IMPACT OF HYDRODYNAMIC DRAG COEFFICIENT UNCERTAINTY IN 15 MW FLOATING OFFSHORE WIND TURBINE POWER REGULATION

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Introduction

- Uncertainty sources in FOWTs → Drag coefficient one of the most uncertain parameters to define simulation models
- **Objective**: analyse the impact of the drag coefficient uncertainty in the power regulation of large FOWTs
- Machines selected:
  - IEA 15 MW on UMaine VolturnUS-S (semisubmersible)
  - IEA 15 MW on WindCrete (spar)

Figure 1 IEA 15MW reference wind turbine mounted on UMaine Volturn US-S (left) and WindCrete (right) floating platforms

- Drag coefficient has high uncertainty, as it depends on many other parameters (Keulegan-Carpenter Number, Reynolds Number, roughness…)
- Usually CFD calculations or tank tests to provide a reasonable value

Methodology

- Selected floating platforms have been divided by components (columns, heave plates and pontoons) and drag coefficient uncertainty has been quantified for each component

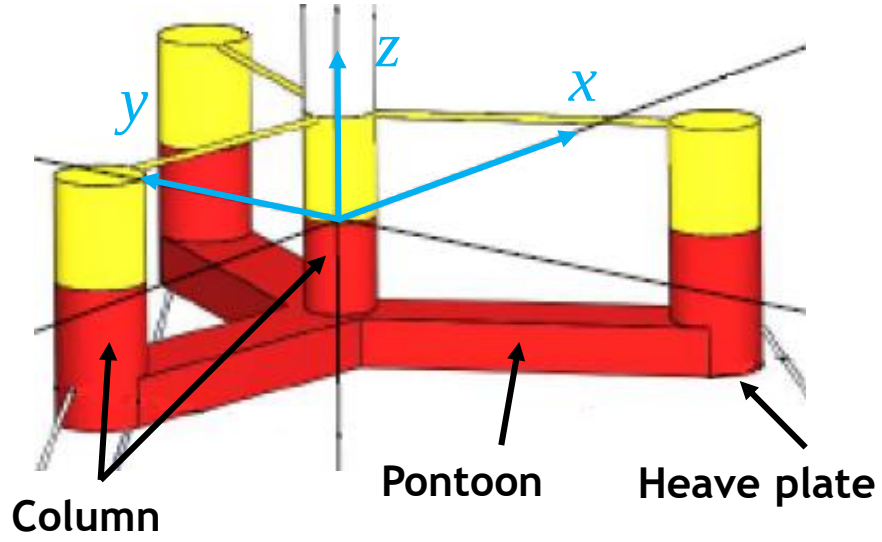


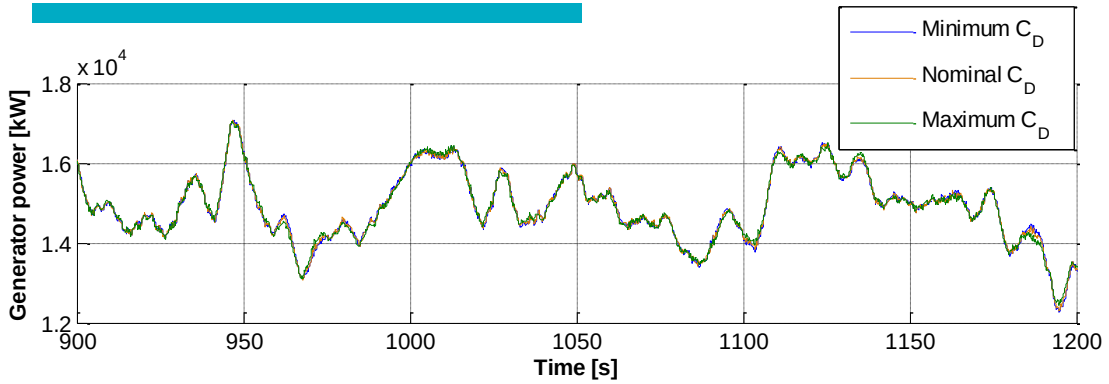
Figure 2 Platform components (for UMaine VolturnUS-S platform)

