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Engineering Consulting

EERA DEEPWIND 2021

“OC6 semisubmersible under waves and constant thrust”

Sebastien GUEYDON, 15 January 2021



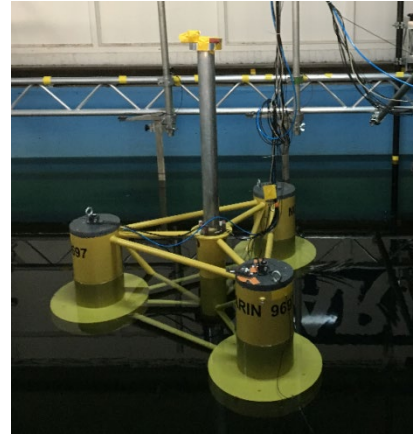
- **Intro: OC6 + constant thrust**
- Objective & methodology
- Test matrix
- Selection of results
- Conclusions



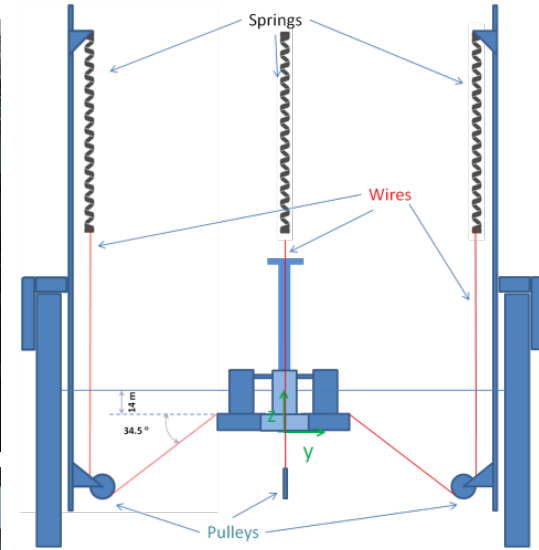
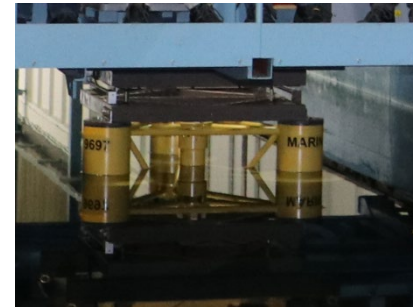
Background: IEA Wind task OC6 led by NREL

(OC3), OC6 = (Offshore Code Comparison Collaboration), Continued with Correlation and unCertainty Phase I (2019-2020)

- Configuration 1: moored with spring lines



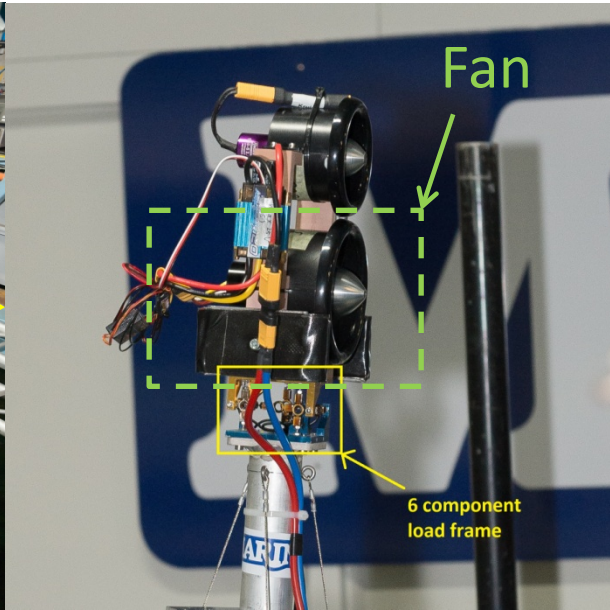
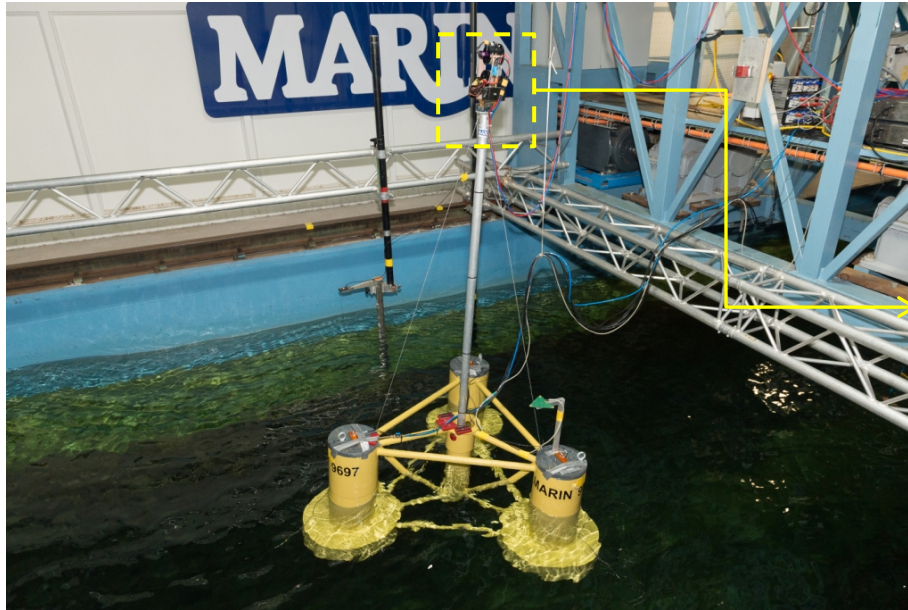
- Configuration 2: fixed to carriage for towing



