Solving the linearized forward-speed radiation problem using a high-order finite difference method on overlapping grids - DTU Orbit (09/12/2018)

Solving the linearized forward-speed radiation problem using a high-order finite difference method on overlapping grids

The linearized potential flow approximation for the forward speed radiation problem is solved in the time domain using a high-order finite difference method. The finite-difference discretization is developed on overlapping, curvilinear body-fitted grids. To ensure numerical stability, the convective derivatives in the free-surface boundary conditions are treated using an upwind-biased stencil. Instead of solving for the radiation impulse response functions, a pseudo-impulsive Gaussian type displacement is employed in order to tailor the frequency-content to the discrete spatial resolution. Frequency-domain results are then obtained from a Fourier transform of the force and motion signals. In order to make a robust Fourier transform, and capture the response around the critical frequency, the tail of the force signal is asymptotically extrapolated assuming a linear decay rate. Fourth-order convergence of the calculations on simple geometries is demonstrated, along with a nearly linear scaling of the solution effort with increasing grid resolution. The code is validated by comparison with analytical and semi-analytical solutions using submerged and floating closed-form geometries. Calculations are also made for a modern bulk carrier, and good agreement is found with experimental measurements.

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