NUMERICAL AND EXPERIMENTAL STUDY OF MOORING SYSTEMS WITH CLUMP WEIGHTS FOR FLOATING WIND TURBINES

Programa de Doctorado en Ingeniería Naval y Oceánica - Universidad Politécnica de Madrid

Tomás Lopez Olocco

Director: Leo Miguel González Gutiérrez **Codirector: Javier Calderón Sánchez**

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Abstract

The exploitation of offshore wind energy is very promising economically but has also come with a significant technical challenge due to the increasing trend of placing wind turbines in deep waters. This implies that the length of the mooring lines, and therefore their weight and costs, increase considerably. Thus, optimizing the mooring lines is crucial for the demanded cost reduction of this growing technology, and for this purpose, an exhaustive and comprehensive study of their dynamics is necessary.

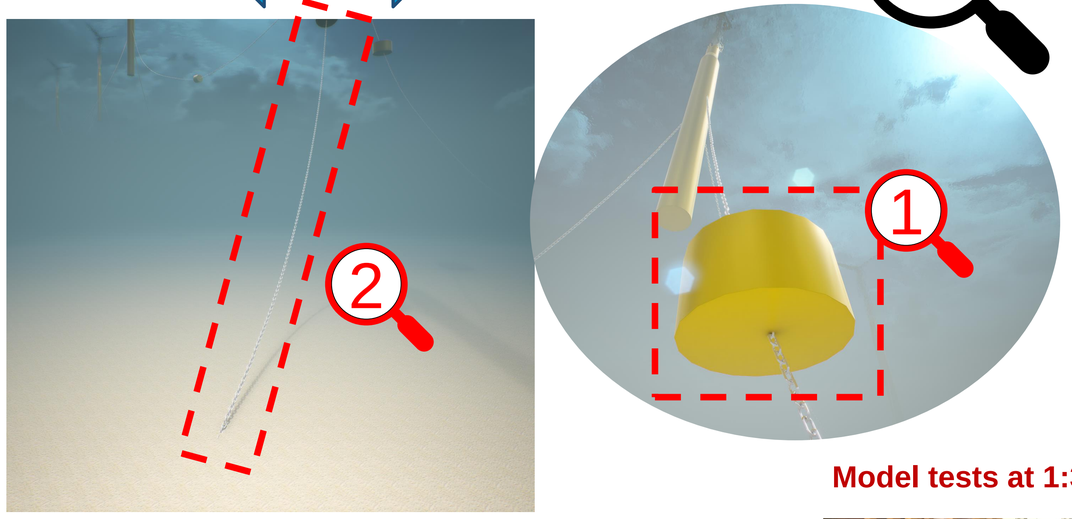
A reduction in motions allows the turbine to generate electricity over a broader range of sea states, and smaller motions reduce the tensions on the line and the associated costs. Therefore, the main objective of this research project is to reduce the loads to which the mooring lines are subjected and to minimize the motions of offshore wind turbine platforms.

