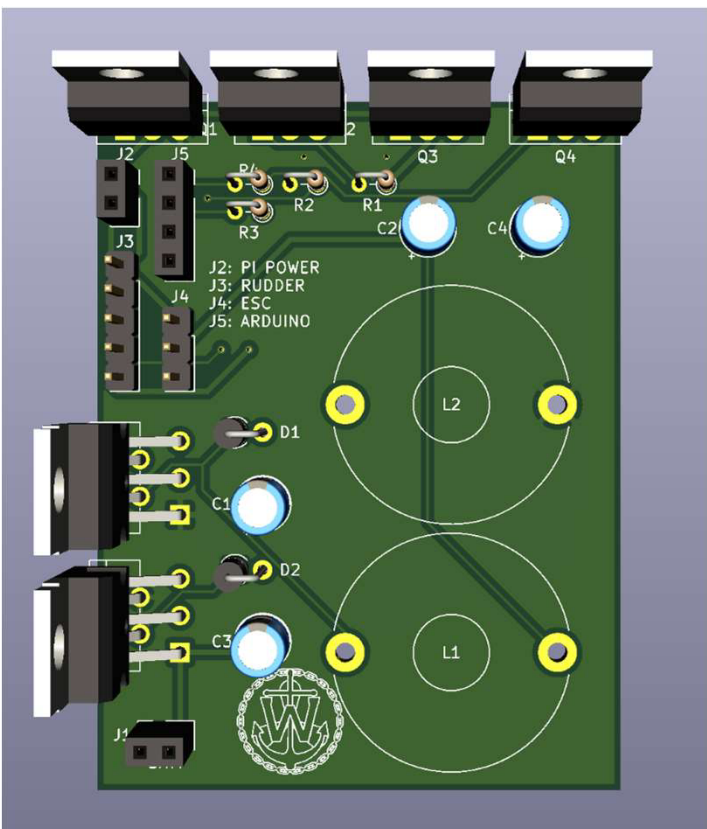
CODING PRINCIPLES

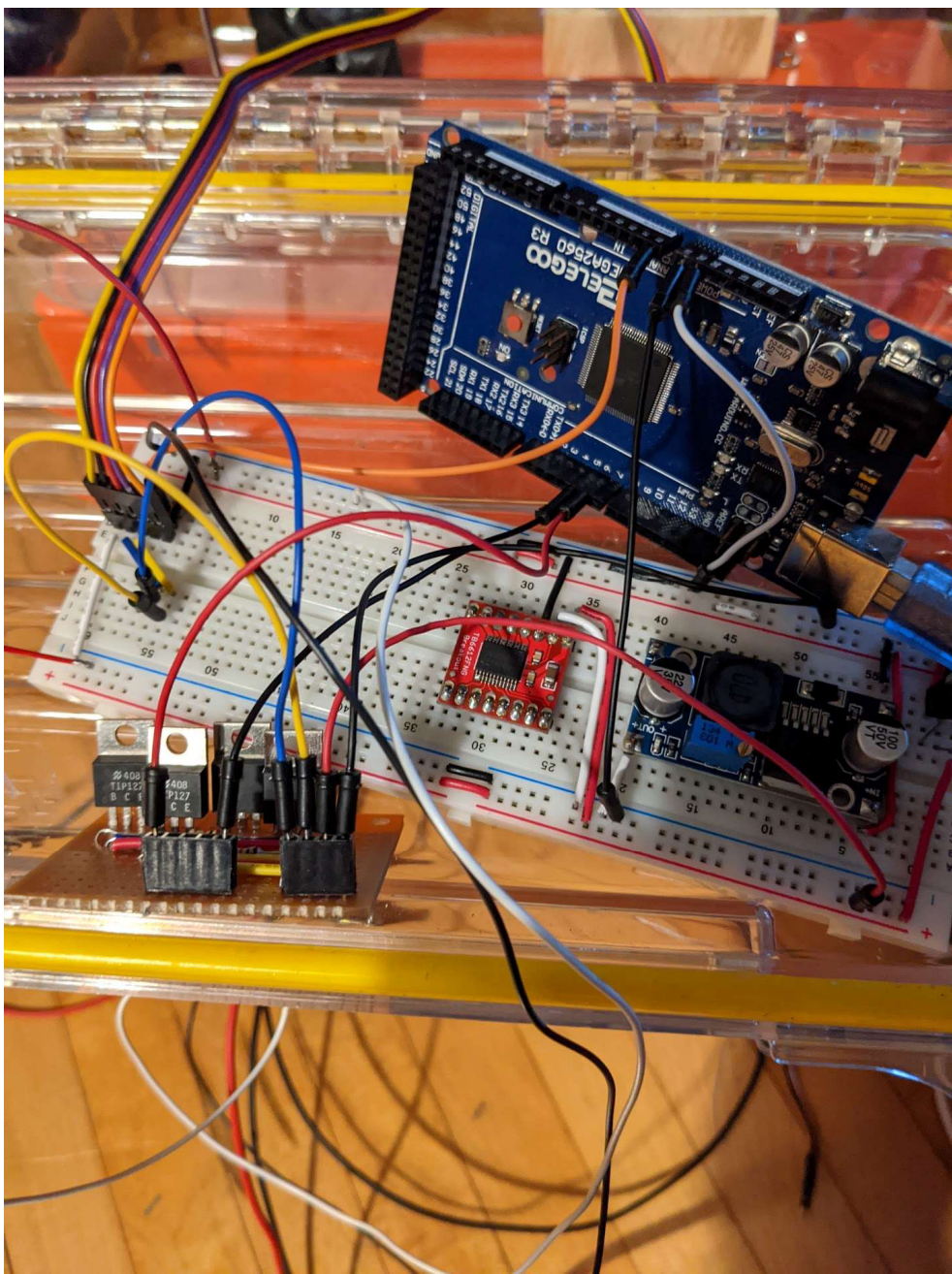PERFORMANCE

MODULARITY

SIMPLICITY

DOCUMENTATION

ELECTRONIC DESIGN

- Main processor: Raspberry Pi 4 8GB
- Hardware interface: Arduino over USB
- Custom Printed Circuit Board
  - Power supply circuits
  - Rudder motor controller

TESTING

Benchtop: Ensure electronic functionality

Dry-Land: Test basic vessel responses in safe conditions

Open-Water: Tune navigational controllers and test performance