Solving the linear radiation problem using a volume method on an overset grid - DTU Orbit (04/12/2018)

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This paper describes recent progress towards the development of a computational tool, based on potential flow theory, that can accurately and efficiently simulate wave-induced loadings on marine structures. Engsig-Karup et al. (2009) have successfully developed an arbitrary-order, finite-difference-based, potential flow model to represent the propagation of fully non-linear waves in coastal regions of varying bathymetry. The present objective is to develop this methodology to include the presence of a floating structure. To represent the curvilinear boundaries of the structure and the bottom, the single-block methodology developed previously is applied to multiple, overlapping grid blocks using the overset approach. While the ultimate aim of this work is to model fully non-linear wave-structure interaction, a linear solver has been initially implemented to permit the use of a fixed grid, and to allow comparison of numerical results with established analytical solutions.

The linear radiation problem is considered in this paper. A two-dimensional computational tool has been developed to calculate the force applied to a floating body of arbitrary form in response to a prescribed displacement. Fourier transforms of the time-dependent displacement and force are applied, and the ratio of the resulting signals used to determine the radiation added mass and damping of the body as a function of frequency. The present software implementation has been validated by comparing numerical results from the linear model with analytical solutions for several test cases. The dynamic behaviour of a cylinder and barge on variable bathymetry has been investigated on a multi-block grid in two dimensions. Simulations have been performed to evaluate the induced flow field and radiation forces generated by these bodies in response to a Gaussian displacement. The hydrodynamic coefficients associated with body motions in surge, heave, and pitch have been calculated and compared with exact solutions. A three-dimensional implementation of the linear model has recently been completed.

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