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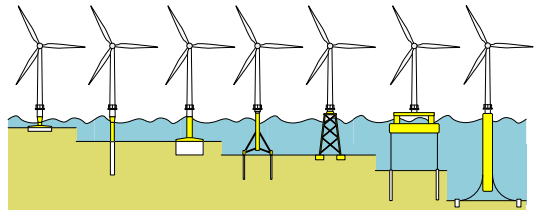
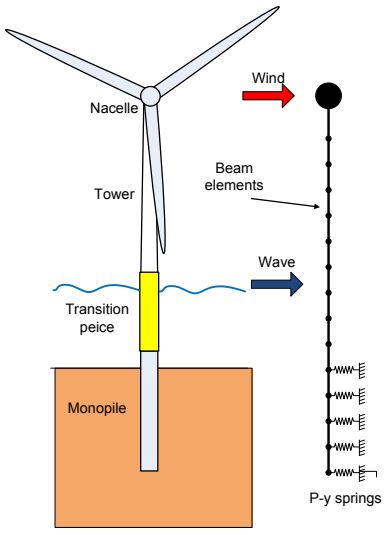
Wind Europe Bilbao
3 April 2019

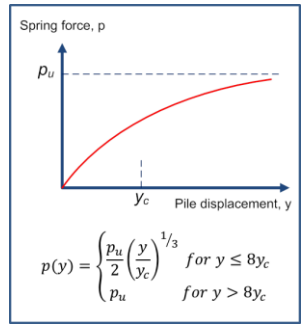
Integrated Structural and Foundation Monitoring for Offshore Wind Turbines

Byron Byrne and Anela Bajric-Hodzic

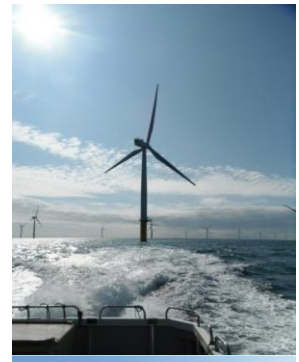


Monopile Design





Simplified soil-structure interaction models allow for the many calculations needed to optimise wind farm foundations



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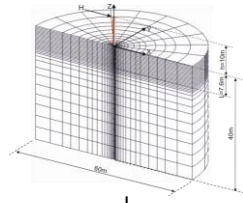
PISA Project – 2.5 years and £3.5m

3D FE

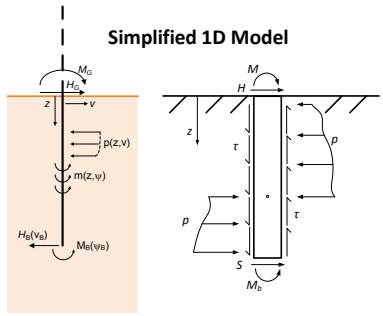


Design

Validate

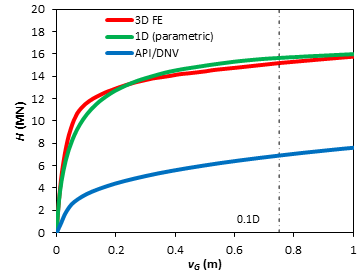
Field Tests - 2 Test Sites

Simplified 1D Model



Apply

Accurate Response Prediction



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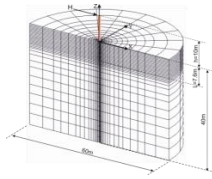
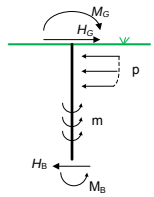
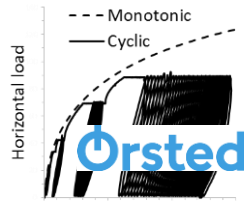
Initiatives from PISA

PISA





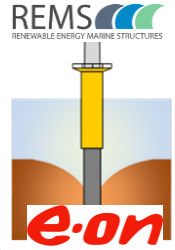
Cyclic Modelling



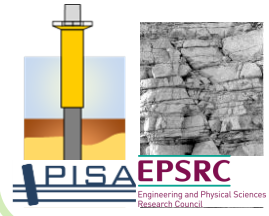
MoDeTo

Monitoring

Foundation Scour



Layered (PISA2) and Other Materials (ALPACA)



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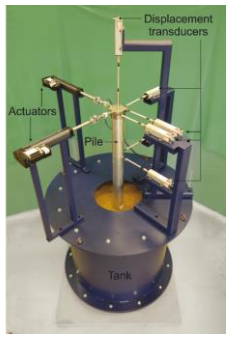
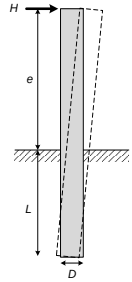
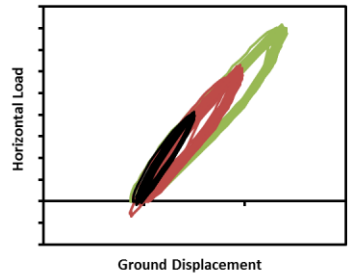
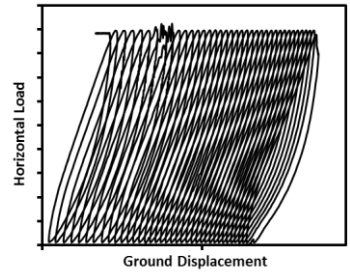
Cyclic Loading









