FAST PARAMETRIC ROLLING SIMULATIONS OF CONTAINER SHIPS

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ABSTRACT:

The term parametric roll is used to describe the phenomenon of large unstable roll motion suddenly occurring in (close to) head or following seas. The prime reason for parametric rolling is the variation of the ship's stability characteristics because of the constant change of the underwater hull geometry as waves travel past the ship. The increasing demand in container transportation is met by use of increasing number of large container ships including Post-Panamax type. The parametric rolling resonance became one of the main subjects of investigations over the past ten years due to more frequent occurrences of this phenomenon which increases the probability of seasickness of the crew, reduces the operability of the onboard systems and, in the worst case, can cause capsize of the vessel.

The hybrid time-domain nonlinear strip theory in 6 degrees-of-freedom has been extended to predict ship motions by combining a quasi-static approach adopted for heave, roll, and pitch motions with dynamic and hydrodynamic effects in waves included in the response calculations. Hydrodynamic memory effect due to the free-surface wave motion is not incorporated since computation of time convolution limits the practical applications. Given the rather special operational conditions that lead to parametric rolling, this proposition is sought of as an approximate alternative method which covers all the nonlinear intricacies adequately. Time-domain simulations are performed for a C11 Panamax Container ship at different headings and encounter frequencies with the coupling effects and parametric resonance investigated and validated with experiments. The results are consolidated within graphical representations of 2D and 3D polar plots. A very intuitive outlook is enabled showing the full range of the parametric rolling realizations.