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SuperGen ORE Hub
Annual Assembly 2019

Physical Testing and Control of Tidal Turbines

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The University of Edinburgh · University of Exeter · University of Strathclyde Glasgow · Swansea University Prifysgol Abertawe · Cardiff University Prifysgol Caerdydd · University of Oxford · University of Dundee · University of Southampton · Sea Change with Plymouth University

SuperGenTEC team

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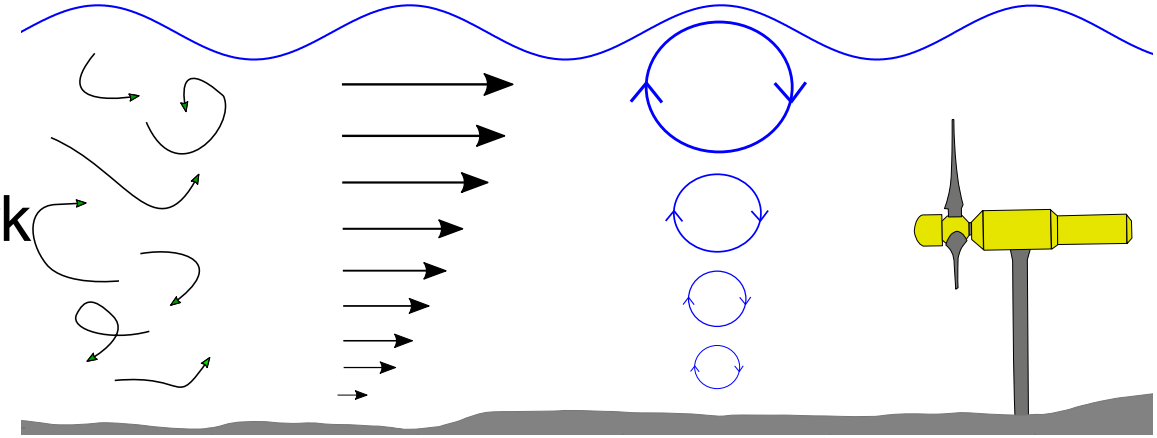
Edd Nixon
Donald Noble
Gregory Payne
Brian Sellar
Jeffrey Steynor

Programme objective

To explore through physical testing the interactions of tidal devices with:

- their energy fluxes
- each other
- the electricity network



to understand:

