STUDY OF HYDRODYNAMIC LOADS ON A TRUNCATED CIRCULAR CYLINDER WITH A HEAVE PLATE IN IRREGULAR SEAS

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SEUNG-YOON HAN[†,*], SYLVAIN DELACROIX[†], DWI LESTARI[†], BENJAMIN BOUSCASSE[†], VINCENT LEROY[†], FÉLICIEN BONNEFOY[†], JEAN-CHRISTOPHE GILLOTEAUX[‡], and DAVID LE TOUZÉ[†]

[†]Nantes Université, École Centrale Nantes, CNRS, LHEEA, UMR 6598,
1 rue de la Noë, 44321, Nantes
e-mail: seung-yoon.han@ec-nantes.fr; sylvain.delacroix@ec-nantes.fr; dwi.lestari@eleves.ec-nantes.fr; benjamin.bouscasse@ec-nantes.fr; vincent.leroy@ec-nantes.fr; felicien.bonnefoy@ec-nantes.fr; david.letouze@ec-nantes.fr

[‡] INNOSEA,
11 rue Arthur III, 44200, Nantes
Email: jeanchristophe.gilloteaux@innosea.fr

ABSTRACT

Hydrodynamic tools used to design floating structures with heave plates are being challenged given the importance of nonlinear hydrodynamic loads and viscous effects. The loads are commonly modelled in time domain as additional hydrodynamic coefficients in Cummins' equation. The coefficients are obtained by experiments or numerical solutions in an oscillatory flow with a set of representative motion amplitudes and frequencies. The validation of the coupled dynamic model in irregular seas is rarely done after calibration of the coefficients. This is the object of the present study.

The study presents an experimental and numerical investigation of the nonlinear hydrodynamic loads on a truncated circular cylinder with a heave plate in irregular sea-states. A captive model technique is used to measure the hydrodynamic loads of the irregular waves with motions imposed by a hexapod system. The motion responses are pre-calculated by OpenFAST based on OC4-DeepCWind semi-submersible platform (NREL) with the irregular waves computed by Higher-Oder Spectral (HOS) method. The hydrodynamic loads are successfully obtained by extracting the inertia, hydrostatic and gravitational loads from the measured loads.

The experimental data is compared with the solution of a Computational Fluid Dynamic (CFD) solver based on OpenFOAM for solving the wave-structure interaction problem. A HOS wrapper program is used to generate the irregular wave fields in OpenFOAM. We perform the validation study with different simulation parametrizations in the CFD tool to calculate the hydrodynamic loads with irregular motions and waves. All the results are also compared against the state-of-the-art potential flow theory.