OC6 + constant thrust

(OC3), OC6 = (Offshore Code Comparison Collaboration), Continued with Correlation and unCertainty

- OCF = OC6 configuration 1 + ducted Fan (constant thrust)



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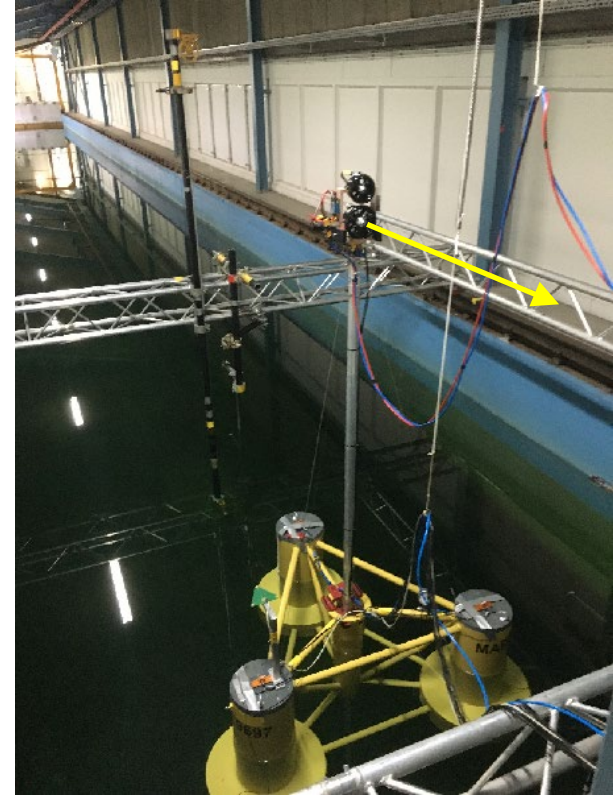


Goal:

- Obtain experimental results of the response of a floating wind semisubmersible under the combined effect of waves and constant thrust.

How?

- Add multiple levels of thrust to the wave conditions of the OC6 phase I config 1