- cyclic and extreme forces acting on the turbine
- structural loadings

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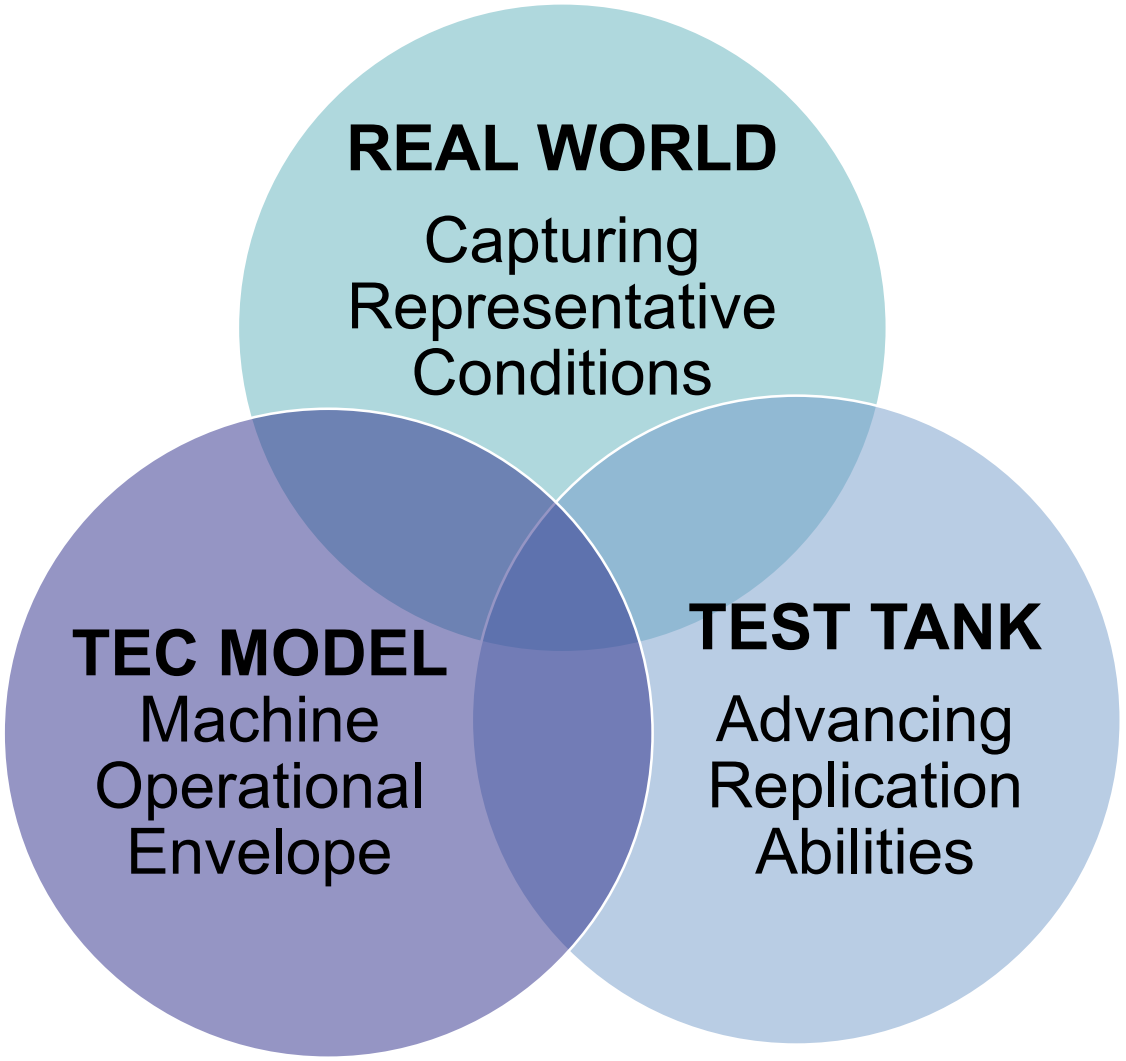
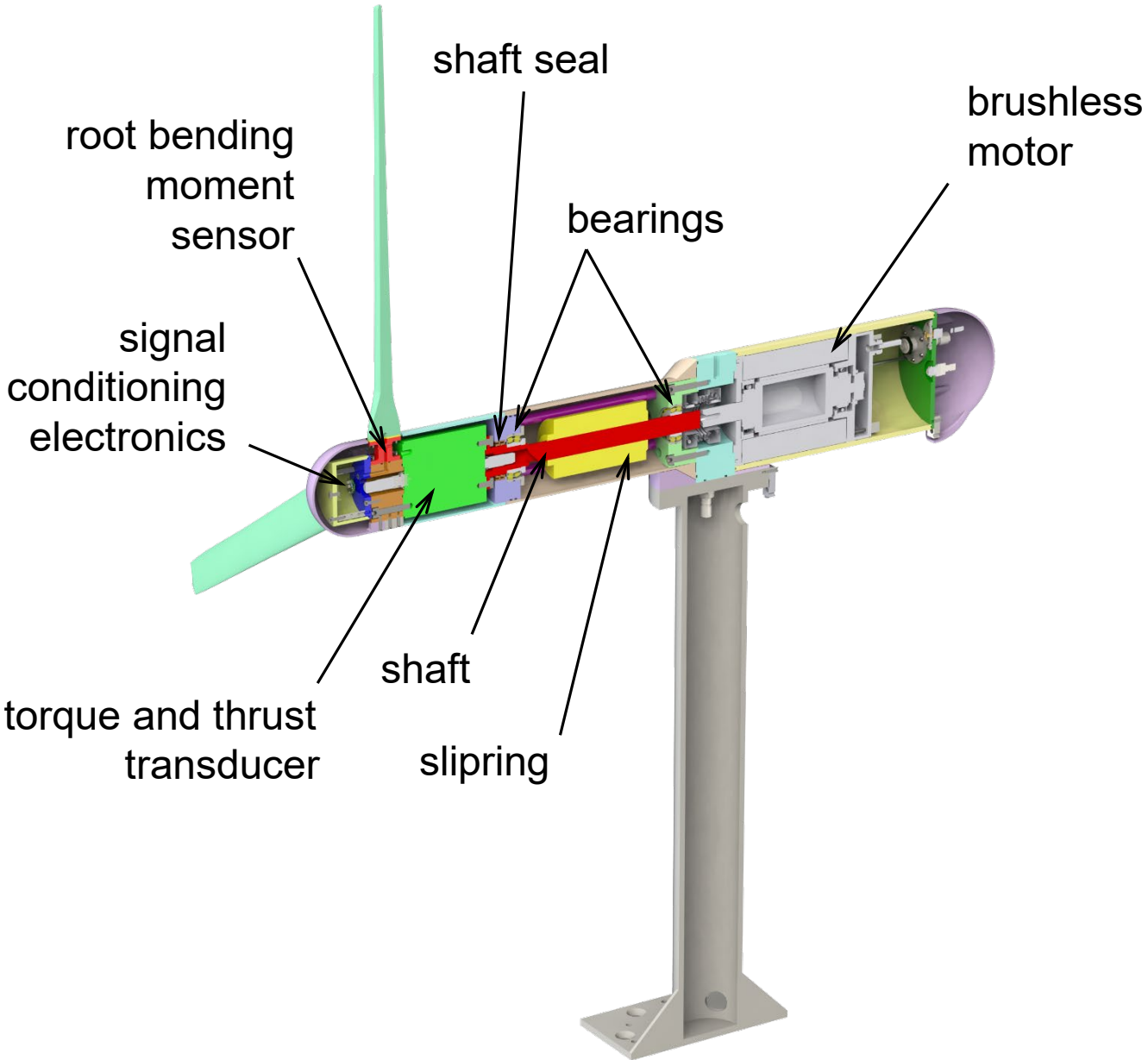