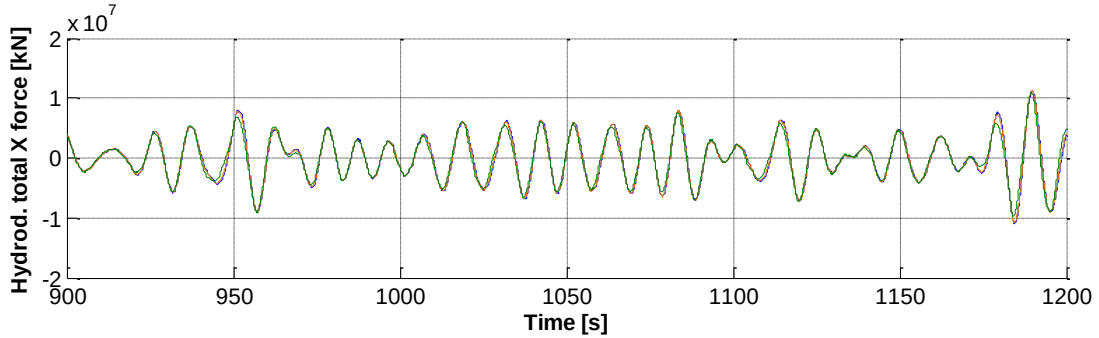
Table 1 Drag coefficient uncertainty range for each platform component

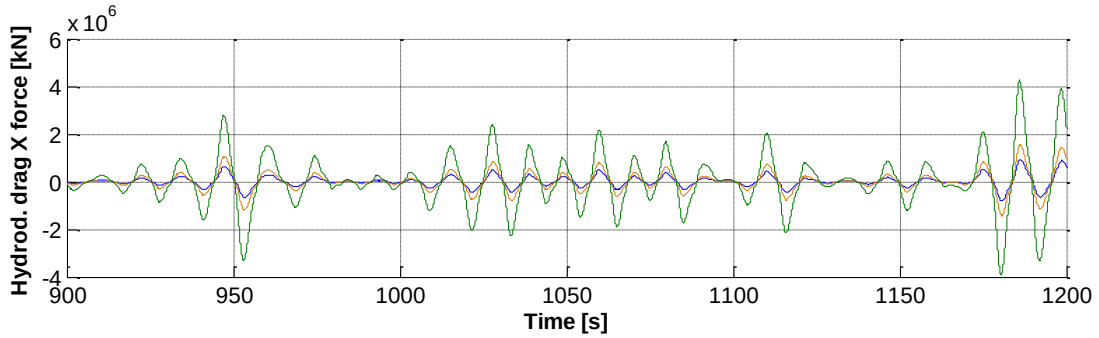
Component	Minimum C_D	Nominal C_D	Maximum C_D
Column	0,4	0,6	2,0
Heave plate	0,7	1,5	3,1
Pontoon	0,7	1,5	3,2

- FOWTs have been modelled in OpenFAST 2.4 using a hybrid potential/Morison model
- NREL ROSCO state-of-the-art controller has been used in simulations
- Time domain simulations have been run with collinear turbulent wind and irregular waves

