Fully-nonlinear wave-current-body interaction analysis by a harmonic polynomial cell method

A new numerical 2D cell method has been proposed by the authors, based on representing the velocity potential in each cell by harmonic polynomials. The method was named the harmonic polynomial cell (HPC) method. The method was later extended to 3D to study potential-flow problems in marine hydrodynamics. With the considered number of unknowns that are typical in marine hydrodynamics, the comparisons with some existing boundary element-based methods, including the fast multipole accelerated boundary element methods, showed that the HPC method is very competitive in terms of both accuracy and efficiency. The HPC method has also been applied to study fully-nonlinear wavebody interactions; for example, sloshing in tanks, nonlinear waves over different seabottom topographies, and nonlinear wave diffraction by a bottom-mounted vertical circular cylinder. However, no current effects were considered. In this paper, we study the fully-nonlinear time-domain wave-body interaction considering the current effects. In order to validate and verify the method, a bottom-mounted vertical circular cylinder, which has been studied extensively in the literature, will first be examined. Comparisons are made with the published numerical results and experimental results. As a further application, the HPC method will be used to study multiple bottom-mounted cylinders. An example of the wave diffraction of two bottom-mounted cylinders is also presented. © 2014 by ASME.

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