Turbine design

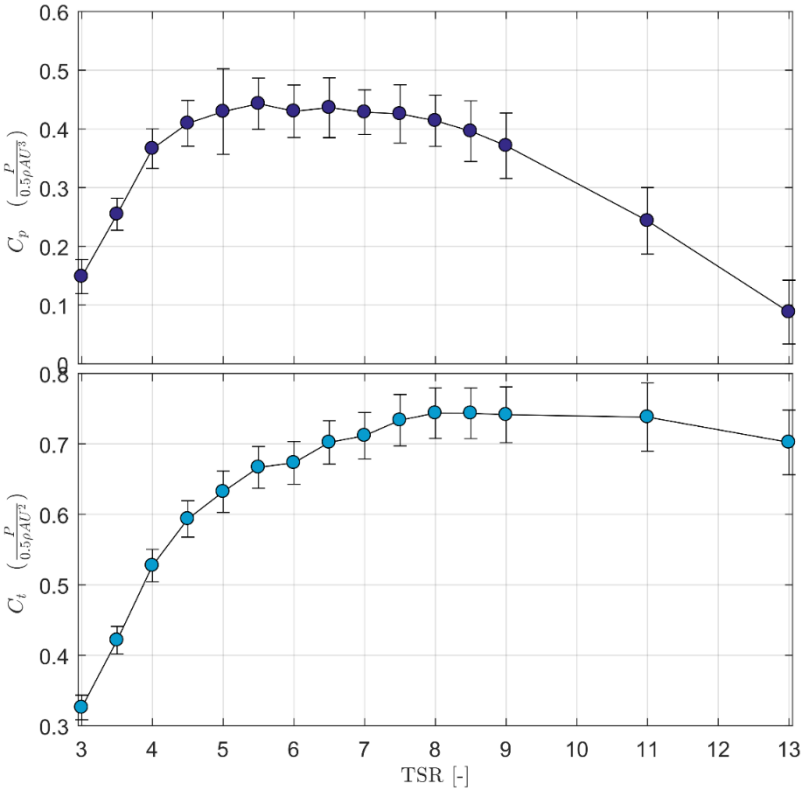
- 1:15 scale, rotor diameter: 1.2 m
- Similar radial variation of rotor thrust coefficient to full-scale generic turbine
- Instrumented, controllable
- Max continuous torque: 37 Nm