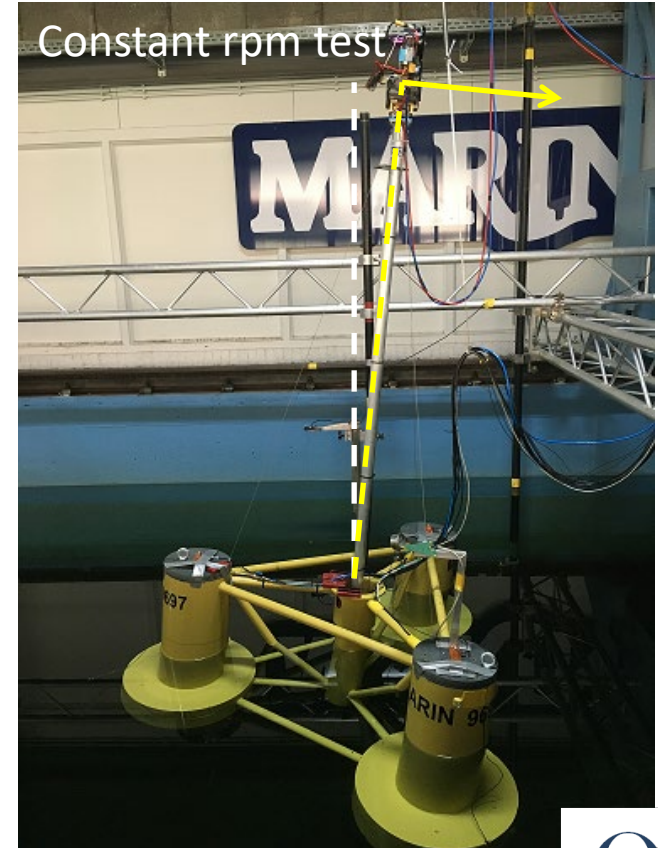
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- Static load
 - Surge (14 steps)
- Decay
 - Surge, sway, heave, roll, pitch, yaw
- Wave only

- Wind only (i.e. 7 levels of rpm)

- Wave + wind (i.e. constant levels of rpm)



- Wave + wind (i.e. constant levels of rpm)

Description	Waves	Rpm settings
Regular wave 1	$H= 7.1 \text{ m}$, $T= 12.1 \text{ s}$	0, 3600, 4650
Regular wave 2	$H= 4 \text{ m}$, $T= 9 \text{ s}$	0, 4650
White noise	$H_s= 7.1 \text{ m}$, $T= 6\text{-}26 \text{ s}$	0, 3960, 4650, 4710, 5400
Irregular wave	$H_s= 7.1 \text{ m}$, $T_p= 12.1 \text{ s}$	0, 3960, 4650, 5400



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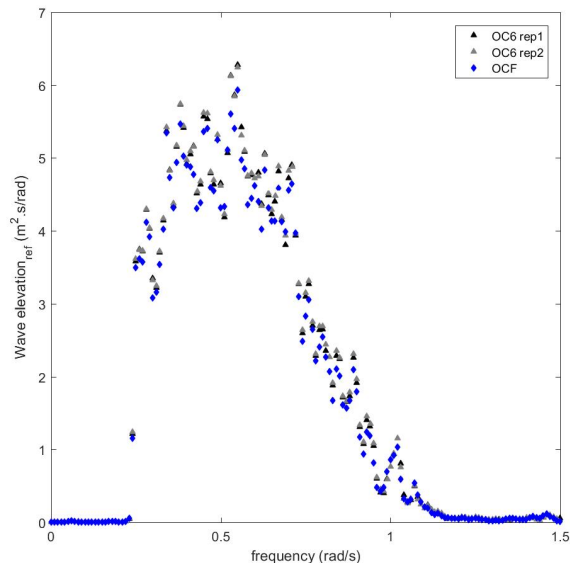


- Wave + wind (i.e. constant levels of rpm)

