Project 5IVE: Fast Forward From Floater to Farm (VKI, IMDC & tbc)

Project proposal idea by von Karman Institute for Fluid Dynamics (VKI) Team Wind & IMDC
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Scope of this 2 pager: Partner search & identification of industrial research topics for floating wind.

Problem statement: Floating offshore wind energy presents a diversification opportunity for the Belgian supply chain, but its successful deployment requires a.o. holistic modelling, advanced interface engineering and manufacturing at scale. Due to the additional technical interfaces and degrees of freedom of floating wind, the bottom fixed wind methods are insufficient. Floating wind needs additional development and operational tools, and site specific metocean data early on in the design process for optimal siting and basic design.

Challenges. Multiple frameworks try to integrate aerodynamics, hydrodynamics, structural response, control systems, grid integration and site specific data like metocean, geophysics and geotechnics. These multidisciplinary models face significant scaling challenges, often requiring trade-offs between fidelity, computational cost, and physical realism, especially when extrapolating from small-scale prototypes to full-scale systems.

Local opportunity and international enabler(s). A major barrier is the lack of full scale validation data, undermining confidence in simulation results and limiting the reliability of design and operations. International organizations have been advocating for large-scale floating wind demonstrator project(s), or even open air scaled wind farms to bridge the gap between laboratory and full scale. Flanders (& Belgium), with no domestic floating wind potential, seems to lag behind. The current slowdown in floating wind development provides an opportunity to catch up in selective themes.

Envisaged approach & solution. Acknowledging that a fully integrated high fidelity engineering setup is unfeasible and overshooting the practical useability, Project 5IVE wants to **address 3 to 5 specific industrial research questions. By integrating just the essential parts in 3 to 5 "minimum viable numerical and experimental workflows", so called tracks**, we aim to develop and optimize lean and specific tools for floating wind.

Research Questions. The current consortium is open to **explore *any* relevant industrial research questions relevant for DBC members**, but the current core expertise is focused around aerodynamics (environmental flows and rotor interaction such as wind flow fields, wakes & production data) for VKI and hydrodynamics & realistic metocean conditions for IMDC. Our strength lies in the expertise in aero- & hydrodynamics, control strategies, the robust and fast coupling between them, site specific metocean and the experimental validation of these aspects with upgraded test facilities at VKI.

Currently, we are proposing **the following research questions** (based on a combination of our expertise and the assumed industrial relevance for the Flemish supply chain).

1. How can we incorporate **site-specific metocean data** into early-stage design and cost modelling?
2. To what extent can the reduced order models be used to **accelerate the design** process without sacrificing accuracy? Or conversely, how can high-fidelity models be used in the early design phase, without excessive cost or time?

3. How can we use machine learning and **statistical downscaling** to generate synthetic long-term datasets from short-term measurements or satellite data to address the lack of accuracy in site specific multi-model wave systems or extreme events (like long period swells) to improve the **mooring design, survivability assessment and damping on floater motion**?
4. Can we improve the state of the art modelling of an **individual single turbine FOWT > 18-20MW** with coupled wave-wind loads for parameters like power production or displacement?
5. Can we develop or improve **floating Wind Farm Parametrization (fWFP)** schemes able to quantify the effect of sea states on **farm power production**?
6. By combining 4 & 5, and extending the approach to high fidelity modelling describing the key physical phenomena, can we develop a **control strategy**
7. Can a scaled windturbine with a **hexapod**, mimicking the displacement response of any substructure or floater, be used to bridge the aero- and hydrodynamic behavior in the lab?
8. **…**

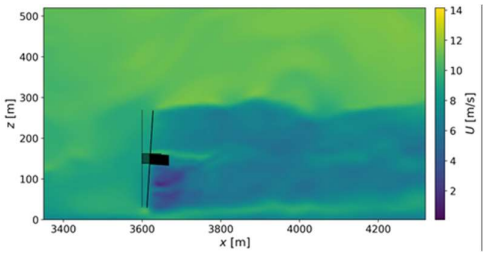
The final research questions will be finalized in consensus with the consortium partners.

Potential applications (tbc). We would combine and tweak these models for resolving the physics for multiple specific industry relevant applications, such as, but not limited to: floater dynamics & displacement (inc. loads), viscous damping, refraction loading, response amplitude operators (RAO), power curve validation, yield estimation, non-synoptic wind profiles, loads characterization (design load cases), advanced control strategies,….

Partner profile. Project 5IVE is looking for industrial partners that have specific R&D questions within this scope. We aim for a **3 year project**, trying to build the minimum viable tracks initially in the first part of the project, in order to calibrate and validate experimentally, or optionally to improve or reiterate them in the second part.

Examples: Floating Wind Developers, engineering & consultancy firms, specific component supply chain suppliers, IT (scada) integrators, or partners that can provide, or have a specific request for scaled testing,….that are willing to submit in the next DBC call (deadline 10 pager: 2 October).

VKI



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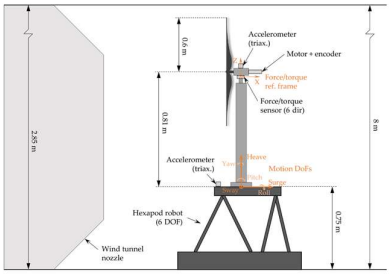

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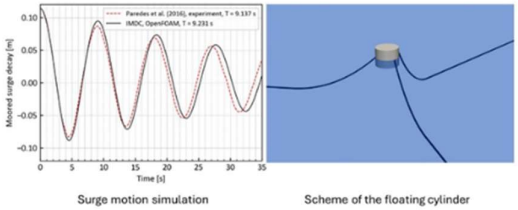

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