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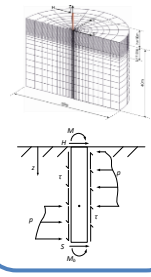
ROYAL ACADEMY OF ENGINEERING

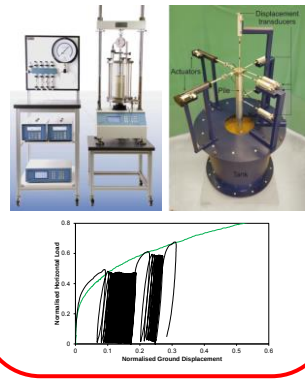
Ørsted

Oxford-Ørsted Project : 2018 to 2023

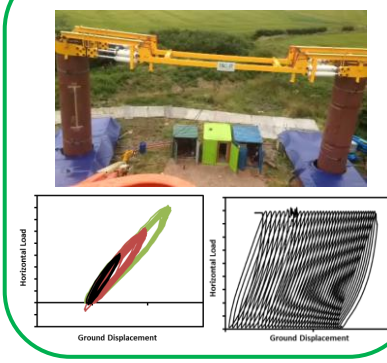
WP1: Modelling



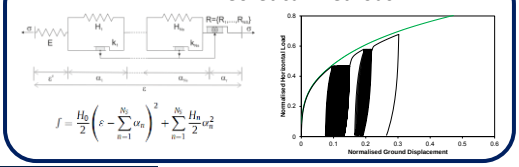
WP2: Laboratory Testing



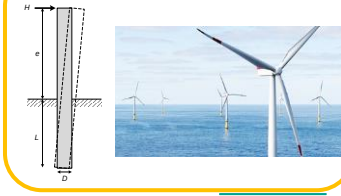
WP4: Field Testing



WP4: Theoretical Methods



WP5: Application to Design



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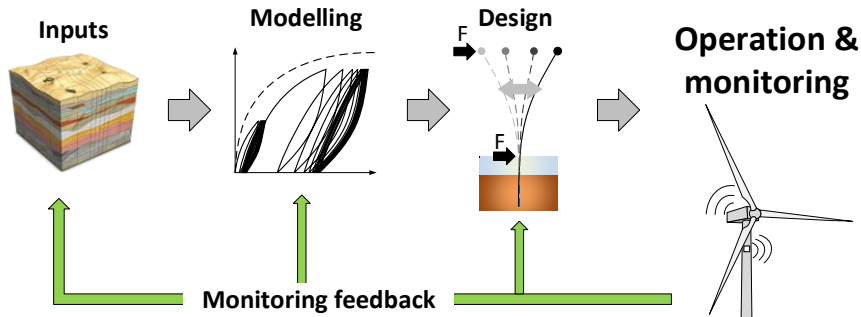
Monitoring Framework



Monitoring data allows

- ✓ support for implementing new foundation design methods
- ✓ verification response and load limits
- ✓ a reduction of periodic O&M inspections
- ✓ informed decision on life time extension

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Monitoring Analysis for Offshore Wind Turbines

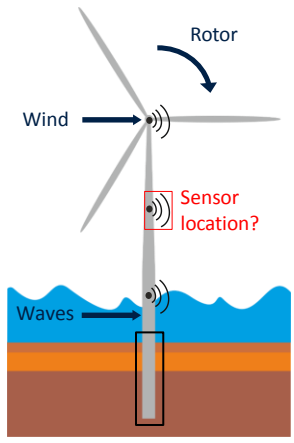
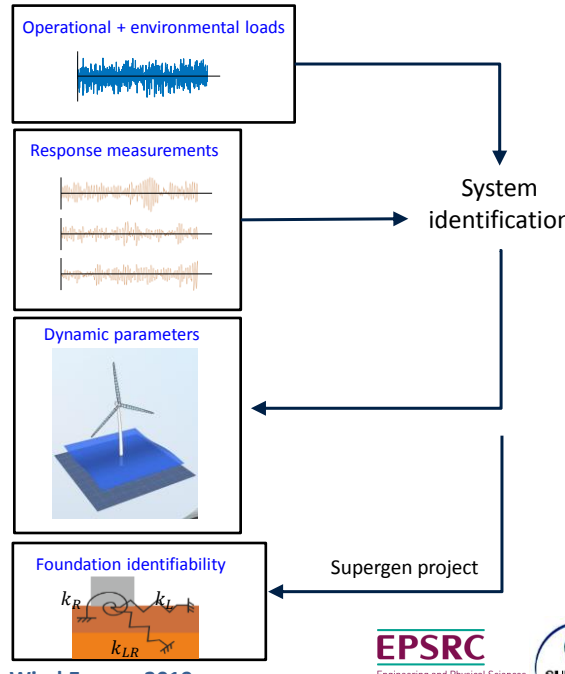


