Performance Monitoring of Ships

The purpose of the research project is to establish a reliable index in the performance evaluation of ships. During operation the ship will experience added resistance due to fouling of hull and propeller. The added resistance will lead to increased fuel consumption and thus increased emissions to the environment. The monitoring of the ship’s performance can be used as decision support in determining when actions to improve performance should be taken. The performance evaluation is based on a model of the ship and the added resistance from wind and waves during operation. Logged data on board the ship is used as input to the system and by comparing model and ship behaviour, an index describing the ship’s performance is generated.

The work in this thesis is based on data logged through the automation system on board a PostPanmax container ship where data have been logged through a year. A routine handling drift in time series, spikes and outliers have been suggested for the purpose of introducing an automatic logging system.

The performance system is modelled in software based on the Bond Graph method. The system is described by bond graph elements which describe the characteristics of each component and several ships are modelled in the system. A simple model is used as initial model and several elements are added to improve the estimate of the performance. Several resistance models are compared in order to determine which is giving the best estimate of the performance.

Constraints in the models have been identified. The models used in this work are based on empirical relations or based on regression analyses of model tests and full-scale trials. In order to achieve valid results the conditions where performance is estimated have to be inside the boundaries of the model. Filters have been determined to establish cases where the ship is in steady state conditions and where these conditions are inside the boundaries of the constraints of the model.

Several indexes have been used in the evaluation. Two indexes relate to the ship’s logged speed and one relates to the measured torque on the propeller shaft. Further, an index based on the properties of the ship’s propeller, is used. The different indexes are described in a case study where the performance of a container ship is evaluated over one year. The reliability of the performance index is measured from the scatter in results and the ability of identifying the events that improves performance e.g. propeller and hull clean.

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