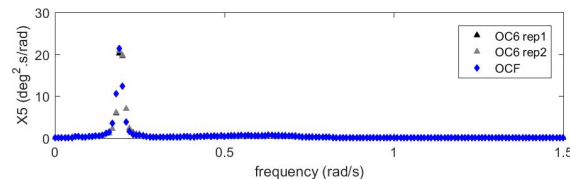
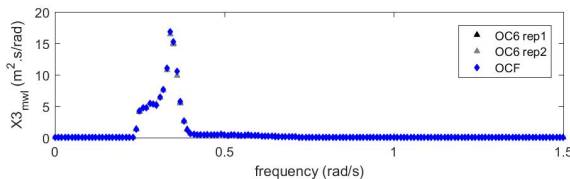
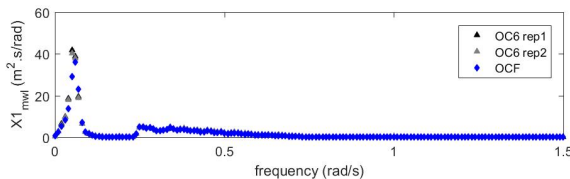
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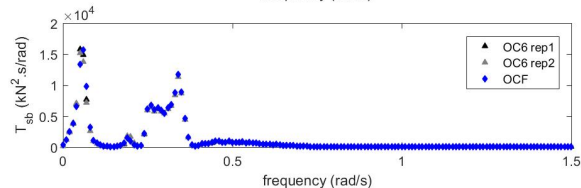
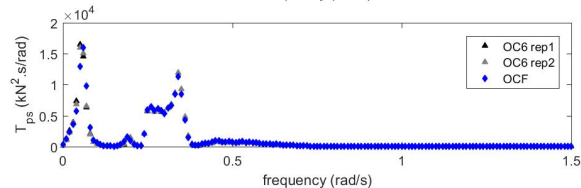
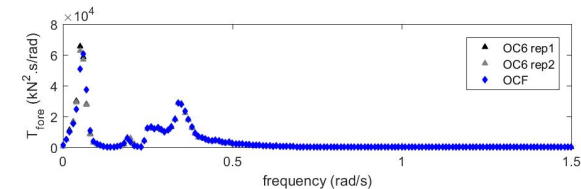
- White noise (0 rpm)
- Power spectral densities



Wave elevation PSD



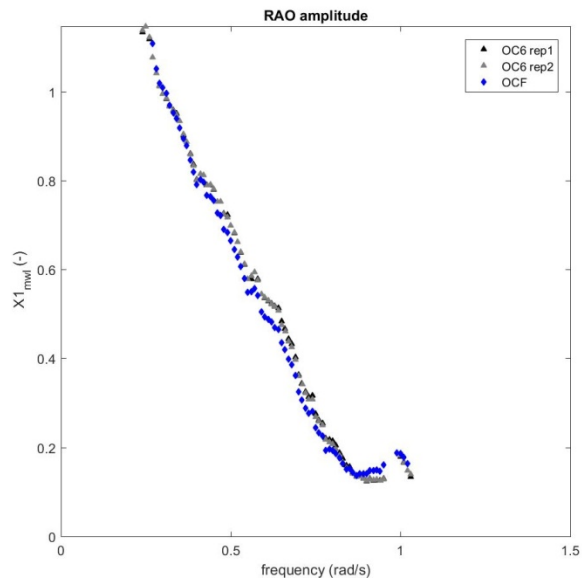
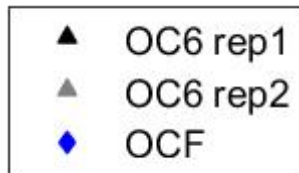
Motion PSD



