

Fuel Consumption Prediction Methodology for Early Stages of Naval Ship Design

Abstract

In recent years, fuel consumption has increased in importance as a design parameter in Navy ships. Economical fuel consumption is important not only for operating cost measures but also for ship endurance tankage requirements. Minimizing fuel consumption has many benefits for both naval and commercial ships. This thesis work will suggest a new comprehensive approach to early-stage ship design to determine fuel consumption for the whole system.

A hull must be designed to work harmoniously with an optimized propulsor and propulsion plant to ensure best performance and to comply with imposed design requirements. Thus, this work will address three main aspects of the fuel consumption equation:

- Ship's resistance is calculated using a computational fluid dynamics simulation of the vessel in calm water at various speeds up to maximum speed.
- Propeller performance is based on propeller curves for the chosen propulsor.
- Efficiencies of the drive train and electrical production and distribution system are calculated for all operating conditions. Note that for an electric-drive ship, the non-propulsion electrical loads must be included in the calculations.

These three major components of the ship efficiency equation are assessed for each speed and battle condition of the mission profile. In addition, the corresponding operating conditions for each piece of machinery will be specified to estimate the total fuel consumption and tankage required.

In this thesis work, I will suggest a design methodology to determine hull resistance and total power for a given ship with a specified operational profile. The total power for the operational profile will be translated to fuel consumption, thus producing annual fuel consumption requirements and recommended tankage to support the operational needs.

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