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Numerical Investigation of Wave-Induced Motions, Loads, and Stresses on a Container Ship

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The accurate estimation of ship motions, acting forces, and stress states is crucial for the structural integrity and operational efficiency of container ships navigating in ocean waves. This study presents a numerical investigation of the hydrodynamic response of a container ship subjected to varying wave conditions, including different wave frequencies, directions, and ship cruising speeds.
Hydrodynamic analyses are conducted using a numerical approach to model the complex interactions between the ship and the surrounding fluid environment. The study focuses on evaluating key parameters such as heave, pitch, and roll motions, as well as the resulting loads and stress distributions on the ship's hull. The resulting hydrodynamic loads are then used as input for finite element method (FEM) analyses to assess the structural reliability of the vessel. Particular attention is given to identifying the most stressed areas of the hull under different operating conditions. The computed stress distributions have been compared with the design criteria established by classification societies.
The findings contribute to a better understanding of the effects of wave characteristics and ship speed on structural loads, which can support the design and optimization of more resilient container ships. Furthermore, the study highlights the importance of advanced numerical simulations in predicting and mitigating the risks associated with extreme sea conditions.

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