

Supergen



Offshore
Renewable
Energy

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Supergen ORE Hub – Co-Director

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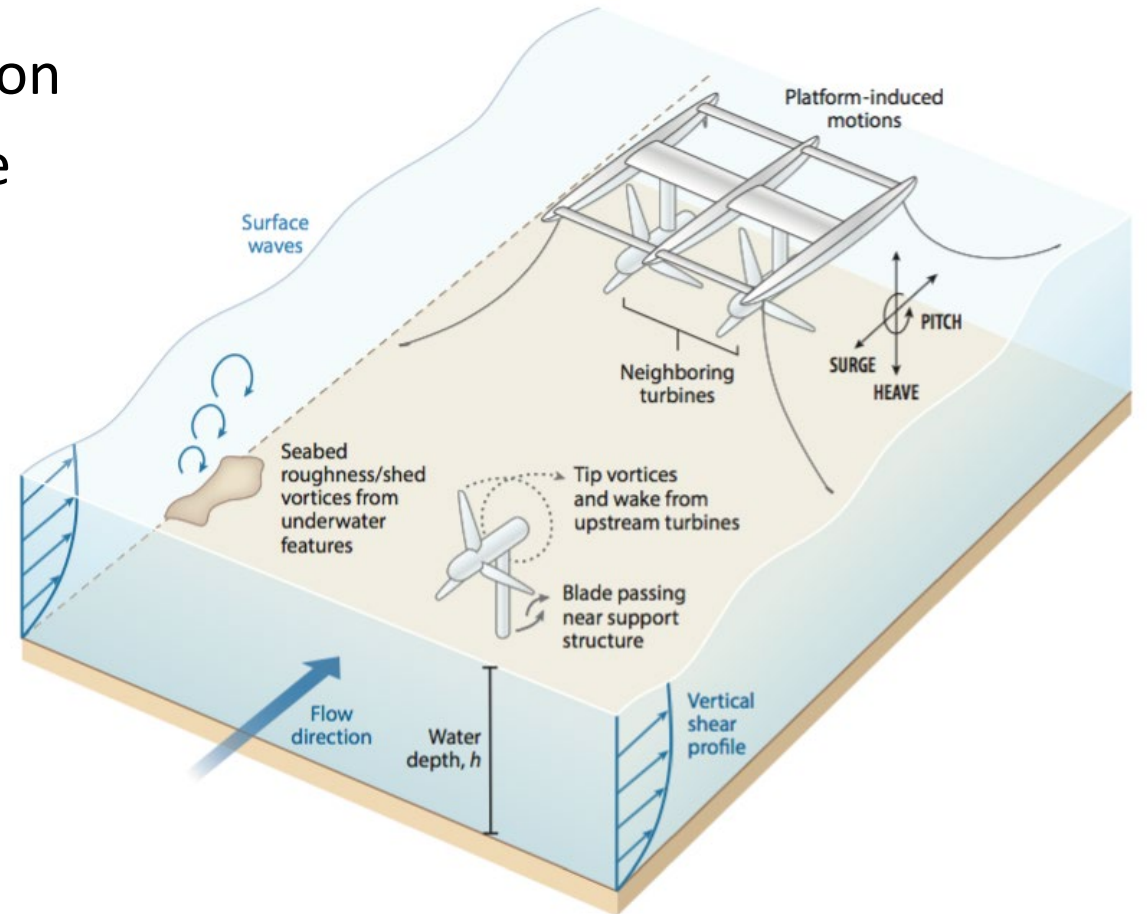
University of Oxford