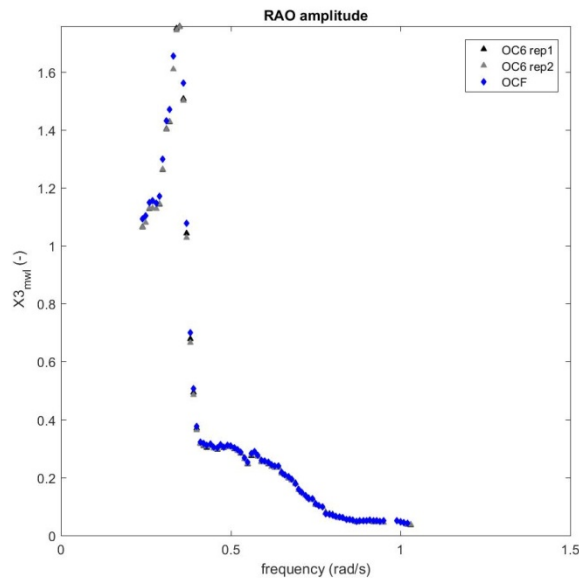
Mooring line tension PSD



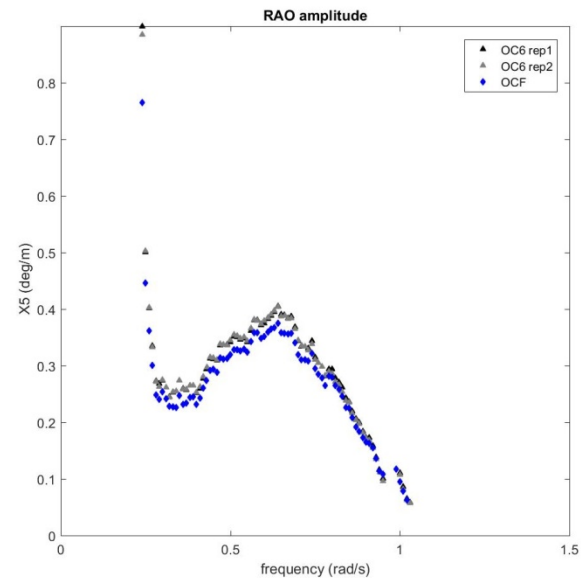
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Surge RAO



Heave RAO

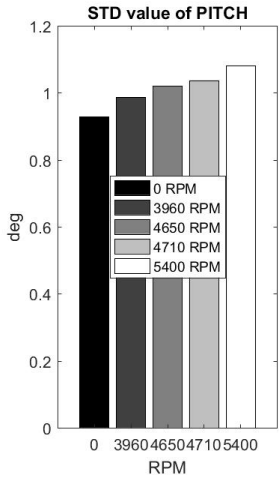
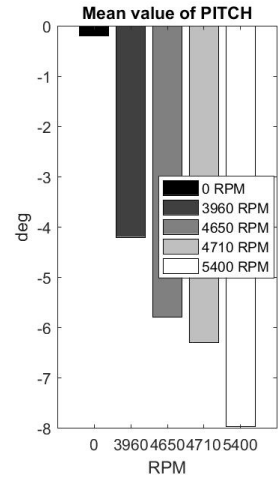
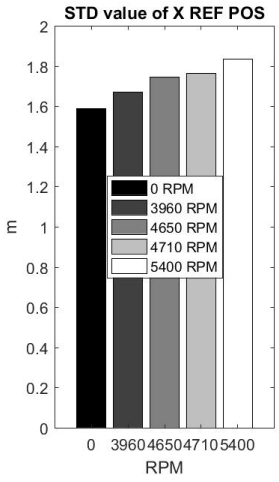
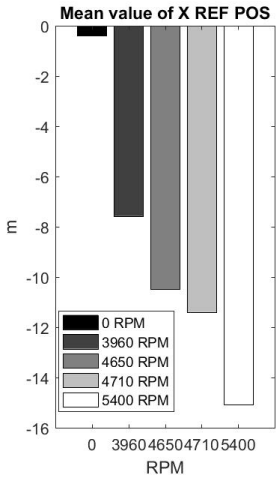
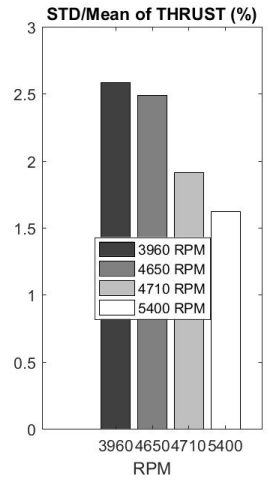
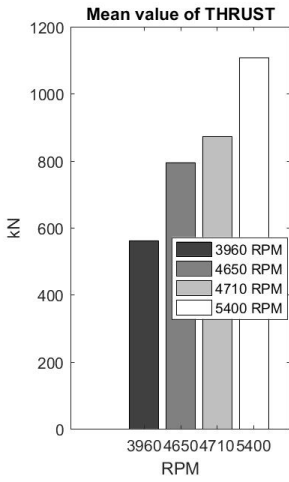
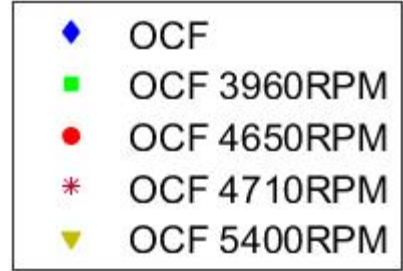


