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A fast high-order boundary element method for the study of nonlinear waves inside wave tanks JOAO SEIXAS DE MEDEIROS, YUMING LIU, DICK YUE, Massachusetts Institute of Technology — The ability to predict the nonlinear dynamics of extreme events inside large wave tanks (dimensions of hundreds of meters) is a critical component in the preparation of modern experimental tests. Currently there is no efficient numerical method capable of solving the inverse problem of extreme waves in large tanks, or effectively providing wavemaker kinematics that generate desired wave conditions for experiments. To overcome this deficiency we develop a fast and robust numerical method for modeling nonlinear waves inside wave tanks based on the Zakharov equation and a perturbation expansion of the velocity potential up to an arbitrary order in wave steepness. The boundary-value problem (BVP) for each term of the expansion is solved through a quadratic boundary element method which is accelerated with a pre-corrected Fast Fourier Transform scheme (pFFT), reducing the computational effort to $O(NlogN)$, where N is the number of collocation points used to discretize the boundaries of the tank. The efficiency and accuracy of the method over current fully-nonlinear potential flow methods is demonstrated through a wave focusing numerical experiment.

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