Supergen ORE Hub – Co-Director



Theme B: Fluid Structure Seabed Interaction

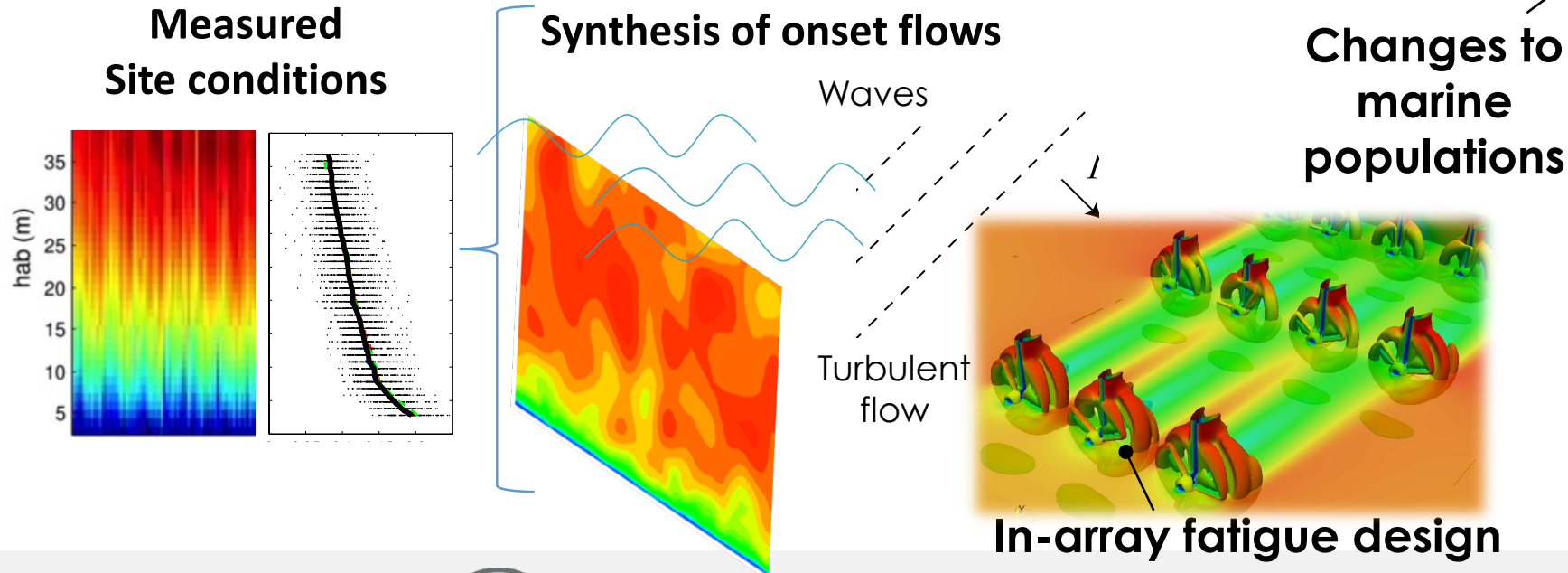
- Realistic fluid-structure-seabed **design tools that work together**, not in isolation
- **Novel device concepts** – rethinking the mechanism of energy extraction
- **Multi-purpose hybrid systems** for ORE and ocean resources
- Design of **reliable cabling systems**
- **Moorings, anchors and foundations**



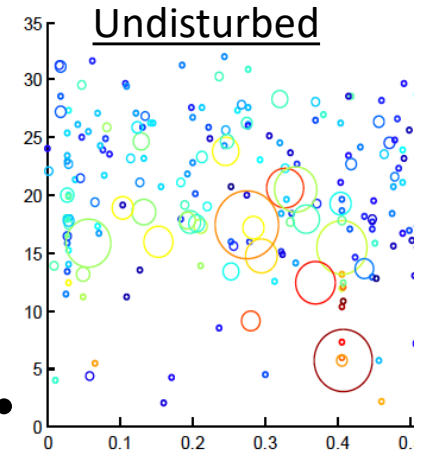
Modelling Across Scales

Synthesis and extension of local unsteady metocean conditions:

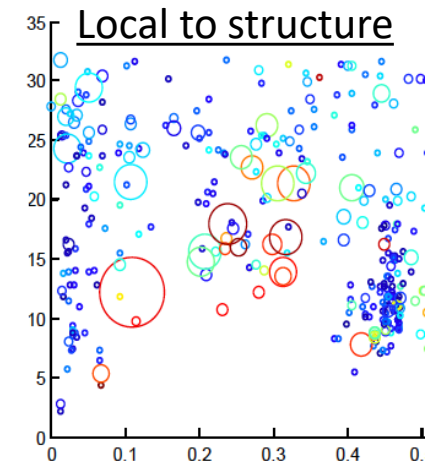
- Onset conditions for representative sites and for *in-array* design
- Regional-scale array effects across alternative operating points
- Disruption to marine populations responding to turbulence changes