Turbine design



Snippets of tests – in current

- TSR sweeps - different flow speeds
- TEC control - different control parameters
- Flow measurements – instream flow, wake, near field z-profiles
- Array of two and three turbines



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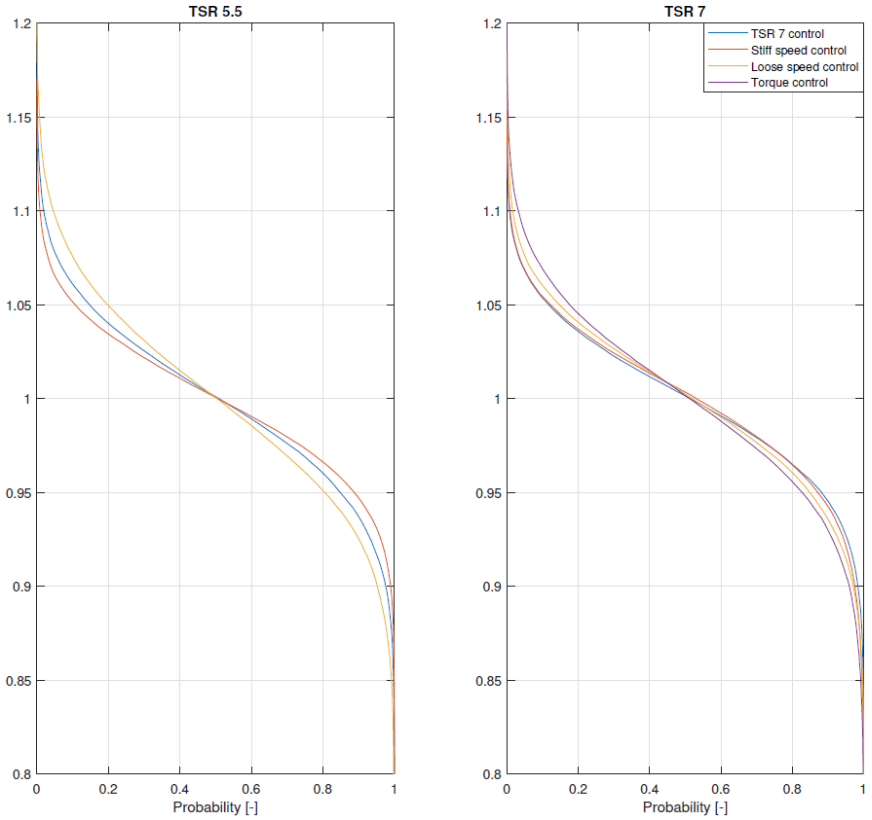

