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Simple and advanced numerical methods for determining the hydrodynamic properties of a TLP-type floating wind turbine

Pawel Dymarski[1,*], Ewelina Ciba[1] , Miroslaw Grygorowicz[1]

[1] Faculty of Mechanical Engineering and Ship Technology, Gdansk University of Technology, Gabriela Narutowicza 11/12, 80-233 Gdansk, Poland

[*] pawdymar@pg.edu.pl

ABSTRACT

The analysis of the motion of a floating wind turbine (FWT) subjected to the action of waves, wind and sea currents is a key issue in the process of designing a floating support structure. The results of computer simulations include, among others, the amplitudes of motion, the amplitudes of the nacelle accelerations and the forces in the mooring system.
Universities and research centers are developing software for performing fast analyses of the dynamics of FWTs subjected to the impact of the environment (Jonkman et al., 2010).

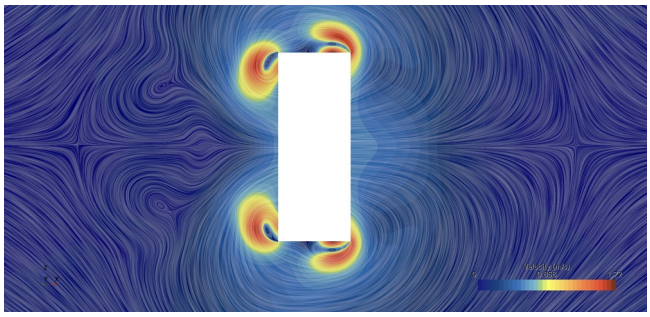

Figure1: 2D flow around section of the TLP-type floating wind turbine

One of the key elements that determines the correctness of the results of software based on simplified methods is the accurate determination of the hydrodynamic parameters of the floater, such as damping coefficients and added mass coefficients (Ciba et al., 2022).

In this article, we present methods for determining hydrodynamic coefficients for a TLP-type floating wind turbine based on the results of forced oscillation calculations using advanced RANSE-CFD software. The C_A and C_D coefficients were determined for individual segments of floater - based on 2D flow simulations (Fig. 1) as well as for the entire floater geometry based on 3D flow simulations of forced oscillations performed for each of the six degrees of freedom. The obtained hydrodynamic coefficients were used as input data for two different calculation models: software based on the Morison equation (developed at the Gdansk University of Technology) and commercial software based on the diffraction theory.

In order to verify the accuracy of the calculations with the simplified computational models used, free oscillation simulations were carried out, as well as calculations of the motion of a floating wind turbine subjected to regular wave - RAO determination - were performed. The results obtained were compared with the results of the RANSE-CFD analyses as well as with the results from the model tests.

References

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