Design Space Exploration and Optimization Using Modern Ship Design Tools

LT Adam Thomas Jones, USN

Prof. Jerod Ketcham	Pat Hale
Thesis Supervisor	Thesis Reader

Modern Naval Architects use a variety of design tools to explore feasible options for clean sheet ship designs. Under the Naval Sea Systems Command (NAVSEA), the Naval Surface Warfare Center, Carderock Division (NSWCCD) has created computer tools for ship design and analysis purposes. This paper presents an overview of some of these tools, specifically the Advanced Surface Ship Evaluation Tool (ASSET) version 6.3 and the Integrated Hull Design Environment (IHDE). The goal of the paper is to provide a detailed explanation of a ship design using these advanced tools and to present methods for optimizing the performance of the hullform and for optimizing the engines selected for the ship. The detailed ship design will explore the design space given a set of specific requirements for a cruiser-type naval vessel.

The hullform optimization technique entails the reduction of a ship's residual resistance by using both ASSET and IHDE in a Design of Experiments (DoE) approach to reaching an optimum solution. The paper will provide a detailed example resulting in a 12% reduction in total ship drag by implementing this technique on a previously designed hullform.

The engine selection optimization technique involves a MATLAB code that calculates the engine configuration at all required ship powers that minimizes fuel consumption. For a given speed-time or power-time profile, the code will evaluate hundreds of combinations of engines and provide the optimum engine combination for reducing the total fuel consumption. This optimization has the potential to reduce fuel consumption of current naval warships by upwards of 30%.

Naval Engineer
Master of Science in Engineering and Management