SOFTWIND project

HYBRID MODEL TESTING OF FLOATING WIND TURBINES

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SOFTWIND project

Purpose: Development of an experimental platform based on a software-in-the-loop approach and dedicated to floating wind turbine.

Duration : 3 years (started in Nov. 2017)

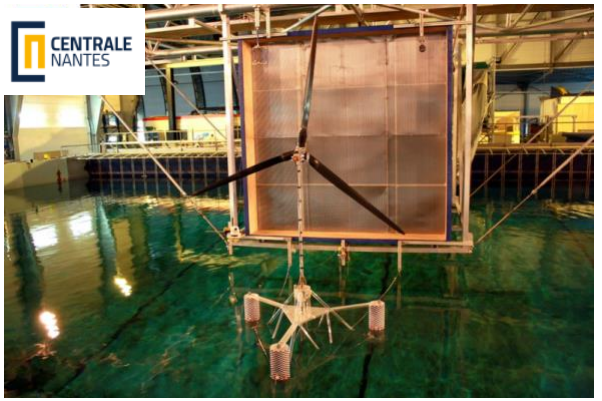
Objectives:

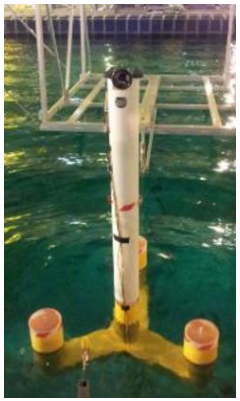
- Robust experimental platform,
- Test of innovative control strategies developed by the SME D-Ice Eng.

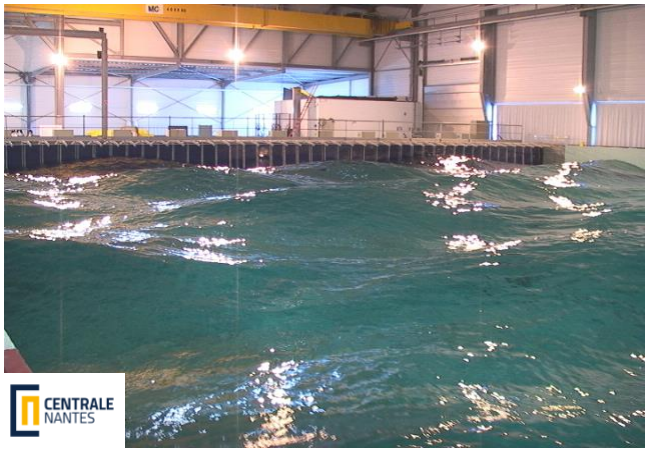
Tools: Experiments in controlled conditions (ECN Ocean wave bassin)

Partners: LS2N Laboratoire des Sciences du Numérique de Nantes — D-ICE Engineering

Funding body: WEAMEC Research, Education & Innovation in Pays de la Loire FOR MARINE ENERGY







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Methodology
Specifications of actuators setpoints :

Preliminary analysis of the characteristics of the aerodynamic tensor based on numerical simulations of:

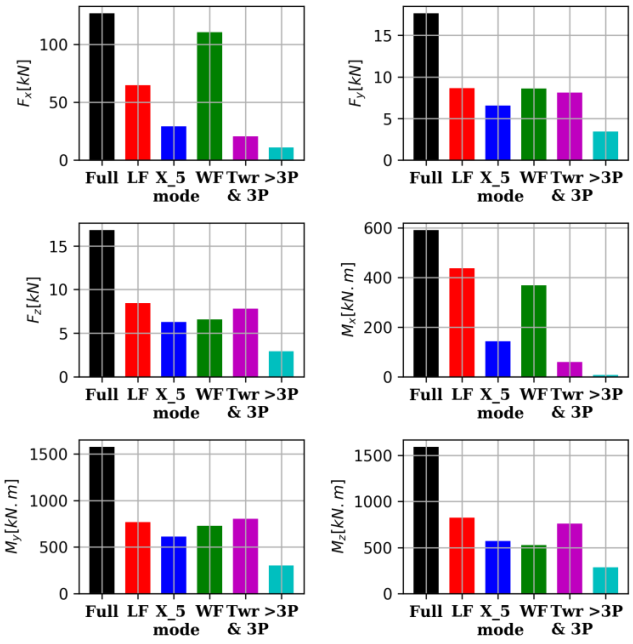
3 different FOWTs:

- OC4 semi submersible (5MW)
- OC3 Hywind (5MW)
- Triple Spar (10MW)

For Norm Design Load Cases of type 1.X (power production)

- Severe waves
- Normal Turbulence Model
- Wind-wave misalignment

Analysis of the relative contributions of the different frequencies of interest
=> Standard deviations of the aerodynamic load components by frequency bandwidth