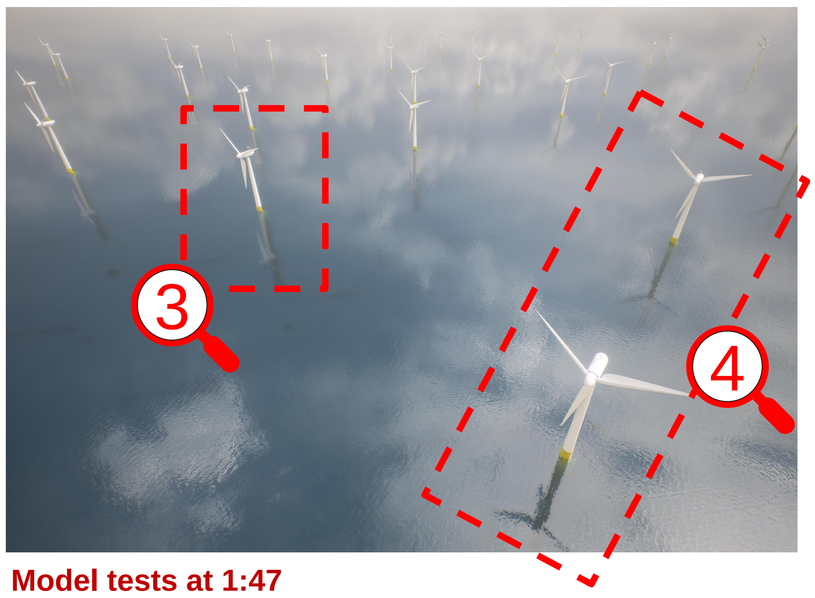
Objectives

"Contribute to the development of comprehensive, and experimentally validated, computational tools for studying mooring lines that incorporate inertial elements such as clump weights along their length."

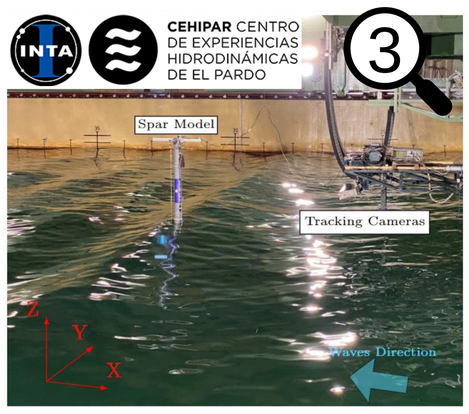
Methodology

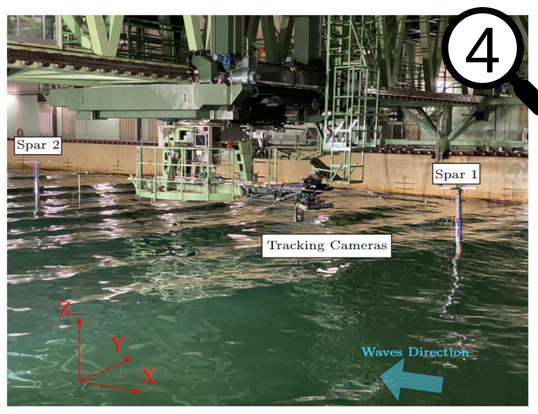
Experimental study VS. **Numerical study** *… For every "zoom level"*





Model tests at 1:47





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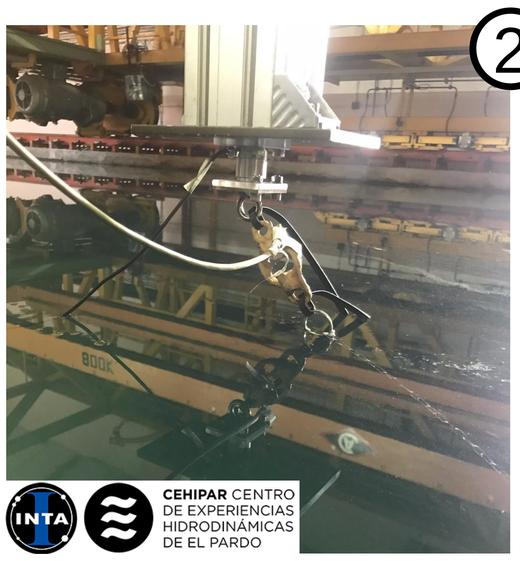