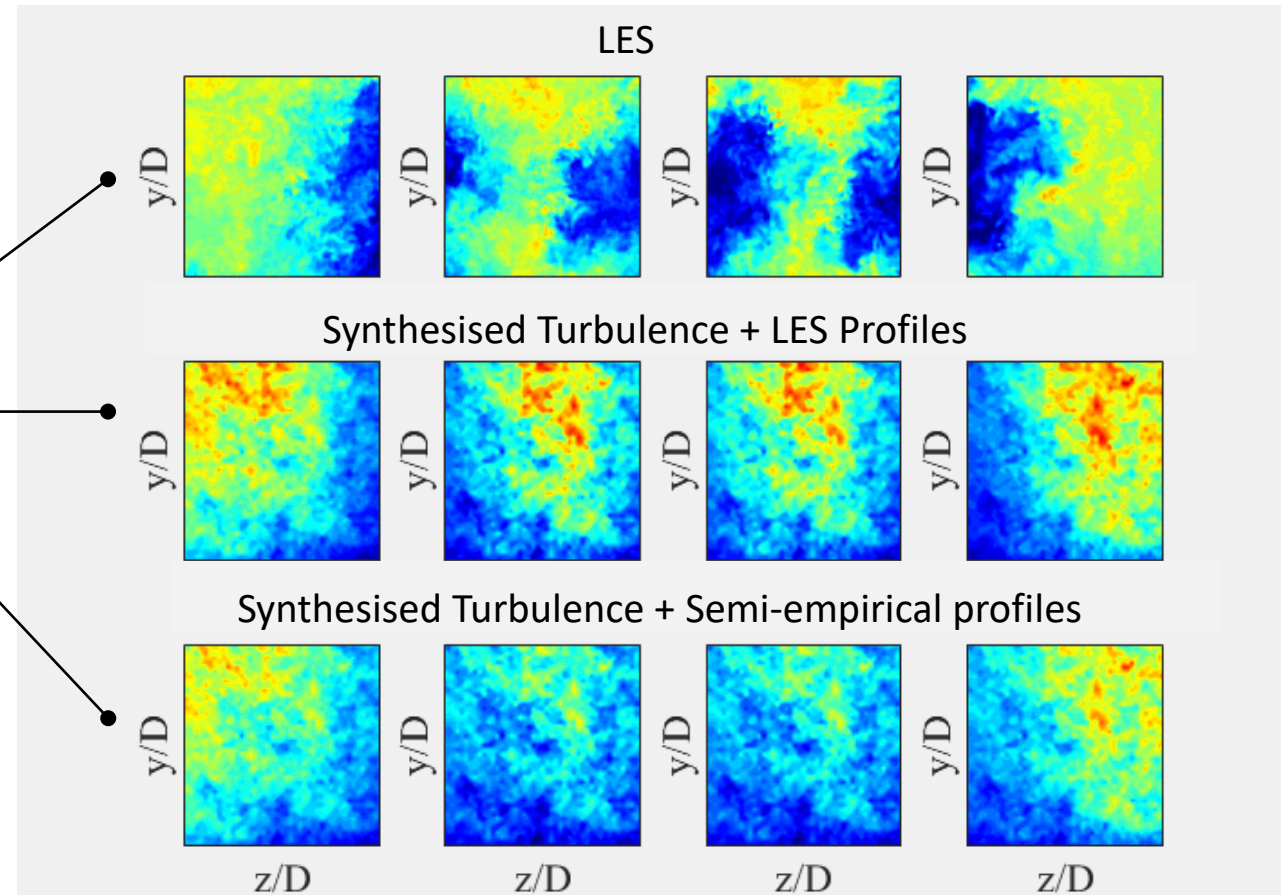
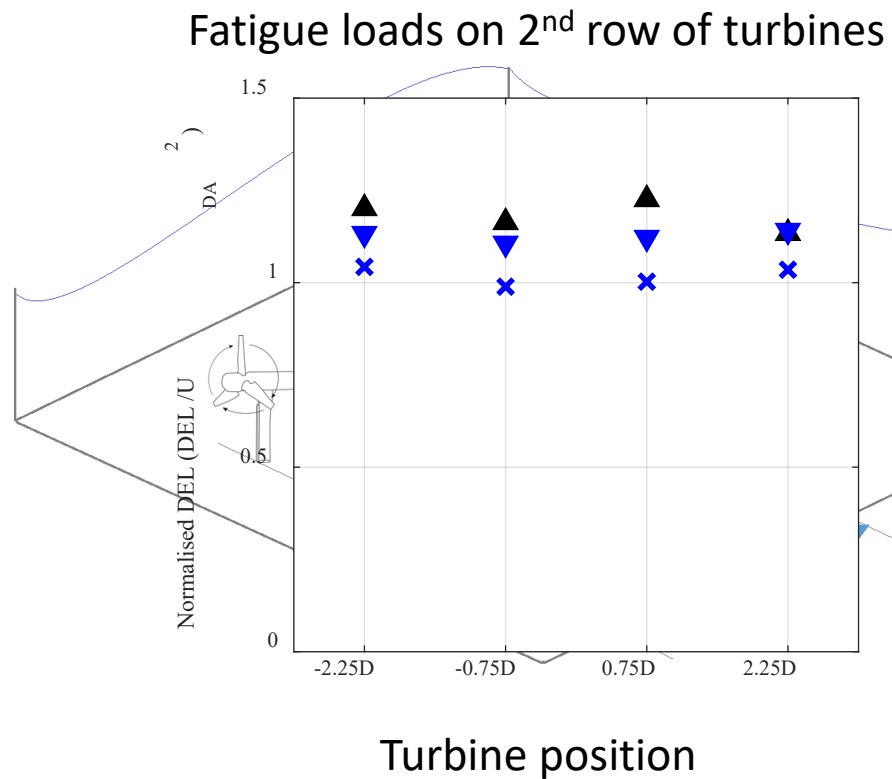
Fish shoal densities at tidal site



