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Towards guidelines for consistent wave propagation in CFD simulations

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While most of the current Computational Fluid Dynamics (CFD) work focusing on calm-water seems to be under control, attention is now brought on simulating ships in waves. However, a lot of scatter exists in how those simulations are performed. In particular, no consensus on grid generation and time-stepping guidelines seems to exist when it comes to includes waves in the simulations. From this observation, we took a step back and attempted to derive consistent guideline for wave propagation in CFD. In this process, linear wave theory helps us with the definition of the grid topology. Using this background, we performed a systematic grid convergence study for 2D waves at zero speed. The results are analysed on basis of the wave dispersion, amplitude diffusion and reflection at the boundaries. The convergence study was then extended with a turbulence model, forward speed and finally in shallow water. Finally the derived guidelines are applied to typical CFD applications : roll motions of a ship section with bilge keels in transverse waves, and a ship at forward speed in incoming waves.

Primary authors: Mr CREPIER, Pierre (MARIN); Mr RAPUC, Stephane (MARIN)

Co-authors: Mr JAOUEN, Frederick (MARIN); Mrs REGNIER, Pauline (ENSTA Bretagne)

Presenter: Mr CREPIER, Pierre (MARIN)

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