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Experimental and numerical study of an oscillating foil near the free surface

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ABSTRACT

Previous studies have explored hydrofoils as a means to enhance ship propulsion in waves, focusing on both passive and active motion control (X. Wu et al., 2020). However, some aspects as free-surface effects on thrust performance remains less understood for 3D configurations, including with regular waves at the surface (J. Deng et al., 2022 ; N. Petikidis et al. 2023).

This work presents experimental and numerical results to study the performances of an actively pitching and heaving NACA0015 near the free surface. The experiments are carried out in the Ifremer current and wave tank at Boulogne sur Mer for several heave and pitch amplitudes. The influence of the phase lag between the pitch and heave motions is also investigated, as well as the hydrofoil performances in regular waves. The experiments consists of forces measurements and there are compared with numerical predictions of the hydrodynamic forces using the potential flow code PUFFIn in its latest unsteady version, based on the boundary element method (P. Perali et al., 2024). Overall, the mean numerical forces exhibit similar trends to the experimental averages, validating the use of the potential flow code to optimize foil kinematics or geometry.

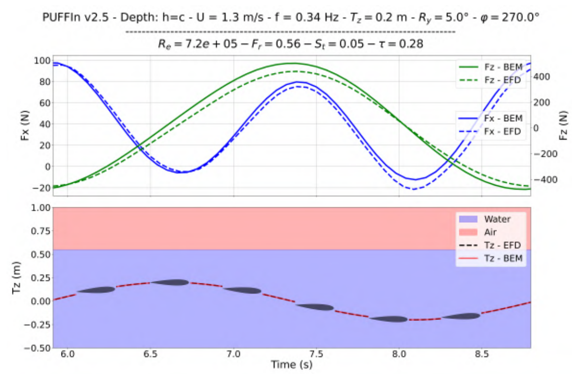

Figure 1: Temporal comparisons of experimentally and numerically generated forces by an oscillating foil in heave and pitch near the free surface.

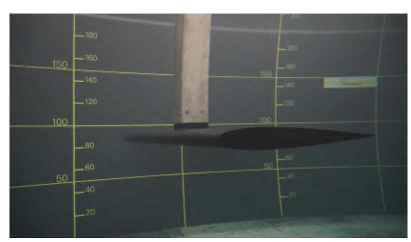

Figure 2: NACA0015 hydrofoil employed for experimental testing in the Boulogne-sur-Mer towing tank.

References

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