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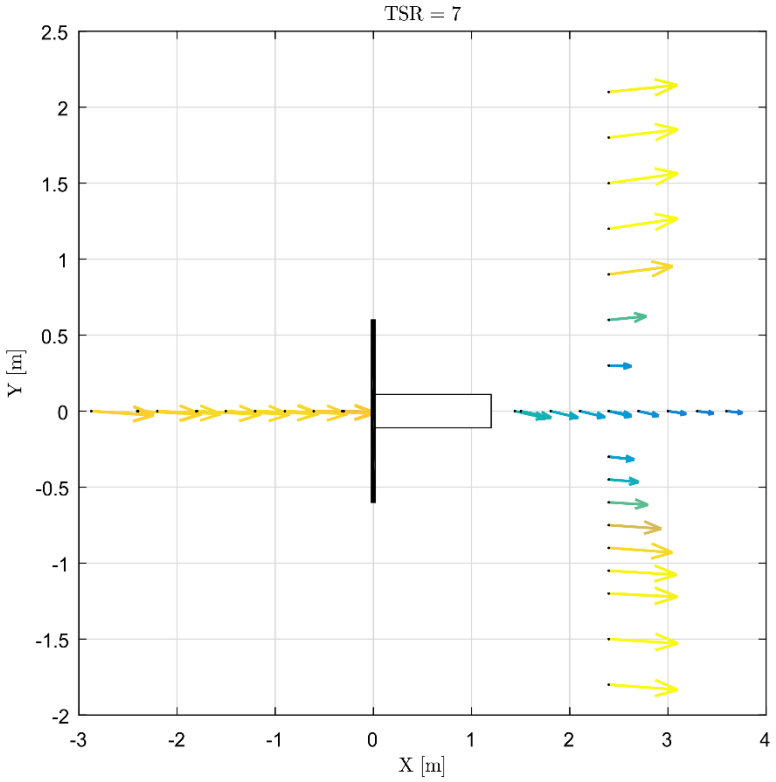

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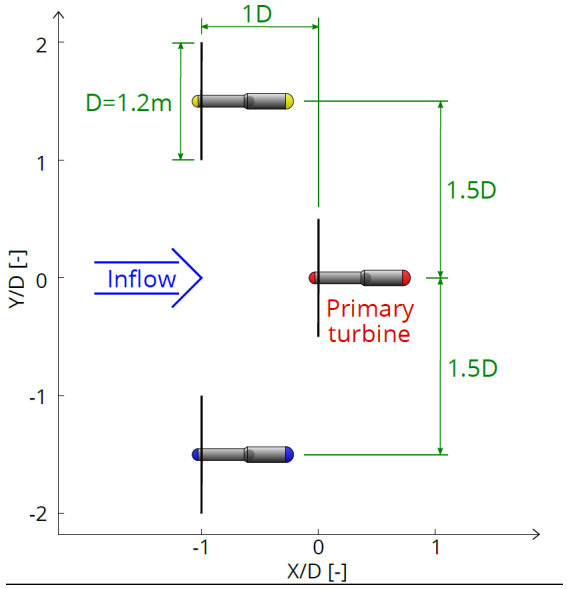

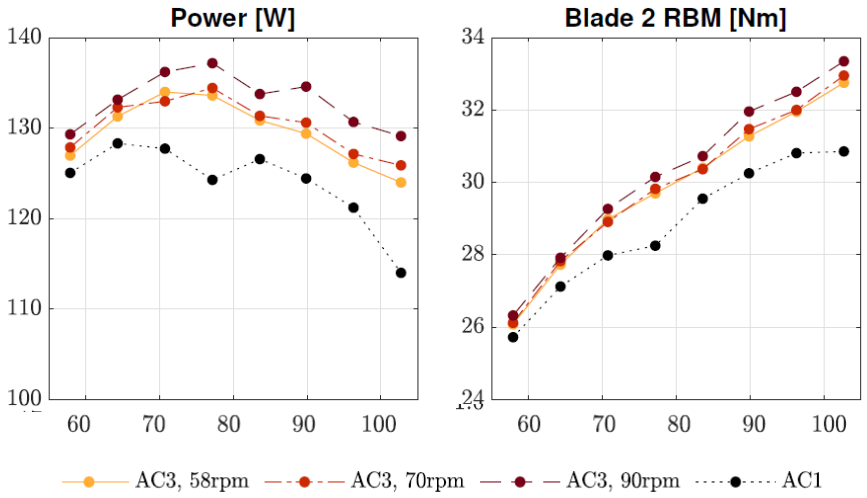

Snippets of tests – with waves

- Regular wave repeats to study loading
- Irregular waves - extended set and angles
- NewWave focussed wave groups
- Real-time control