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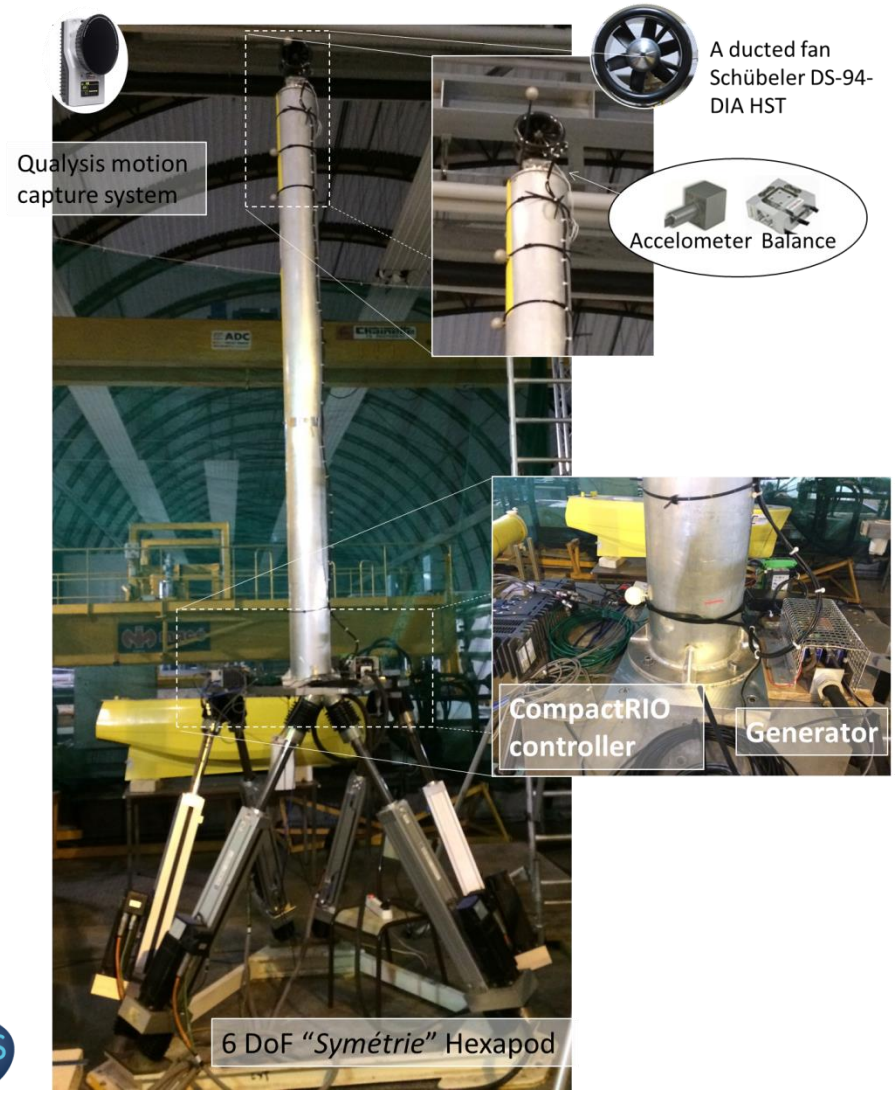
Methodology

Validation of the experimental setup with imposed motions



A test bench with a single actuator is currently tested. The purpose of this set up is the validation of :

- the communication protocols,
- the real-time execution of the numerical model,
- the motion and force observers,
- the preliminary actuator model identification.

Preliminary validation tests consist in imposed motions by means of a hexapod and will be followed by wave tank tests next September.

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TEST BENCH
Validation of the methodology

✓ Overall validated methodology

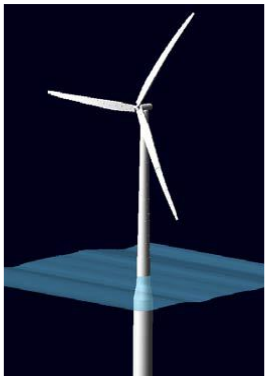
1. Realistic FWT motions
2. Motions reproduced by Hexapod
3. Motions capture
4. Force computed in real-time by integrated numerical code
5. Actuator commanded to reproduce this force

✓ Success Indicators :

- The real-time computed force corresponds to the load case we are reproducing.
- The actuator reproduces with a sufficient accuracy the setpoint force.

OC3 Hywind Spar – 5MW scale 1:30

- Rigid blades and tower
- Active controler



	H_s [m]	T_p [s]	U_w [m/s]	Mean thrust [kN]
LC1	3	5	11.4	680
LC2	4	5	18	320
LC3	6	10	11.4	680
LC4	7	10	18	320
LC5	7	17	11.4	660
LC6	8	17	18	320

