Executive Summary

The Medium Displacement Unmanned Surveillance Asset (MDUSA) project was sponsored by the Future Surface Combatant Division of the Surface Warfare Directorate, OPNAV N96, and serves as an exploration of future Fleet capabilities. MDUSA aims to be at the forefront of Naval application of USV platform technology, executing missions typical of major combatants in environments deemed too hostile for manned platforms. Advancements in USV technology to date have provided a critical foundation for the current effort, while at-sea testing is now proving concept viability for autonomous systems in Fleet operating environments. The MDUSA project serves as an extension of this subset of Naval vessels to autonomous search, detection, tracking, and identification of Air, Surface, and Sub-surface craft as well as kinetic weapons capability.

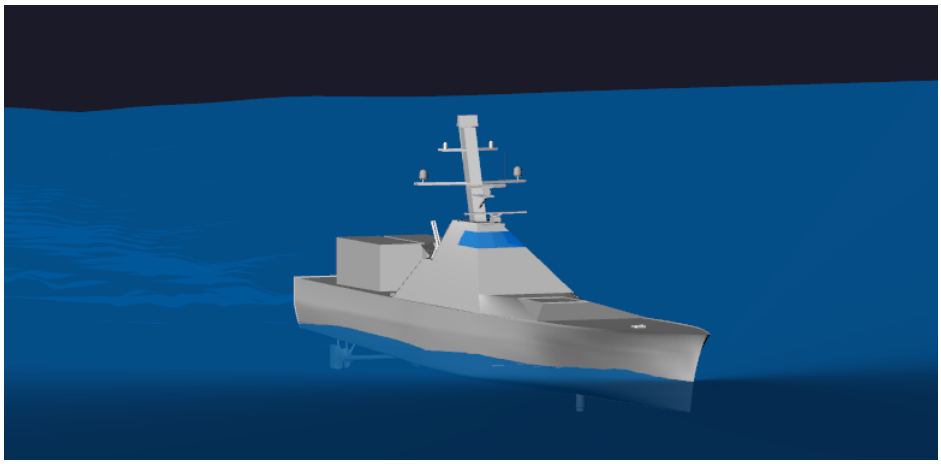

Figure 1: MDUSA Hull and Superstructure Geometry - Isometric View

Conceptual Design Summary

The design concept consists of a steel monohull with a combined diesel and diesel engine room, and dual propeller configuration. The hull and superstructure were designed to accommodate weapons and sensor systems and to offer margin in area and volume for future design growth. A MK53 MOD 1 Decoy Launch System is installed on the after side of the deckhouse to provide point self-defense and a MK56 Vertical Launch System was

Table 1: Design Summary Versus Sponsor Defined Values

Requirement	Sponsor Defined Value	MDUSA
Displacement	200-300 LT	318 LT
Length Overall	-	53.4 m
Maximum Speed	30 kts	30 kts
Endurance Speed	-	12 kts
Endurance Range	10,000 nm	10,000 nm
Operation Length	60 days	60 days
Sea State	5 (Operational)	5 (Operational)
	7 (Survivable)	7 (Survivable)
Sensing Systems	Hull Mounted Sonar	Hull Mounted Sonar
	Air/Surface Search Radar	SEA GIRAFFE
Defensive Systems	Self-Defense	MK53 MOD1 DLS
Offensive Systems	Kinetic Weapons Capability	MK56 VLS (ESSM)
Average Cost/Ship	<$50M USD	∼$35M USD

integrated forward of the superstructure to provide a level of kinetic weapons capability with an ESSM payload. The concept incorporates an air and surface search radar and a hull mounted sonar system to provide search, detection, and tracking capabilities. The platform iss equipped with additional sensors and satellite communications systems to support autonomous operations and detection, identification, and data transmission of the over the horizon operating picture. Deck area and margin in the ship's center of gravity are available for the incorporation of two 20 ft equivalent units, totaling 10 mt in weight, arranged side by side aft of the deckhouse. Table 1 provides a summary of the design with respect to sponsor defined values.

Recommendations and Areas for Further Investigation

Several areas investigated through the course of this study require further development and would be addressed during a future design iterations:

- Strictly Define Design Specifications - Through the course of the design effort, the lack of design standards and specifications for unmanned Naval vessels required the design team to make assumptions with respect to standards and specifications. While these assumptions were rooted in sound engineering practice, strict definition of design requirements is critical to further development of this unmanned concept. It is expected that other programs pursuing the application of USV technology to Naval applications will experience similar obstacles in their design efforts, making this a high priority for future work.

- Structural Optimization and Fatigue Analysis - As shown in Table 1 the design presented exceeded the customer defined value of displacement. This was primarily due to an excessive structural weight. An optimization of the structural arrangement, incorporating fatigue analysis results, should be conducted. It is expected that such an optimization would result in satisfying the displacement requirement.

- Roll Compensation System - The pitch and roll limitations imposed on the active sonar system were limiting at the customer defined operational sea state 5. A roll compensation system should be investigated to expand this envelope of effective operations for the active component of the sonar suite.

- Set-Based Design Execution - Future work should revisit other feasible designs exposed in the set-based design process and enter updated information in the PTAT model to further refine design selections such as main engine equipment and configuration, improve upon hull construction and design, and evaluate mission system selection.

- Refueling Capability - Conduct an in-depth study of refueling at sea capability which could extend operational endurance.

- Propeller Matching - Conduct an in-depth study to appropriately match propeller to main engines.

- Granularity to Mission System Requirements - Further refine the concept of operations and mission roles for a medium-displacement unmanned surface vehicle, towards the goal of well-defined mission system requirements.

- Analysis of Additional Systems and Payload - Continue exploration of the missions systems tradespace and perform detailed analyses on required system performance parameters such as communications bandwidth required to support external command and control and communication of data.