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Statistics of extreme body motions in nonlinear wave fields. XIANLIANG GONG, YULIN PAN, Department of Naval Architecture and Marine Engineering, University of Michigan — We consider the statistics of extreme body motion in a nonlinear irregular wave field. In addition to the excitation by extreme waves, the extreme motions can be physically resulted from wave-body resonance or parametric excitation. Therefore, their statistics cannot be directly derived from extreme wave statistics which has been studied extensively. The computation of the statistics, however, requires the Monte-Carlo method, which can become computationally intractable (when coupled with high-fidelity simulations) due to the rareness of the extreme events. In this work, we develop a general framework, which enables an efficient resolution of the statistics of extreme body motions in a nonlinear wave field. This leverages a range of physics and learning based approaches, including nonlinear wave simulations, body response simulations, dimension-reduction techniques, sequential sampling and Gaussian process regression (Kriging). The developed method is benchmarked for its effectiveness in accurately resolving the statistics, and applied to study the extreme statistics of ship roll motions in an evolving narrow-banded nonlinear wave field.

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