TEST BENCH
Validation of the methodology

OC3 Hywind Spar – 5MW at scale 1:30

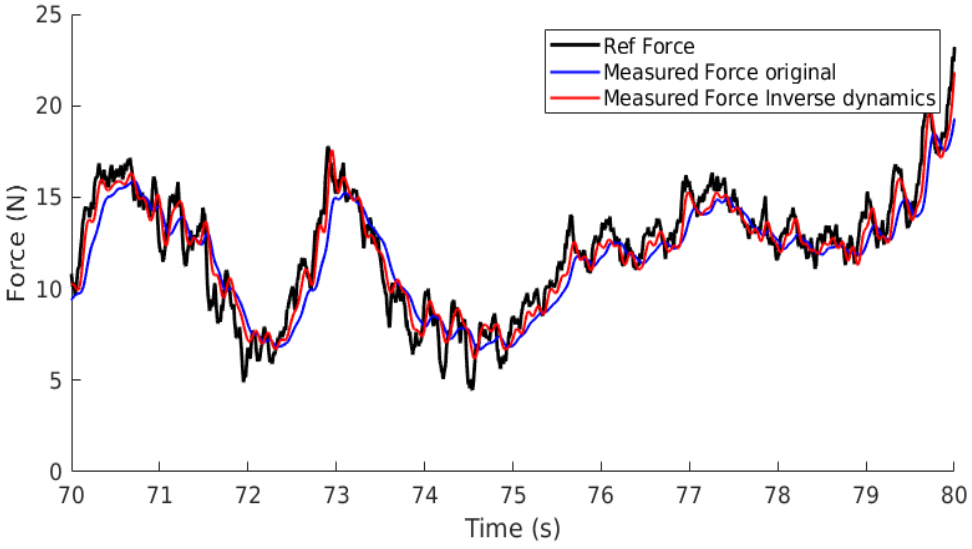
Waves conditions :

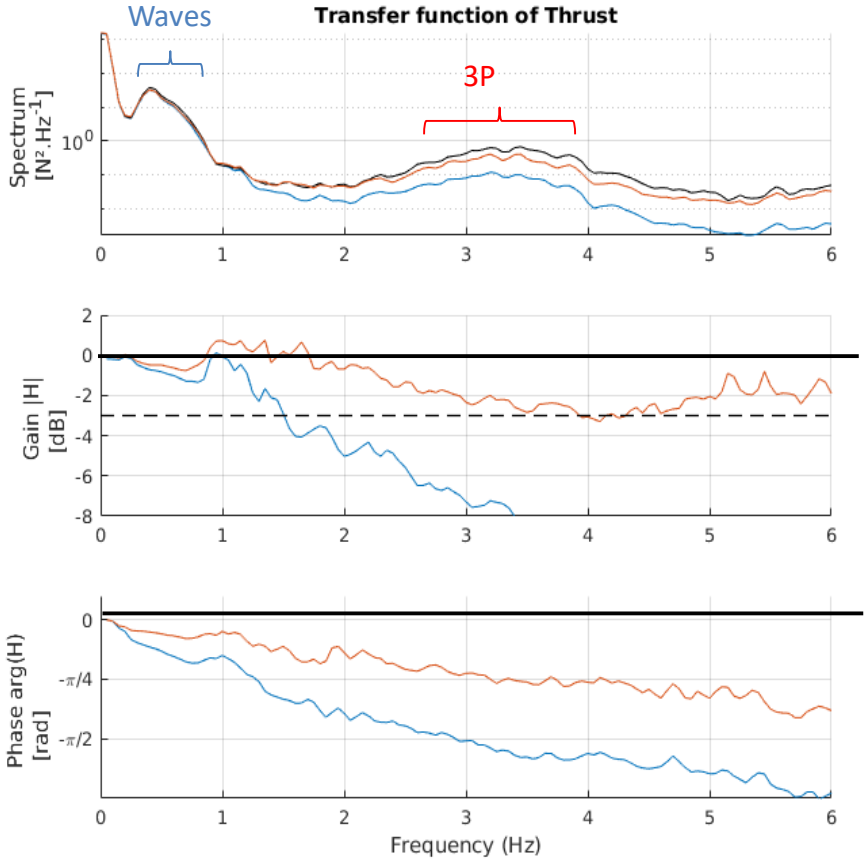
Severe Sea State, $H_s = 8.6m\ T_p = 13s$;

Wind conditions :

Normal Turbulence Model, $U_w = 18m.s^{-1}$; $T_I = 14.6\%$;

Load Case	Mean Thrust (N)	Error (%)
LC1	25	3
LC2	12.5	5
LC3	25	5
LC4	12	10
LC5	24	4
LC6	12	5





Improvement with the use of inverse dynamics

But still 30 ms pure delay

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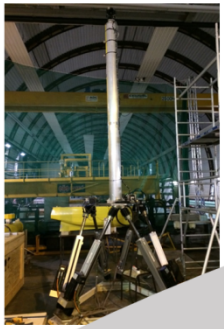
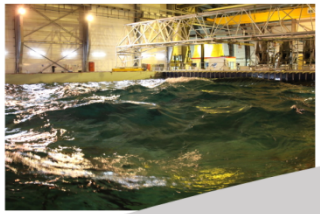
SOFTWIND project: Schedule





October 2017:
Kick-Off

2018

Test with imposed motions and 1 DOF emulator

2019

1st Wave tank test with 1 DOF emulator

2019

2nd experimental test with imposed motions and advanced emulator

2020

2nd Wave tank tests with advanced emulator

October 2020:
End of the project