Frequency [Hz]	Relative input wave height 0.25	0.5	1 (0.1 m)	1.5	1.75	2	2.25	4
0.308	X	X	X	X				
0.348			X					
0.4			X	X	X	X	X	
0.444			X					
0.5			X					
0.545			X					

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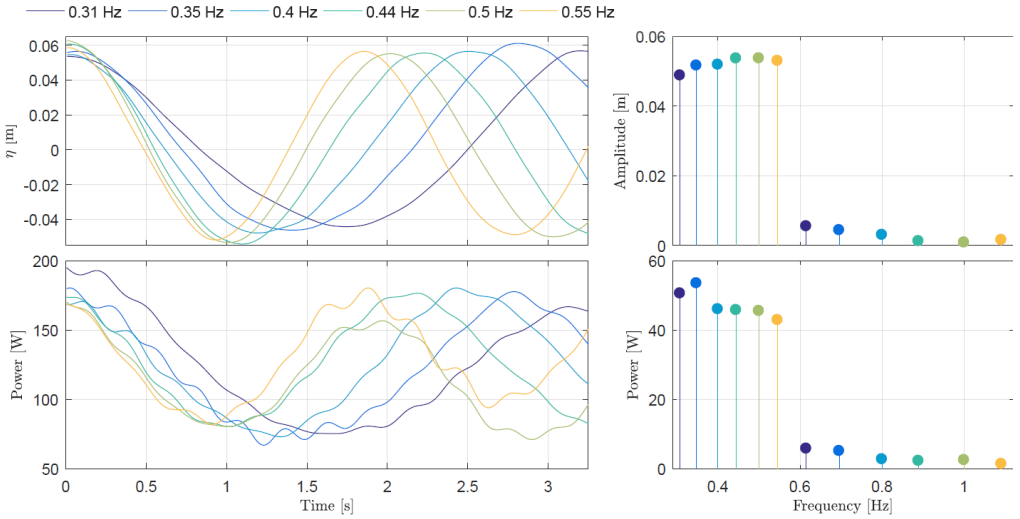

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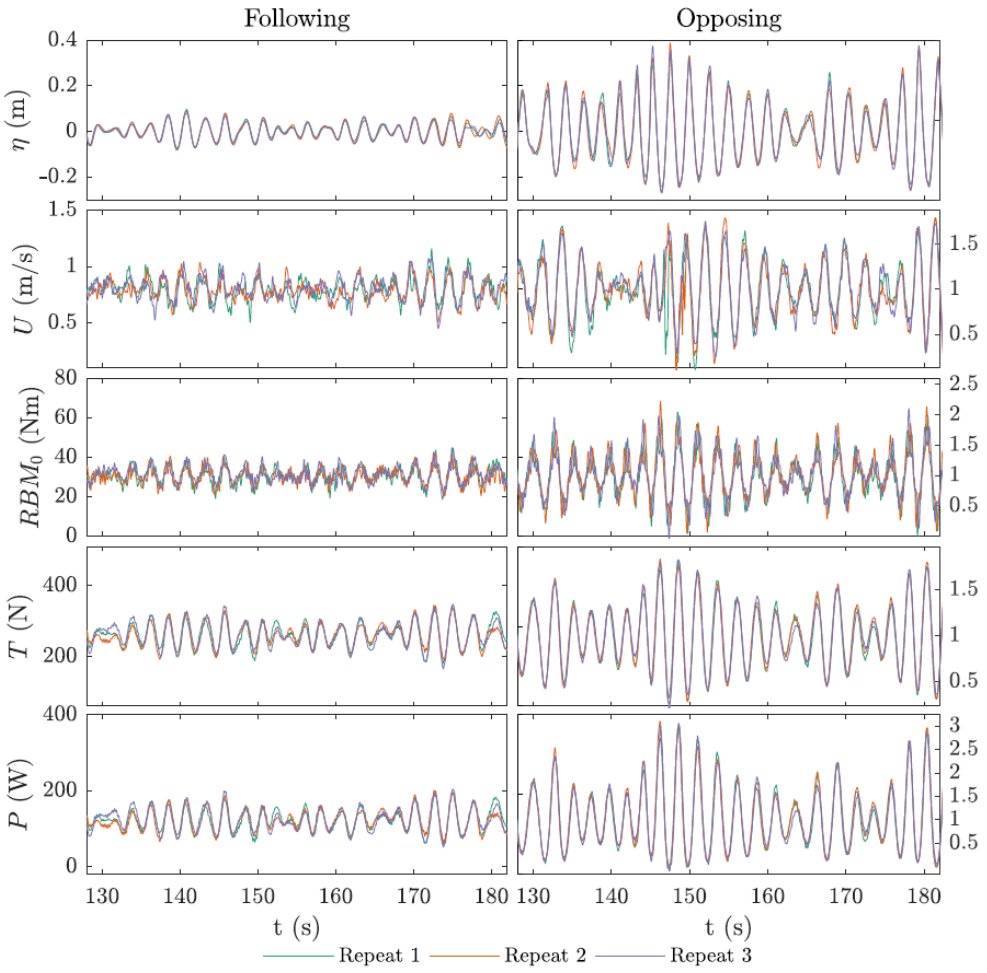

