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Numerical Study on Ship Parametric Roll in Head Waves

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Abstract: Ship parametric roll is one of the main reasons for marine accidents and is introduced into the second-generation intact stability criteria by the International Maritime Organization (IMO) recently. In order to study the inner mechanism and predict the possibility of the ship parametric roll in head waves, a time-domain model based on the IRF (Impulse Response Function) concept and the weakly nonlinear assumptions is constructed to predict large-amplitude ship motions and investigate the phenomenon of parametric roll as well as the key affecting factors in this paper. The F-K forces and the restoring forces are calculated on the instantaneous wet surface while the radiation and diffraction forces are kept linear and tansformed from frequency-domain results. The model is validated with experimental results of S175 to prove its feasibility in motion prediction firstly. Based on this, a ro-ro ship is selected as an example for the investigation of the parametric roll resonance. The effects of wave height, wave length, ship length, ship speed and the relation between wave frequency and roll nature frequency on parametric roll in head waves are discussed.

Key words: Parametric roll; head waves; time-domain model; large-amplitude motion; affecting factors; numerical study

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