Pitch RAO



Effects of thrust on response

- White noise (0, 3960, 4650, 4710, 5400 rpm)
- Mean value & standard deviation



Thrust

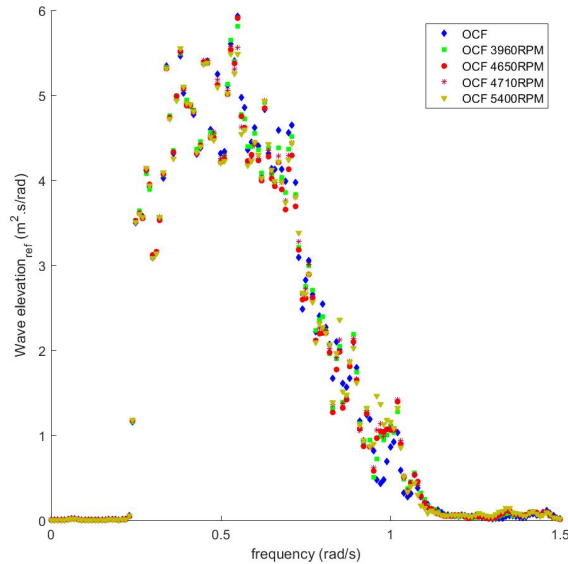
Surge

Pitch

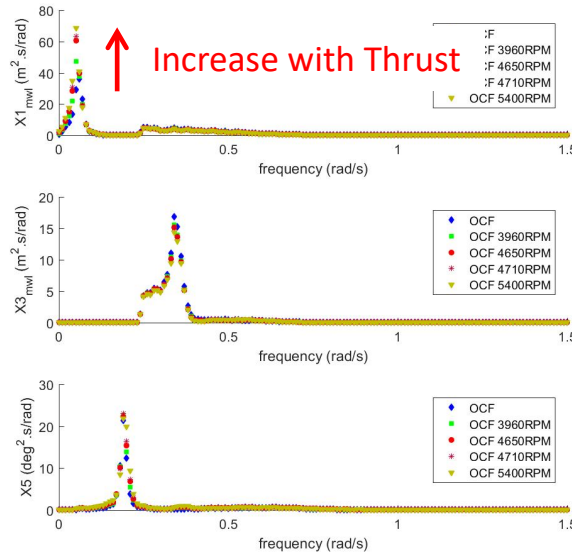


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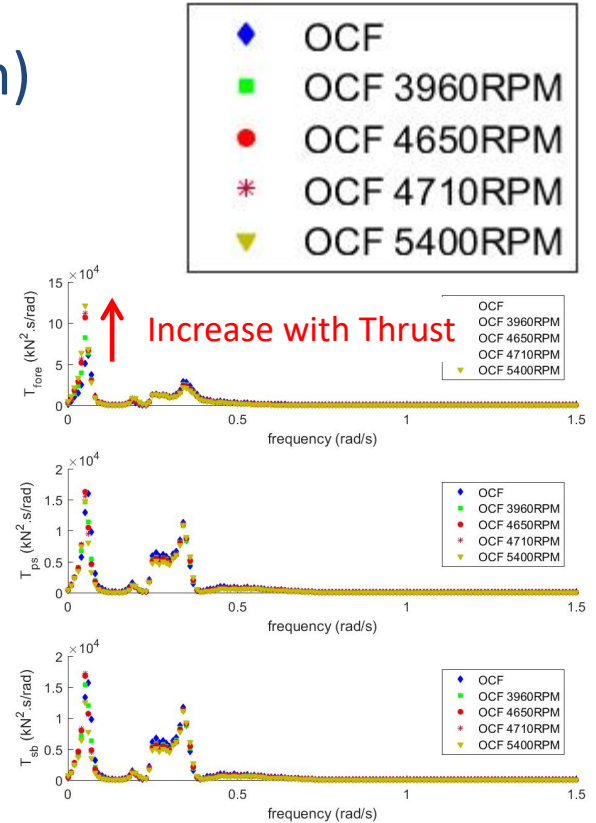
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Motion PSD

