University of Southampton

SEAMLESS
SharEd Anchor Multidirectional Load Envelopes with Strength Synthesis

Supergen ORE Autumn Assembly

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Supergen Offshore Renewable Energy

Royal Academy of Engineering

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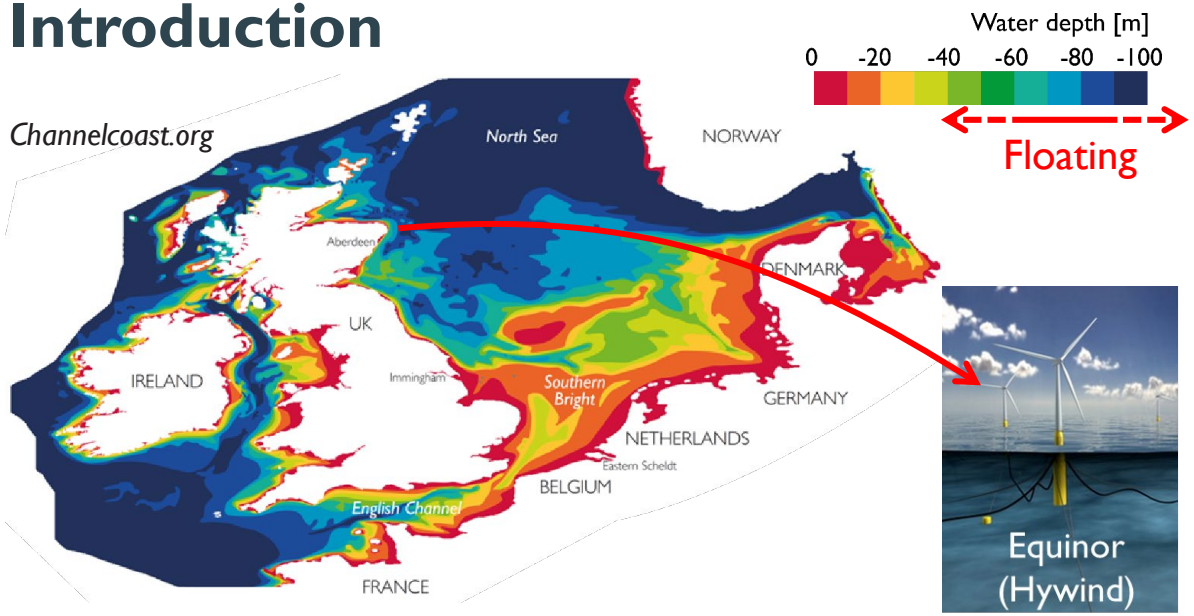
Floating wind challenges

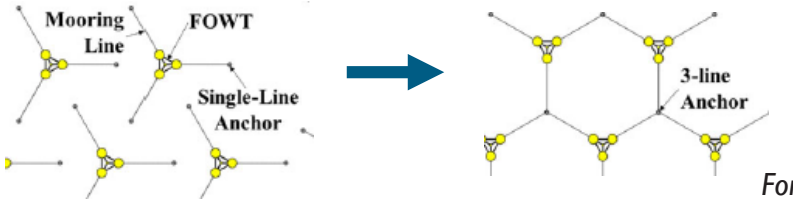
Introduction



Floating wind technologies are developing fast

- Adapted to great water depths
- Each floater is maintained by **at least 3** mooring lines (and **anchors**)

 # Anchors : ↘ 67%



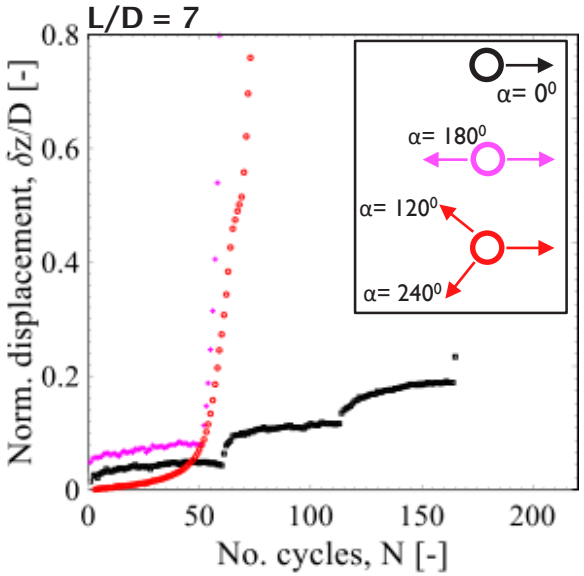
Fontana et al (2018)