Shoals relocate in response to flow

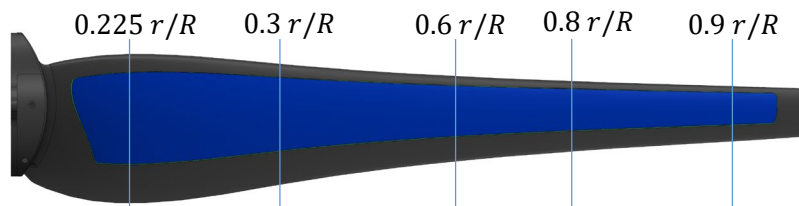
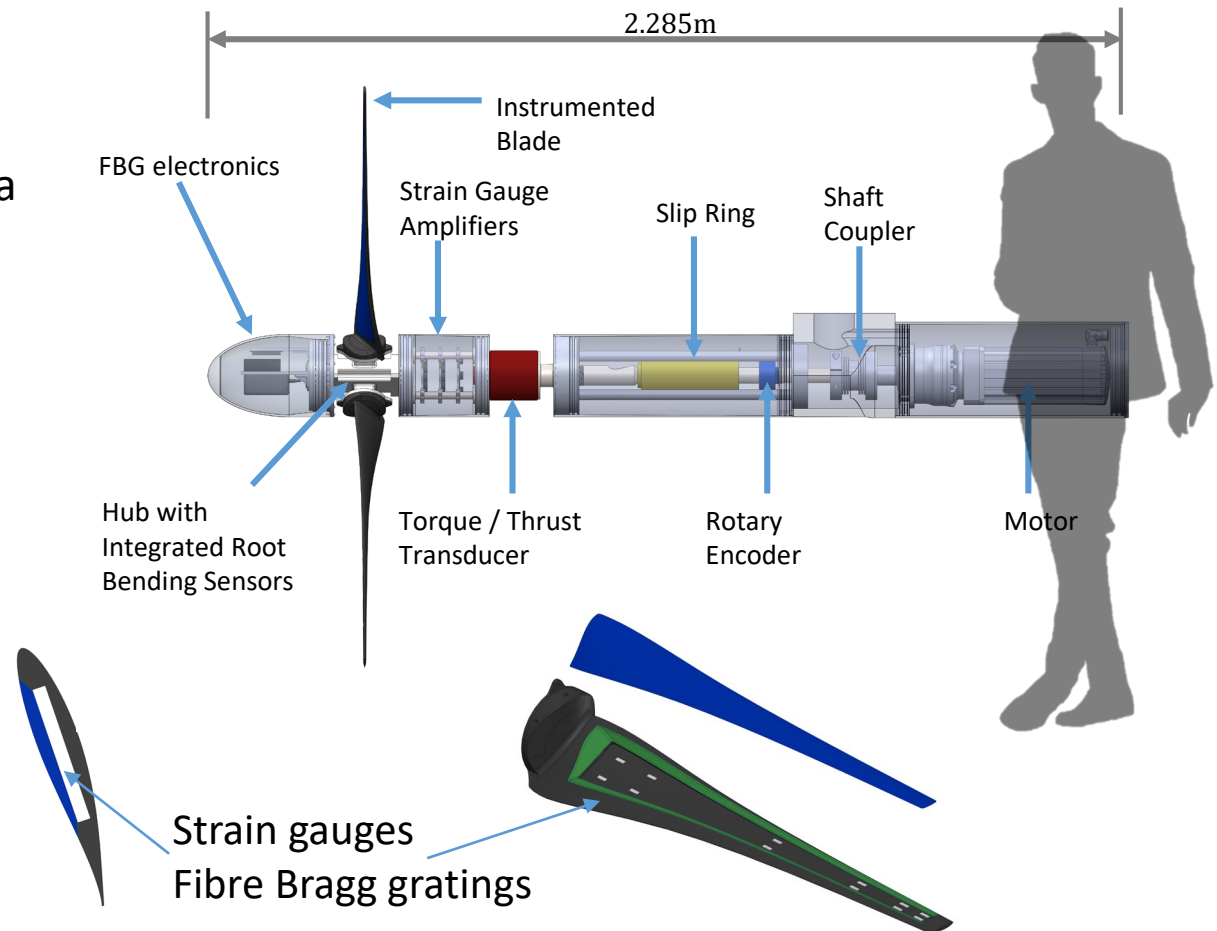


