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# Numerical Wave Generation and Propagation with High Order Spectral Method in OpenFOAM

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## ABSTRACT

In naval and offshore applications, waves are a key component. The ships and offshore structures operate in various sea states, from mild to extreme conditions. When modelling the wave-structure applications in a numerical set-up, various types of waves and waves generation are considered: regular or irregular waves, long crested or short crested waves, infinite ocean or closed experimental tanks with wave makers, etc. Some of these conditions are far from the real conditions encountered by a ship but are used to build extensive datasets to extrapolate over the life span of the structures. To be useful, a numerical wave tank should be able to reproduce these different waves and wave conditions easily. This includes for example: the reproduction of regular and irregular waves exactly as run in a known experimental set-up, including the initial ramp of the waves; the focalisation of a focus wave at a target time and position; short-crested and long-crested irregular sea state.

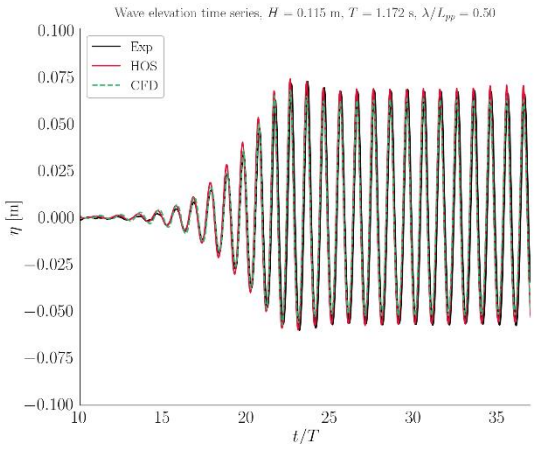


*Figure 1: Reproduction of a regular waves with initial ramp measured in and experimental wave tank, CFD run with coarse Mesh lambda/DeltaX = 39 and H/Delta Z = 4*

In this paper, we present the results of our numerical wave tank to generate efficiently and precisely these different wave and wave-structure cases. We use an in-house viscous flow solver, foamStar, based on the open-source library OpenFOAM. The wave generation is managed through explicit forcing/relaxing-zones method inspired by the library wave2Foam (Jacobsen et al. 2012). Within this technique, it is necessary to have a volumetric solution of the wave field at each time step. Several wave models have been implemented and the focus of this paper is the use of High Order Spectral method (Ducrozet et al. 2012) which provides a nonlinear potential flow solution, through the HOS software developed by the Ecole Centrale de Nantes and the Grid2Grid library developed to reconstruct the volumetric solution (Choi et al. 2023).

## References

Jacobsen, N. G., Fuhrman, D. R., & Fredsøe, J. (2012). A wave generation toolbox for the open-source CFD library: OpenFoam®. *International Journal for numerical methods in fluids*, *70*(9), 1073-1088.

Ducrozet, G., Bonnefoy, F., Le Touzé, D., & Ferrant, P. (2012). A modified high-order spectral method for wavemaker modeling in a numerical wave tank. *European Journal of Mechanics-B/Fluids*, 34, 19-34.

Choi, Y. M., Bouscasse, B., Ducrozet, G., Seng, S., Ferrant, P., Kim, E. S., & Kim, Y. J. (2023). An efficient methodology for the simulation of nonlinear irregular waves in computational fluid dynamics solvers based on the high order spectral method with an application with OpenFOAM. *International Journal of Naval Architecture and Ocean Engineering*, 15, 100510.