HSMV 2020

Contribution ID: **17** Type: **Paper**

A Linear Model Analysis of the Unsteady Force Response of a Planing Hull through Forced Vertical Plane Motion Simulations

Thursday, 15 October 2020 16:15 (30 minutes)

The prediction of planing hull motions and accelerations in a seaway is of paramount importance to the design of high-speed craft to ensure comfort and, in extreme cases, the survivability of passengers and crew. The traditional approaches to predicting the motions and accelerations of a displacement vessel generally are not applicable, because the non-linear effects are more significant on planing hulls than displacement ships. No standard practice for predicting motions or accelerations of planing hulls currently exists, nor does a nonlinear model of the hydrodynamic forces that can be derived by simulation. In this study, captive and virtual planar motion mechanism (VPMM) simulations, using an Unsteady RANSE finite volume solver with volume of fluid approach, are performed on the Generic Prismatic Planing Hull (GPPH) to calculate the linearized added mass, damping, and restoring coefficients in heave and pitch. The linearized added mass and damping coefficients are compared to a simplified theory developed by Faltinsen [6], which combines the method of Savitsky [12] and 2D+t strip theory. The non-linearities in all coefficients will be investigated with respect to both motion amplitude and frequency. Nonlinear contributions to the force response are discussed through comparison of the force response predicted by the linear model and force response measured during simulation. Components of the planing hull dynamics that contribute to nonlinearities in the force response are isolated and discussed.

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Session Classification: Planing Hull Hydrodynamics 2

Track Classification: Seakeeping, Hydrodynamics