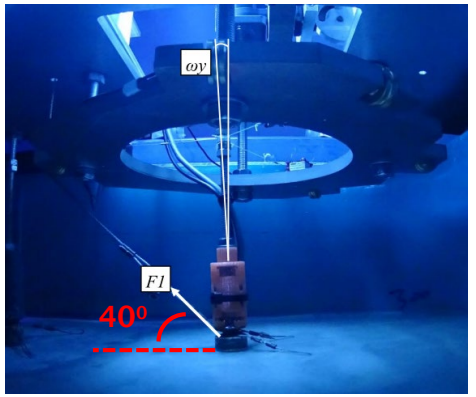
T_{PEAK} : ↘11-67%

- **Shared anchors** to reduce the overall mooring loads and costs
- Similar for floating WEC

Geotechnical ORE Challenges

- Cyclic loads on vertical and horizontal planes varying direction & magnitude
- Lateral-vertical interaction





Outcome:

- Varying directions and magnitudes of resultant anchor load out of plane (with load reversal)
- Adding (H, θ_h) to (V, θ_v) with >1 mooring lines results in excessive vert. displacements and ratcheting of the pile

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Goals

1. To identify a method for shared anchor **geometry optimisation**.
2. To develop new **design guidance**.

Research questions

1. What **threshold** level of **upwards cyclic load** can be sustained without significant ratcheting?
2. How does the stress history of **vertical-lateral load interactions** affect the capacity?

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Prof. Susan Gourvenec,

Chair of Intelligent and Resilient Ocean Engineering (IROE)

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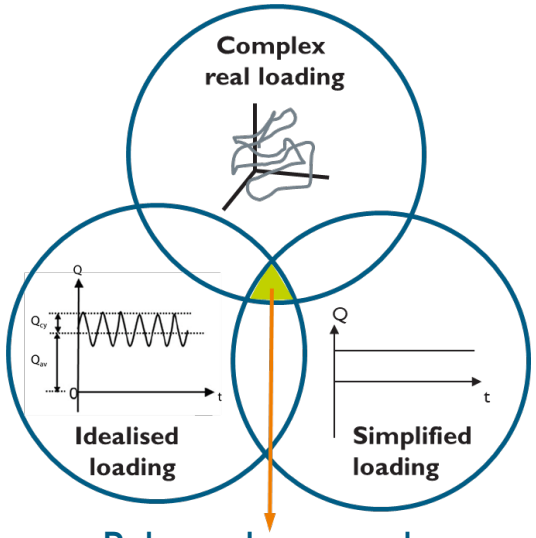
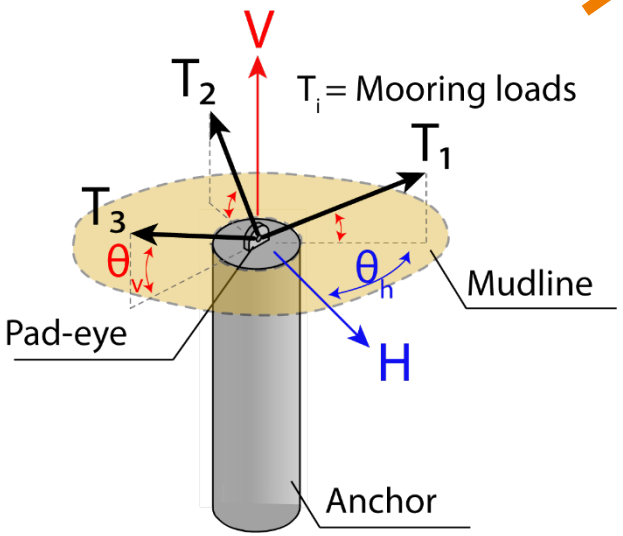
Physical modelling & Design framework



Balanced approach



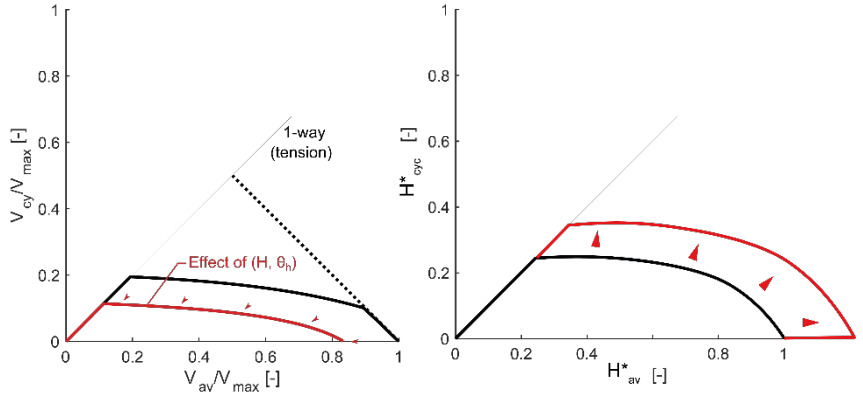
Loading reference frame

Centrifuge tests

Outcome:

