

# Investigating Nonlinear Forces in Ship Dynamics using Machine Learning MARINE 2023

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## ABSTRACT

In this paper a hybrid data-driven method is applied to model the nonlinear heave responses of a two-dimensional wedge in irregular waves. The method uses a machine learning model to learn nonlinear components of the total force. The data-driven force model is embedded in a linear ordinary differential equation which is solved to yield position, velocity, and acceleration. Training data for the wedge are generated for different levels of nonlinear forces, including nonlinear hydrostatics, Froude-Krylov forces, and hydrodynamic memory effects, to investigate how the different forces affect the performance and configuration of the data-driven model. It is found that the data-driven model is most effective when linear forces are not learned, but modeled analytically within the governing equation, and the presence of memory effects requires longer input sequences in the machine learning model.