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Effect of ship pitching on frigate flight deck aerodynamics by CFD analysis and experimental validation

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ABSTRACT

Helicopter recovery maneuvers on frigate are risky and complex procedures, Kääriä et al. (2013). The helicopter operates on the stern (Figure 1), immersed in the ship's aerodynamic interference and affected by the flow detachment and turbulent aerodynamic wake generated by the frigate superstructure. These maneuvers are commonly performed during navigation of the vessel and during calm sea conditions. However, the frigate movement produced by adverse sea conditions could modify the flow conditions on the deck and make the helicopter's maneuvering even more difficult.

Figure 1: Helicopter recovery maneuver.

This study uses CFD to make a prediction of the aerodynamic flow changes occurring on the aft deck of a Simple Frigate Shape 2, when the frigate changes the pitch angle during its navigation. Specifically, the base case without motion at 0º is analyzed and it is verified how the flow is modified at angles between +15 and -15º of pitch (Figure 2). Changes in detached flow and the recirculation bubble above the flight deck are registered, and velocity profiles are also extracted at the height at which the rotor operates during recovery maneuvers under different frigate pitch angles. Finally, experimental data from Particle Image Velocimetry in wind tunnel tests are also extracted to validate the numerical study.

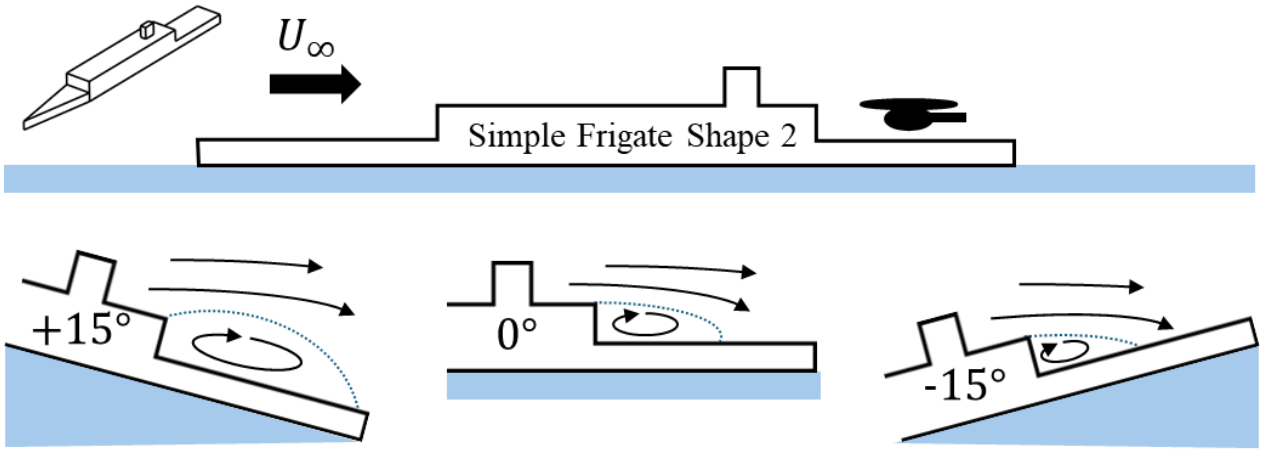

Figure 2: Simple Frigate Shape 2 used for CFD simulations and scheme of aerodynamic changes above the flight deck under different pitch angles of the frigate +15º, 0º, -15º.

References

Kääriä, C., Y. Wang, M. White, and I. Owen. *An Experimental Technique for Evaluating the Aerodynamic Impact of Ship Superstructures on Helicopter Operations. Ocean Engineering,* Vol. 61, pp. 97–108, 2013. DOI:10.1016/j.oceaneng.2012.12.052