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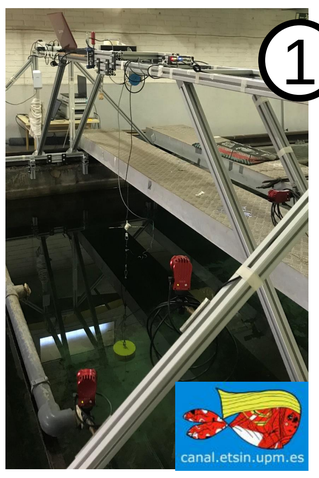
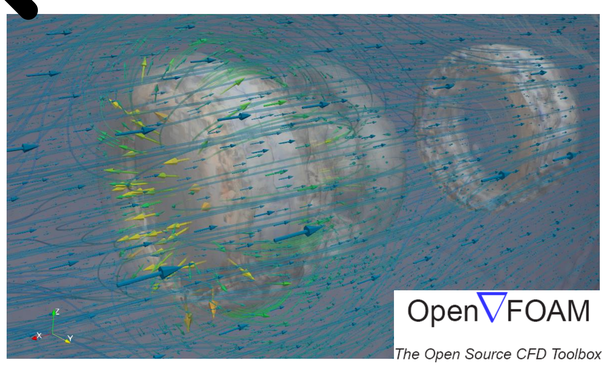


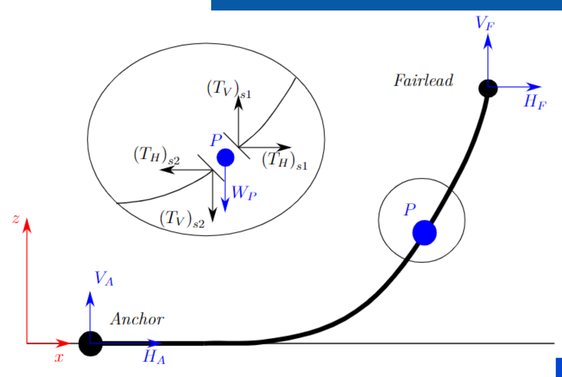
Numerical simulations (CFD) with OpenFOAM



Implementation in the OPASS and MoorDyn codes

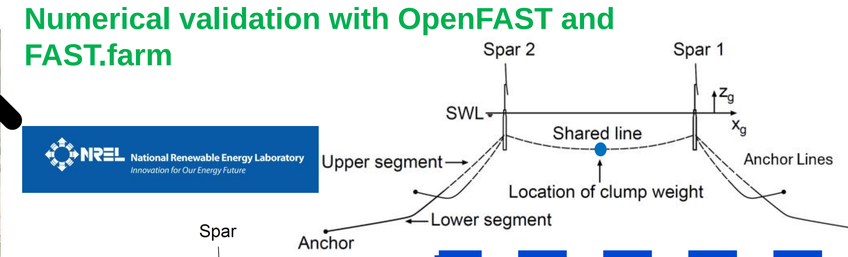
CENER — CENTRO NACIONAL DE ENERGÍAS RENOVABLES

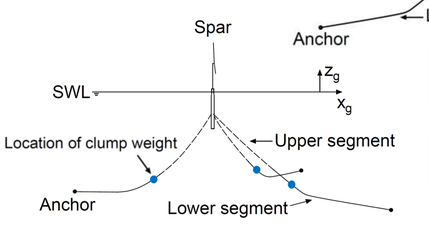
NREL National Renewable Energy Laboratory — Innovation for Our Energy Future

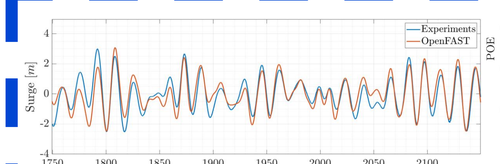


Numerical validation with OpenFAST and FAST.farm

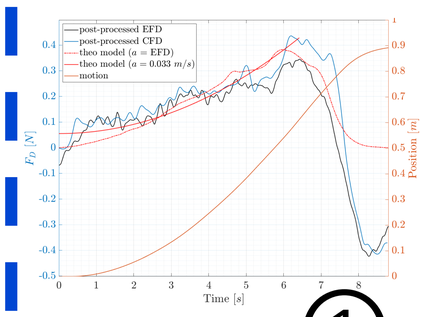
NREL National Renewable Energy Laboratory — Innovation for Our Energy Future



