Design, Construction, and Analysis of a Modular Ship Model and Open-Source Autonomous Surface Vehicle

by

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Abstract

Existing models used to explore hydrostatic, hydrodynamic, seakeeping, and maneuvering characteristics of ships are limited in that their characteristics are essentially static. The effects of various hull appendages, propulsion configurations, and bow and stern designs are difficult to quantify without procuring, instrumenting, and testing entirely new hullform models. Additionally, the realm of marine autonomy has opened up new avenues for exploration in naval architecture which favor endurance and economy over more traditional design goals of speed and capacity. This creates a need for a framework to rapidly design and prototype unmanned surface vessels. This thesis explores the design, manufacture, and analysis of an additively manufactured modular ship model. This model allows for easily altering the shape of the bow and/or stern and it can be lengthened or shortened by the addition or removal of parallel midbody modules. Other designed modules allow the model to be connected to a towing carriage for captive model testing, or be powered and controlled remotely or autonomously for free-running model testing or use as a small Autonomous Surface Vehicle. Analysis of various combinations of these modules was conducted and the results are presented. Additionally, select experiments and design analyses have been developed for educational use as laboratory experiments or academic projects with the goal of furthering the teaching of naval architecture and marine engineering.

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