- Sand material
- Monotonic, in-plane (I-P) & multi-directional (M-D) cyclic loading
- Control pile loads
- Measure displacements and rotations

Design framework

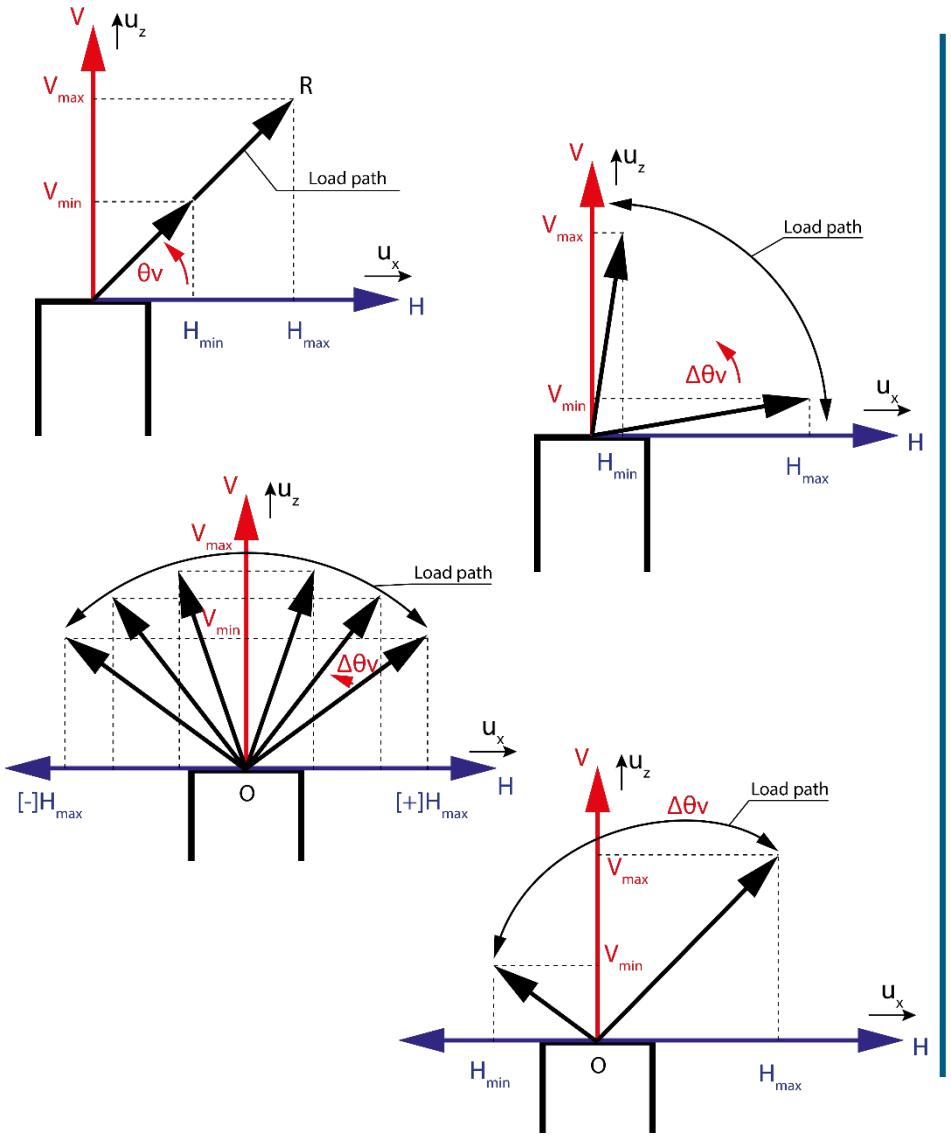


Outcome:

