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Prediction of Global Bifurcation Points as Surf-Riding Threshold in Following Seas.

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Summary: Surf-riding is a prerequisite for broaching-to, which is a major threat to ship capsizing. So far it had been revealed that the threshold of surf-riding is a heteroclinic bifurcation, a kind of global bifurcation. In this research numerical methods identifying the global bifurcation were investigated for predicting a threshold of surf-riding of a ship in following seas. Firstly, the Newton method focusing on the propeller revolution number was applied and then numerical examples were successfully provided. Secondly, for explicitly utilizing other unknown variables, the multi-valued Newton method was developed. Thirdly, for improving efficiently, a method avoiding backward integration in time was proposed based on an analytical investigation, and was confirmed to improve the convergence. Finally, the method was validated with the existing free-running model experiments. It was concluded that these methodology can be used for developing a ship-specific operational guidance as an alternative to IMO's ship-independent guidance.

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