Synthesis of onset flows in-array

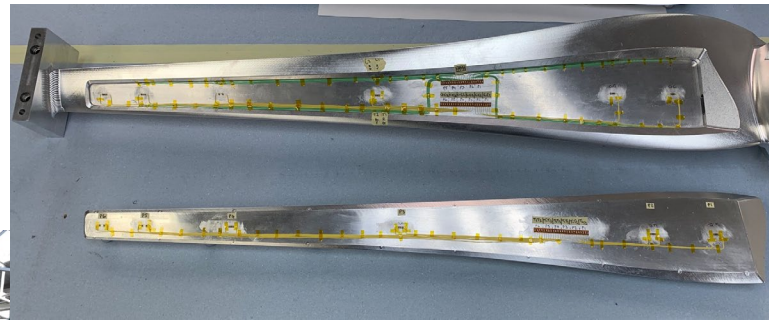
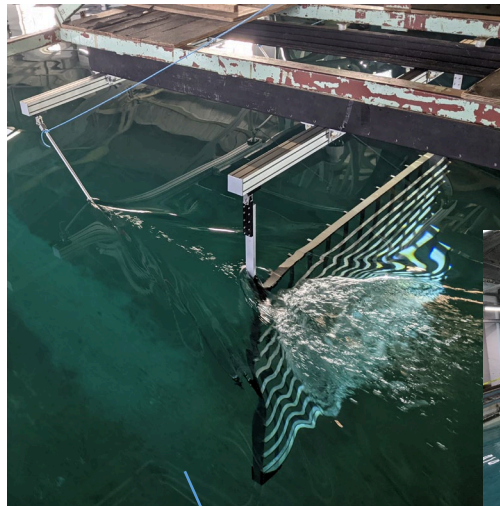


Strategic Opportunity Fund – Tidal Turbine Benchmarking project

- Community engagement project to **improve engineering models for turbines in highly complex flow environments.**
- Conducting detailed high quality experiments of a highly instrumented rotor.
- Towed through a 270m water tank in turbulence and wave conditions.
- Blind prediction exercises and workshops followed by staged release of data sets.



Strategic Opportunity Fund – Tidal Turbine Benchmarking project



Benchmarking briefing at EWTEC conference to kick-start the modelling work



Turbulence Grid Characterisation Experiment I

April 2021

Turbulence Grid and wave characterisation Experiment II

July 2021

EWTEC Conference
Blade Manufacture Complete

September 2021

Benchmarking Turbine Experiment

March 2022

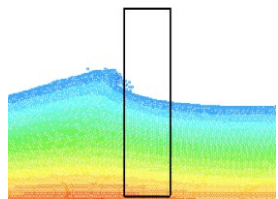
First Benchmarking Workshop (TBC)

June 2022

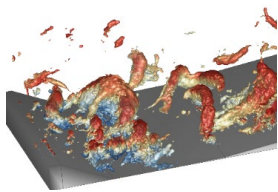
Theme B: Fluid Structure Seabed Interaction

Improved design tools

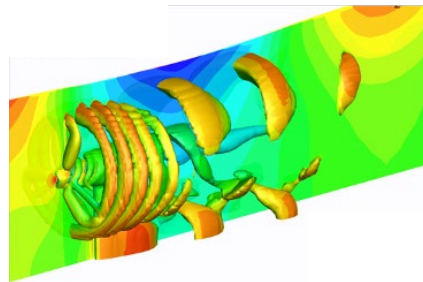
Existing models need to be improved and coupled to provide integrated whole system design tools



