Design and Assessment of a Super High Speed, Hybrid Hydrofoil/SWATH Crew Boat

LTJG Vasileios Georgiadis HN

Prof. Chryssostomos Chryssostomidis	**Dr. Stefano Brizzolara**
Thesis Supervisor	Thesis Advisor

MIT Innovative ship design lab has worked on the hydrodynamic design of a family of hybrid SWATH/Hydrofoil unmanned surface vehicles, published in the 11th International Conference on Fast Sea Transportation (Sep 2011). This research is the first effort to expand this family of vessels and include manned vehicles.

The focus of this thesis was the preliminary design and feasibility assessment of Wavecutter, a high speed vessel designed to provide rapid and flexible crew transportation to and from offshore oil rigs. Wavecutter is based on its unmanned predecessor, the Ultrafast Hybrid HYGE (Hydrofoil Ground Effect)-SWATH (120 knots with 500 NM endurance range). Wavecutter's main characteristics are shown below:

- 85 knots with 480 NM endurance range at full speed
- Payload capacity of 24 passengers and 15 MT cargo
- Required crew of 4
- Operational sea state 4

Wavecutter operates in two modes: displacement (0-17 knots) and foil borne (17-85 knots). In displacement mode, buoyancy is provided by two SWATH hulls and propulsion power by two diesel engines/generator sets through motor driven propellers mounted in the aft of the hulls. In foil borne mode, about 90% of the lift is provided by four surface piercing, super-cavitating hydrofoils that are mounted in the fore and aft parts of the SWATH hulls. The remaining lift is provided by the wing shaped main deck, that is connected to the SWATH hulls via struts. Propulsion thrust in foil borne mode is generated by two turbo fans, located right and left in the aft part of the wing deck. The manned compartments are located in the middle part of the wing deck, inside a tube shaped capsule, which provides structural support and enhances safety.

In the design phase, emphasis was placed in the manned compartments, the creation of which was inspired by airplane internal arrangements. Hydrofoil sizing also required attention, and it was found that front foils need to be larger than the aft, to counteract the large moment produced by the turbo fans. In the feasibility analysis phase, emphasis was placed in static and dynamic stability. Static stability analysis confirmed the inherent stability of the surface piercing, negative dihedral angle configuration in foil borne mode. Dynamic behavior analysis results were also reassuring, but future work is recommended using Computational Fluid Dynamic method to model the dynamic behavior of the vessel more accurately.

Naval Engineer
Master of Science in Mechanical Engineering