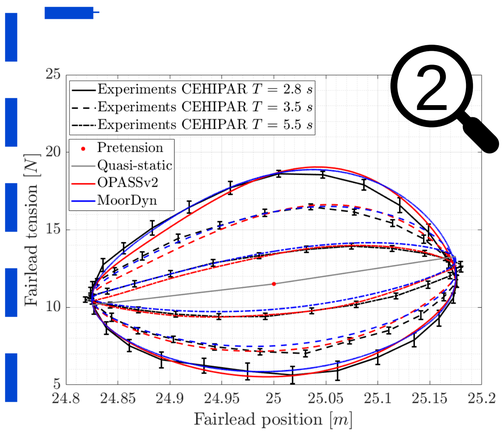




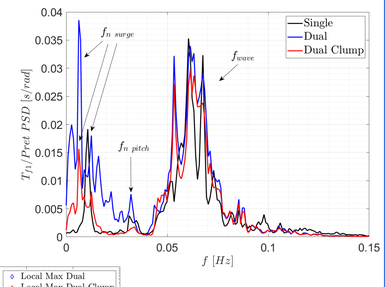
Results

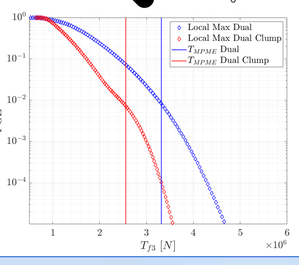


Publication JCR: [1]



Publication JCR: [2]





Publication JCR: [3] y [4]

Publications and Conferences

[1] Tomas LOPEZ-OLOCCO, Javier Calderón-Sánchez, L M. González-Gutiérrez **"**Experimental validation of the simulations of the flow around an impulsively started scaled clump weight using an overset dynamic mesh with OpenFOAM". Journal of Ocean Engineering **(Q1, in revision)**

[2] Tomas LOPEZ-OLOCCO, L M. González-Gutiérrez, Javier Calderón-Sánchez, Adolfo Marón-Loudeiro, Leandro Saavedra-Ynocente, Ana Bezunartea-Barrio, Nicolás Vivar-Valdés **"**Experimental and numerical study of the influence of clumped weights on a scaled mooring line". Journal of Marine Science and Engineering **(Q1)**

[3] Tomas LOPEZ-OLOCCO, Guodong Liang, Antonio Medina-Manuel, Leandro Saavedra Ynocente, Zhiyu Jiang, Antonio Souto-Iglesias **"**Experimental comparison of a dual-spar floating wind farm with shared mooring against a single floating wind turbine under wave conditions". Journal of Engineering Structures **(Q1)**

[4] Guodong Liang, **Tomas LOPEZ-OLOCCO,** Antonio Medina-Manuel, Leandro Saavedra Ynocente, Zhiyu Jiang, Antonio Souto-Iglesias **"**Experimental investigation of two shared mooring configurations for a dual-spar floating offshore wind farm in irregular waves". Journal of Marine Structures **(Q1)**

Presentations in internacional conferences: ECRES2022, IOWTC2022, SNAME2023, MARINE2023, OMAE2024, ENERMAR2024

Planning

References

[A] Azcona, J.; Munduate, X.; González, L.; Nygaard, T.A. Experimental validation of a dynamic mooring lines code with tension and motion measurements of a submerged chain. Ocean Engineering 2017, 129, 415–427.

[B] Hsu, W.Y.; Chuang, T.C.; Yang, R.Y.; Hsu, W.T.; Thiagarajan, K.P. An Experimental Study of Mooring Line Damping and Snap Load in Shallow Water. Journal of Offshore Mechanics and Arctic Engineering 2019, 141.

[C] Yuan, Z.M.; Incecik, A.; Ji, C. Numerical study on a hybrid mooring system with clump weights and buoys. Ocean engineering 2014, 88, 1–11.