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MANEUVERING CONTROL ANALYSIS OF A TUGBOAT BY INTEGRATING SEA-TRIAL TEST DATA

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Abstract

This study presents computations for the motion control of the EGE 2 tugboat, operating in Turkish waters. The vessel, with unrestricted navigation and fire fighting notation, is specifically designed for emergency operations, requiring both a compact hull for sufficient bollard pull and excellent maneuvering capabilities. A ship motion control algorithm is developed by considering model and full-scale test results to accurately control the vessel. With a length of 20.4 meters, a beam of 8.5 meters, and a draft of 3.7 meters, the EGE 2 tugboat is equipped with two main engines each generating 1200 BHP at 2000 rpm. The propulsion system consists of two fixed pitch propellers within nozzles. The study utilizes Figures 1 and 2, providing the physical and CAD views of the vessel. By conducting 10°-10° and 20°-20° zigzag model tests, crucial data for the calculation of the K (Nomoto gain constant) and T (Nomoto time constant) are obtained. On the other hand, several empirical relations are employed to compute the same parameters. These parameters are used to simulate the ship's maneuvering and control its motion. Through a comparison between the values derived from the model test results and the empirical formulas, we were able to gauge the effectiveness of the empirical relations and their applicability. The findings of this study will provide valuable insights for optimizing the maneuvering capabilities of future tugboats designed for emergency operations, contributing to the safety and efficiency of maritime activities.

Keywords: Tugboat, Maneuvrability, PID Control System, Nomoto constants

Figure 1. A photograph of EGE 2 during operation.

Figure 2. The 3D CAD model of EGE 2, 20.4 m tugboat.