Lind et al. 2017

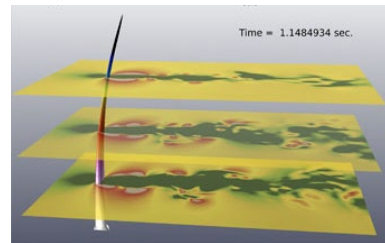


Ouro & Stoessor, 2019



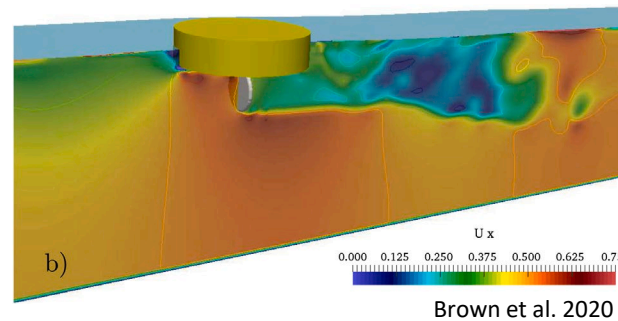
Rotor

Operating conditions
Rotor control
Blade dynamics

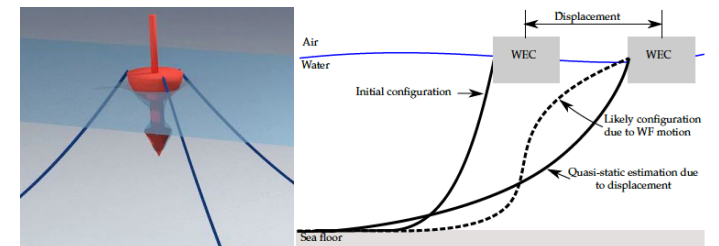


Non-linear coupled model of floating tidal platform

Wave forcing
Rotor forcing
Rotor plane damping



Brown et al. 2020



Davidson & Ringwood, 2017

Infrastructure

Mooring spread
Line characteristics
Anchors and connections

**AIM: To reduce unnecessary conservatism in design.
To enable efficient optimised designs.**

Theme B: Fluid Structure Seabed Interaction

Novel device concepts

Novel concepts, - **alternative turbine or wave device forms** - offer a disruptive step forward; To design for lower (for instance) velocity of flow whilst achieving economic viability.

Multi-purpose hybrid systems for ocean resources

Hybrid systems exploiting more than one ORE or ocean resource, raising utilisation of ocean infrastructure including floating platforms and export cables.

Design of reliable cabling systems

Improved **understanding of cable failure mechanisms** including cable-seabed interaction is needed to support ORE expansion.

Moorings anchors and foundations

Novel and higher performance mooring arrangements, lines, foundations and anchor systems to reduce the costs of support and station keeping, and to optimise the dynamic response of floating devices.

Theme B: Early Career Researcher Projects

- Development of Integrated Anchor model via Industry Engagement.
Katherine Kwa, University of Southampton
- Measuring Wave Modulation by a Large Offshore Wind Farm.
David Christie, Bangor University
- Analytical and experimental modelling of a floating/submerged elastic disk.
Siming Zheng and Simone Michele, University of Plymouth
- Investigating the installation of innovative suction caisson anchors to support offshore renewable energy structures, a feasibility study.
Moura Mehravar, Aston University

Theme B: Flex Fund Projects

- Impact of in-service oscillatory movement on insulation reliability of AC and DC cables serving offshore platforms.

Tony Lujia Chen, University of Manchester

- Cable scour from fluid-seabed interactions in regions of mobile sedimentary bedforms.

Martin Austin, Christopher Unsworth, Bangor University

- Submerged bi-axial fatigue analysis for flexible membrane Wave Energy Converters.

Mokarram Hossain, Swansea University

- Cost Effective Methods of Installing Offshore Wind Infrastructure.

Marcin Kapitaniak, University of Aberdeen

- SharEd Anchor Multidirectional Load Envelopes with Strength Synthesis (SEAMLESS).

Benjamin Cerfontaine, University of Southampton

ORE Research Landscape

- **What other research challenges or related challenges have arisen in this thematic area**, and what has emerged or changed over the last few years?
- **How do these changes or new areas of research relate to this research theme**, and do these developments relate to any of the other themes?
- What research in this area is a priority next and what is the likely impact on future work? How does the new research relate to this theme?