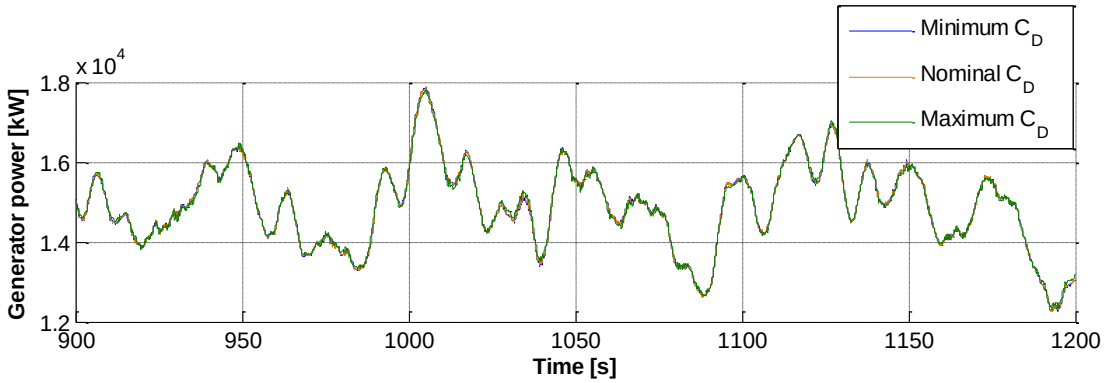
Results for 23 m/s

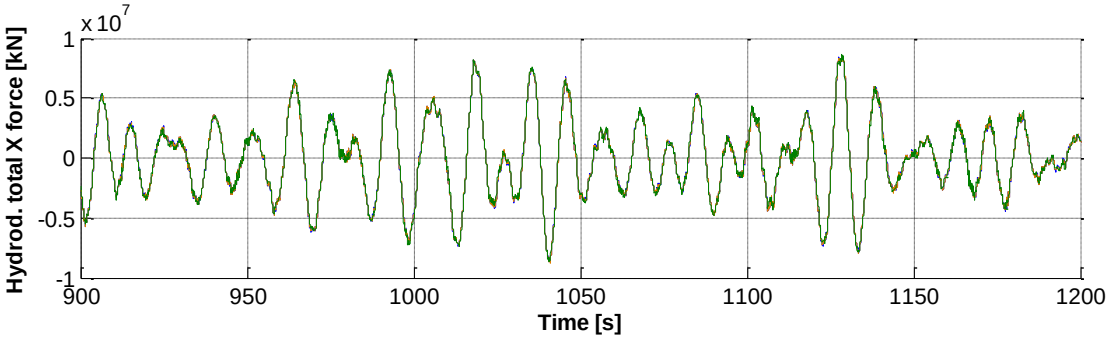


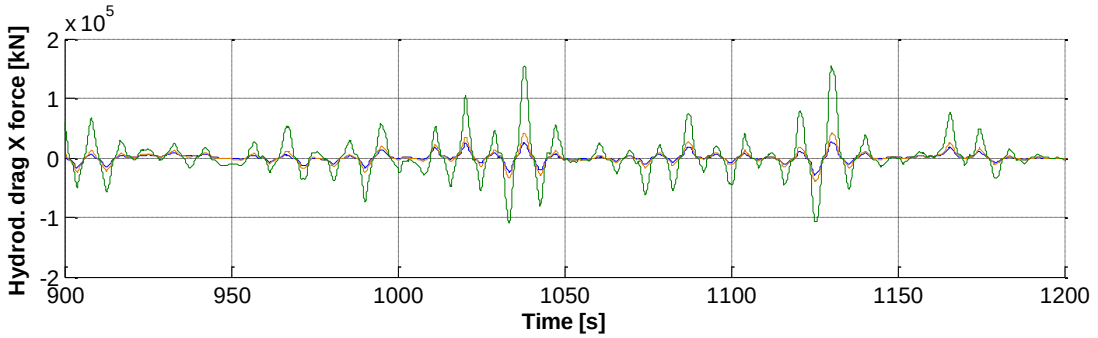




UMaine VolturnUS-S







WindCrete

Conclusions and future work

For the analysed large FOWTs, the following conclusions can be extracted:

- Drag coefficient uncertainty, although being quite large, has almost negligible impact in the power regulation (below 2%)
- Control robustness with respect to drag coefficient uncertainty can be easily achieved
- Hydrodynamic total forces are barely affected by drag forces, as their dynamic response is dominated by inertial ones

As future work, further exploration on control dependency should be carried out for other platform designs, especially slenderer ones, as they are expected to be more drag dependant.

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