Comparative Study on Added Resistance of a Bulk Carrier in Regular Head and Oblique Waves

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ABSTRACT
In this study, a comparative study on motion response and added resistance of a Supramax bulk carrier (K-Supramax Original) in regular waves was carried out to evaluate the reliabilities and accuracies of experimental and numerical simulation techniques. Two kinds of experiments were performed; one is the towing tank model testing for head wave conditions conducted at Seoul National University, and the other is the free-running model test for head and oblique wave conditions conducted at SSPA Sweden AB. Also, nine numerical computation results submitted by seven institutions were compared with the experimental data. The computation results were obtained by various seakeeping analysis methods such as the 2D strip theory, 3D Rankine panel method, and Computational Fluid Dynamics (CFD) based analysis. Based on the comparison, the characteristics of each numerical technique and resultant accuracies of seakeeping analyses were investigated. It was also confirmed that different results were obtained although the same program was used because of the user dependencies; setting for computation parameters, numerical schemes, and mesh generations, etc. Furthermore, the sensitivities of seakeeping quantities with respect to wave amplitudes were examined by conducting both model tests and nonlinear numerical simulations for different wave slopes. Lastly, the tendencies of ship motion and added resistance depending on the heading angle were identified, and the reliabilities of experiments and numerical computations for oblique waves were discussed.

KEY WORDS: Comparative study, Added resistance, Bulk carrier, strip theory, Rankine panel method, CFD

INTRODUCTION
With regard to the regulations of International Maritime Organization (IMO), there have been two big issues about the operation performance of a ship in real sea states. The first is the estimation of weather factor (\(f_w\)), which represents the speed loss induced by environmental loads in the Energy Efficiency Design Index (EEDI). The other issue is related to the minimum required power for maneuverability of a ship in