Prediction of Performance and Maneuvering Dynamics for Marine Vehicles Applied to DDG-1000

by

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Abstract

Being able to accurately model the performance of ships is an integral part of the ship design process. A considerable amount of money is invested into predicting how a ship will maneuver in a given sea state. Furthermore, it is vital to understand the powering requirements and potential limitations of the ship design. Typically, a physical scale model of the ship is constructed and experimented on in a tow tank to determine the hydrodynamic characteristics of the ship to be built. This can also be expensive. Therefore, there is considerable interest in developing a means to predict the hydrodynamic performance of a ship using alternative means. This thesis presents an analytical determination of the hydrodynamic coefficients for the DDG-1000 and compares them to an existing physical model with the intent to use the physical model as a substitute.

Using analytical methods from several established sources, this thesis develops a simulated model for the DDG-1000 that is consistent with expected performance of a ship of this size and class. In addition, this thesis presents a model for the all-electric ship using azimuthing propellers. The analytically determined maneuvering dynamics are applied to the full all-electric ship system model, which incorporates the main generating engines through the power electronics to the motor and propulsion shafts. The results of the simulation form a baseline, from which future optimization of the model can occur.

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