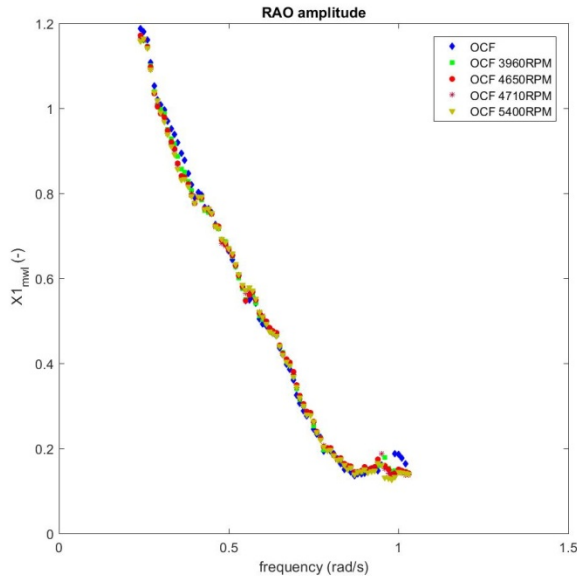
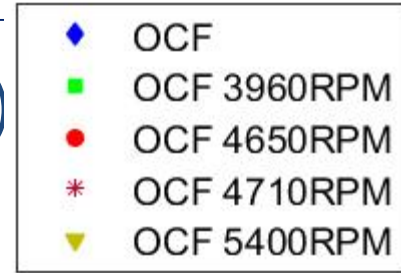


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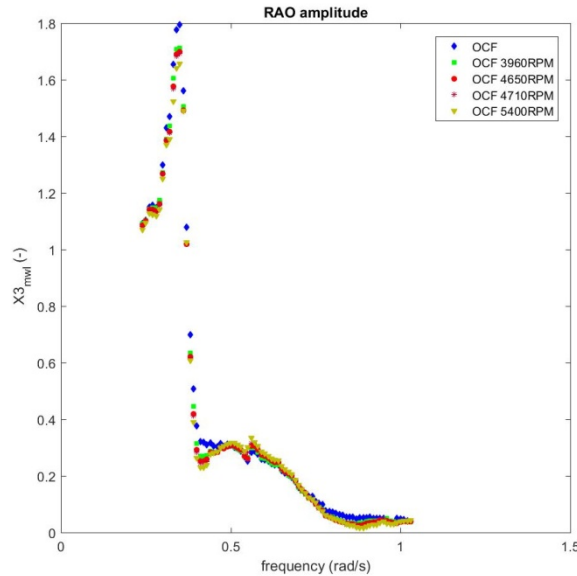


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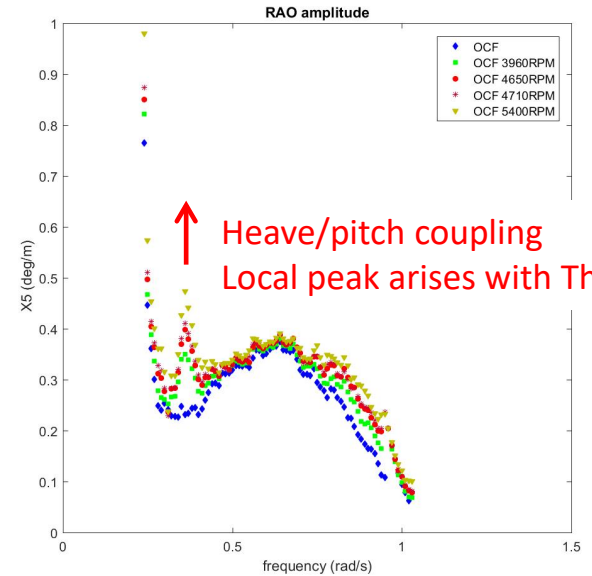
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Pitch RAO



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 - Same conditions as the 2018 OC6 phase I tests
 - Constant thrust levels without waves
 - Combined wave and constant thrust levels
- Several effects of increasing the thrust on the responses of the semisubmersible were observed and explained, e.g.:
 - Increases of the surge and pitch resonance peaks
 - Rise of a heave/pitch coupling resulting in an increasing peak in the pitch RAO at the heave natural period
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Main contributors:

- Ilmas Bayati (supervision of model-tests)
- Ruud van der Veeken, Ruud van Alfen (engineering of scaled model)
- Rene van Dijk (execution of model-tests)
- Wouter van Kampen (design and preparation of fan experimental set-up)
- Rene Bosman (selection of load frame)
- Erik-Jan de Ridder (funding)
- Sebastien Gueydon (design of experiment, analysis, writing of paper)

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