Improving the Reliability and Economy of Anchors for Floating Offshore Wind Energy

School of Science and Engineering

Supervisory team
Main: Dr Pengpeng He, School of Science and Engineering, phe001@dundee.ac.uk
Second: Professor Sue Dawson, School of Humanities Social Science and Law, s.dawson@dundee.ac.uk

Description

As a part of efforts to reach net zero carbon emissions by 2050, the UK offshore wind turbine capacity had reached 13.7 GW by 2022, but a higher growth rate is required to meet the target of 50 GW of installed capacity by 2030. Due to significant cost escalation and a lack of suitable installation vessels, traditional fixed-bottom wind turbines are no longer feasible for deeper water (> 60 m) with more consistent and substantial winds. In this context, floating offshore wind turbines (FOWTs) have come into focus and are attracting significant interest.

However, a significant challenge faced by the floating offshore wind sector is the cost-effectiveness of FOWTs for commercialisation, particularly in relation to the anchoring system. The traditional design of anchors, shaped by the technical and economic considerations of oil and gas facilities, is overly conservative and thus prohibitively expensive. This excess conservatism is a direct consequence of the substantial uncertainties inherent in the design process, specifically in geotechnical site investigation. Sufficient site investigation is crucial to reduce uncertainty in ground conditions, minimising risk to an acceptable level without being overconservative. However, this is lengthy are costly, particularly in offshore settings where the availability of vessels and laboratories is limited. Uncertainty in site investigation propagates to anchor design where further uncertainties in anchor capacity prediction are added, resulting in a heavily overconservative design. To address this challenge, this project aims to optimise site investigations for FOWTs.

This project is based on Dr Pengpeng He's ongoing project of Kan Tong Po International Fellowship 2023 and will utilise results of current PhD Geo Net Zero student H/Langdale (Prof Sue Dawson) looking at assessing the seabed integrity under increased pressures from offshore windfarm developments with a range of identified geo-layers for maximising site selection and environmental risk assessment. In answering these questions, the costs in anchor design will be reduced while maintaining reliability. To achieve the aims, a comprehensive reliability-based risk assessment framework for FOWT anchors, using a Bayesian approach and Random Finite Element Models (RFEM), will be developed for FOWT anchors to systematically quantify the uncertainty in site characterisation and anchor design. The developed framework will serve as a tool to economically optimise the effectiveness of site investigation for anchor design. This will enable improved (optimised) cost and risk estimations for different anchor concepts, thereby facilitating robust design decisions.

The project aligns with the UK Government's Energy Strategy in the key priority area of renewables and will promote the wider deployment of offshore floating wind. The optimised site investigation schemes developed in this project can be used by UK consultancies to give them a distinct market advantage in both domestic and international projects, reinforcing the UK's leading position in offshore wind energy.

For informal enquiries about the project, contact : Dr Pengpeng He, School of Science and Engineering, phe001@dundee.ac.uk

For general enquiries about the University of Dundee, contact doctoralacademy@dundee.ac.uk

Our research community thrives on the diversity of students and staff which helps to make the University of Dundee a UK university of choice for postgraduate research. We welcome applications from all talented individuals and are committed to widening access to those who have the ability and potential to benefit from higher education.

QUALIFICATIONS

Applicants must have obtained, or expect to obtain, a UK honours degree at 2.1 or above (or equivalent for non-UK qualifications), and/or a Masters degree in a relevant discipline. For international qualifications, please see equivalent entry requirements here: www.dundee.ac.uk/study/international/country/.

English language requirement: IELTS (Academic) overall score must be at least 6.5 (with not less than 5.5 in reading, listening, speaking and 6.0 in writing). The University of Dundee accepts a variety of equivalent qualifications and alternative ways to demonstrate language proficiency; please see full details of the University's English language requirements here: www.dundee.ac.uk/guides/english-language-requirements.

APPLICATION PROCESS

Step 1: Email : Dr Pengpeng He, School of Science and Engineering, phe001@dundee.ac.uk to (1) send a copy of your CV and (2) discuss your potential application and any practicalities (e.g. suitable start date).

Step 2: After discussion with : Dr Pengpeng He, formal applications can be made via our direct application system. When applying, please follow the instructions below:

Candidates must apply for the Doctor of Philosophy PhD in Civil Engineering (3 Year);using our direct application system:

Please select the study mode (full-time/part-time) and start date agreed with the lead supervisor.

In the Research Proposal section, please:

- Enter the lead supervisor's name in the 'proposed supervisor' box
- Enter the project title listed at the top of this page in the 'proposed project title' box

In the 'personal statement' section, please outline your suitability for the project selected.

Funding status

Competition Funded PhD Project (Students Worldwide)

Initial application deadline

30 June 2024 for a September 2024 intake

Subject tags

Geotechnical Engineering; Geological Engineering; Energy Technologies; Environmental Engineering; Civil Engineering; Mechanical Engineering; Offshore Engineering

For further details

Contact : Dr Pengpeng He, School of Science and Engineering, phe001@dundee.ac.uk