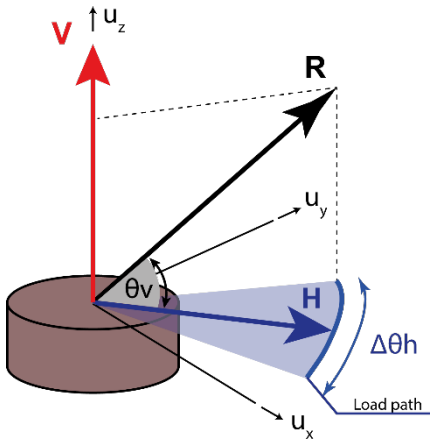
- Enhanced database of results
- Quantify safe V-H load combinations & amplitudes in single stability framework to avoid failure/ratcheting ('wiggling') with cycling

Loading scenarios

Phase 1 '2D' (I-P) M-D cyclic tests

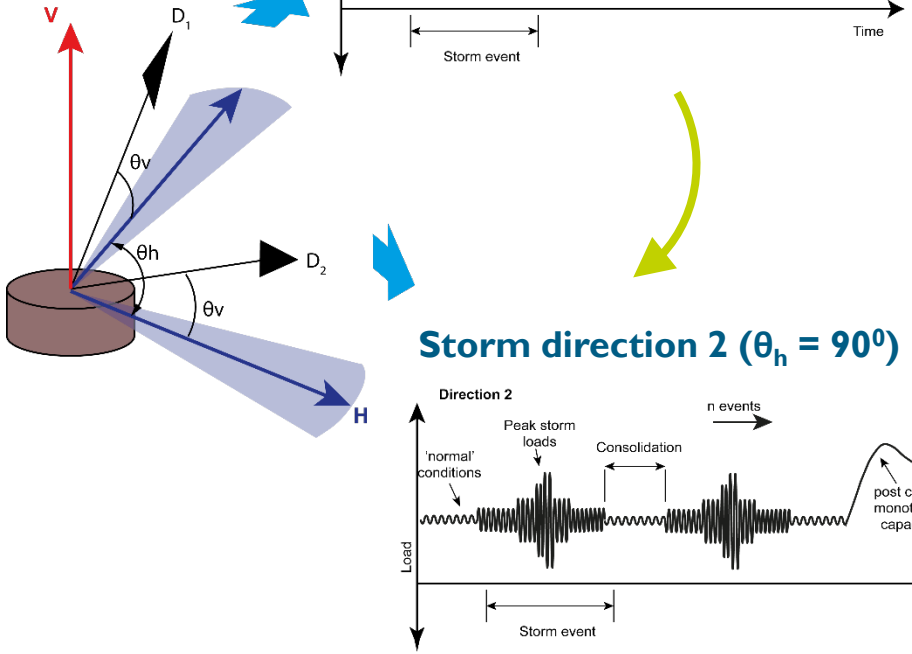


Phase 2: '3D' M-D tests



'Whole life' cyclic tests

Storm direction 1 ($\theta_h = 0^0$)

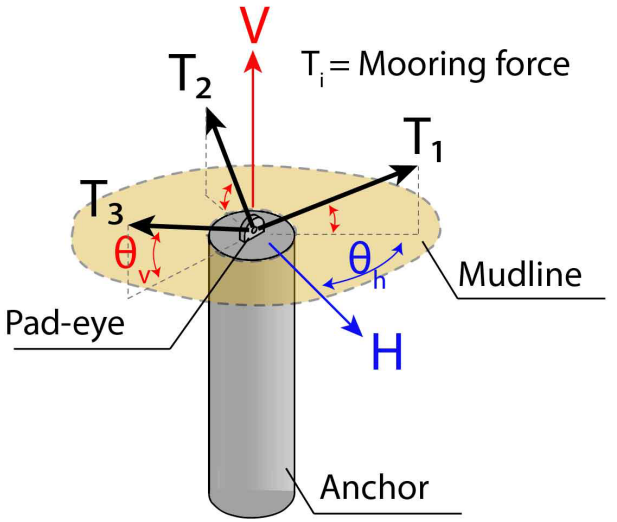


Storm direction 2 ($\theta_h = 90^0$)

Summary

SEAMLESS: addresses geotechnical challenges associated with shared anchors and multidirectional cyclic loading

1. Highlighted effect of adding (H, θ_h) to (V, θ_v) for shared anchors
2. Representative in-plane & multidirectional load scenarios to be modelled in the geotechnical centrifuge
3. Develop database to understand V-H interaction & degradation/improvement with cycling
4. Proposed design framework for shared anchors



Reach out if you would to know about project progress or discuss further:

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URL: https://www.southampton.ac.uk/iroe/projects/seamless.page

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Thank you