Figure Anderson 2019



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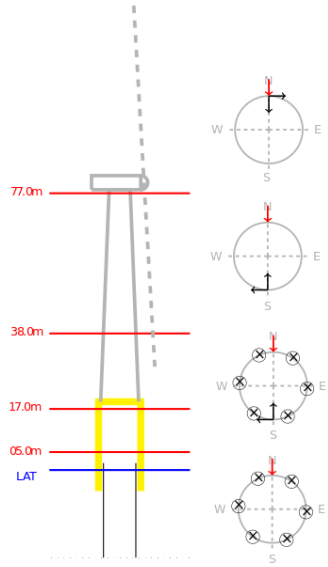
Example Data From Wind Farm



Typically few wind turbines in a farm monitoried

Monitoring above sea:
- Metocean data
- SCADA data
- Accelerometers
- Strain gauges

Monitoring below sea:
- Strain gauges
- Power and earth pressure
- Water temperature

Data summary at Nobel Wind:
100Hz sampling frequency
More than 50 channels
1TB/year

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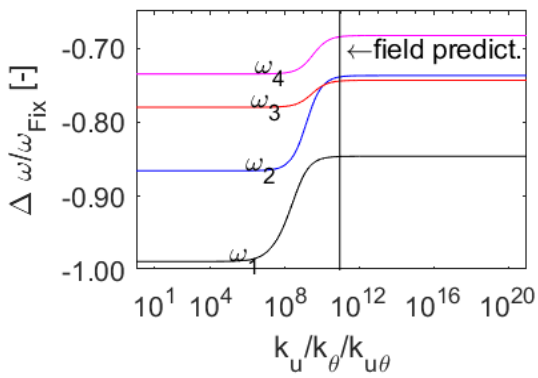
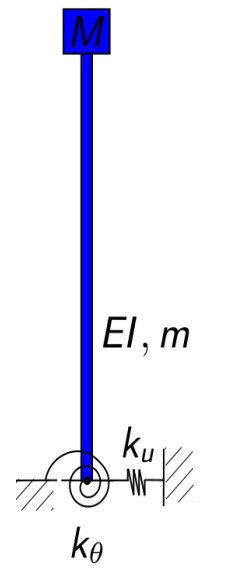
Analysis of Monitoring Data - Examples

Algorithm applicability to field data:
- Acceleration measurements at two locations (>10Hz sampling)
- Standstill conditions during monitoring period
- Known mass of nacelle-rotor assembly, structure and damper

Unique estimation of macro-element foundation





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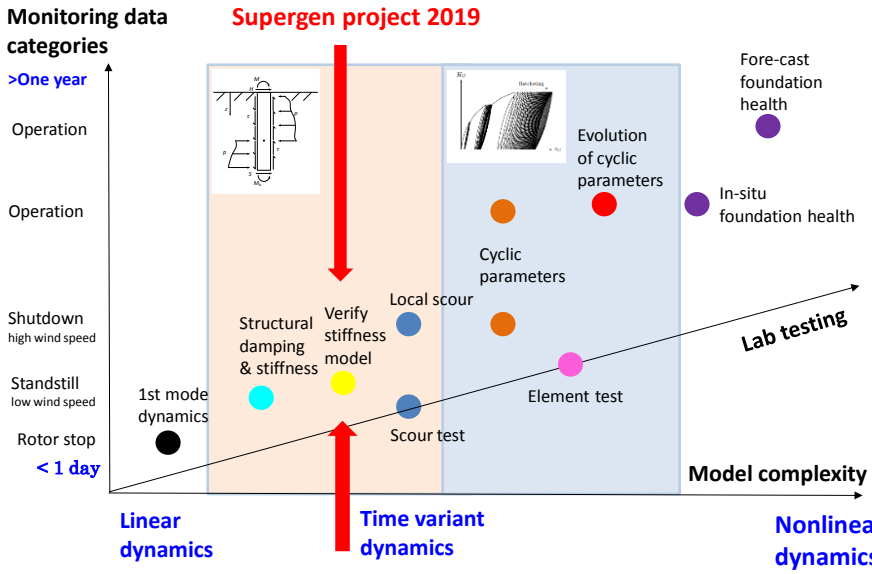
Future data assessed foundations



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Summary and Conclusions

Context:

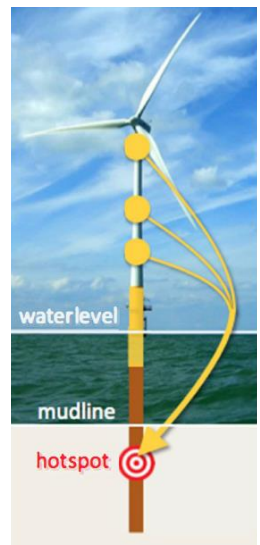
- New advanced site specific foundation design methods enable structural optimisation

Output of Supergen Project:

- novel algorithm for monitoring analysis of offshore wind turbine foundations.
- data-driven assessment of installed monopile foundations

Impact:

- Support for implementing new foundation design methods into engineering practice.
- a reduction of periodic O&M inspections
- informed decision on life time extension



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