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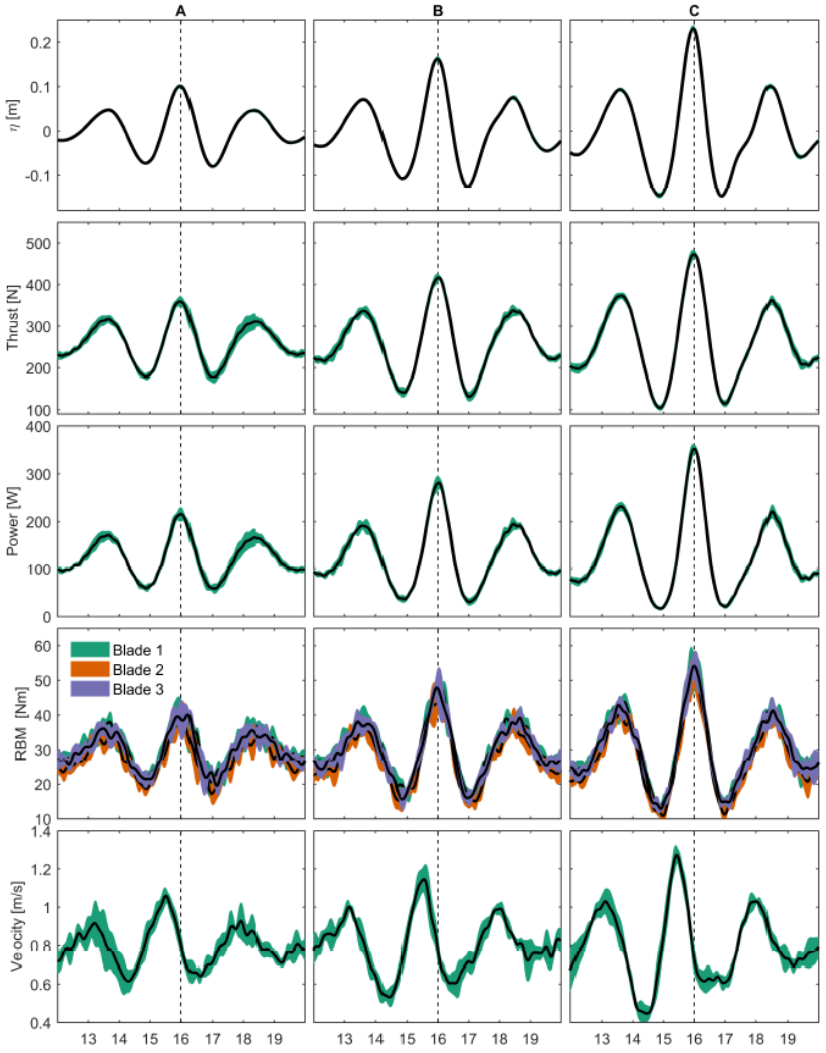

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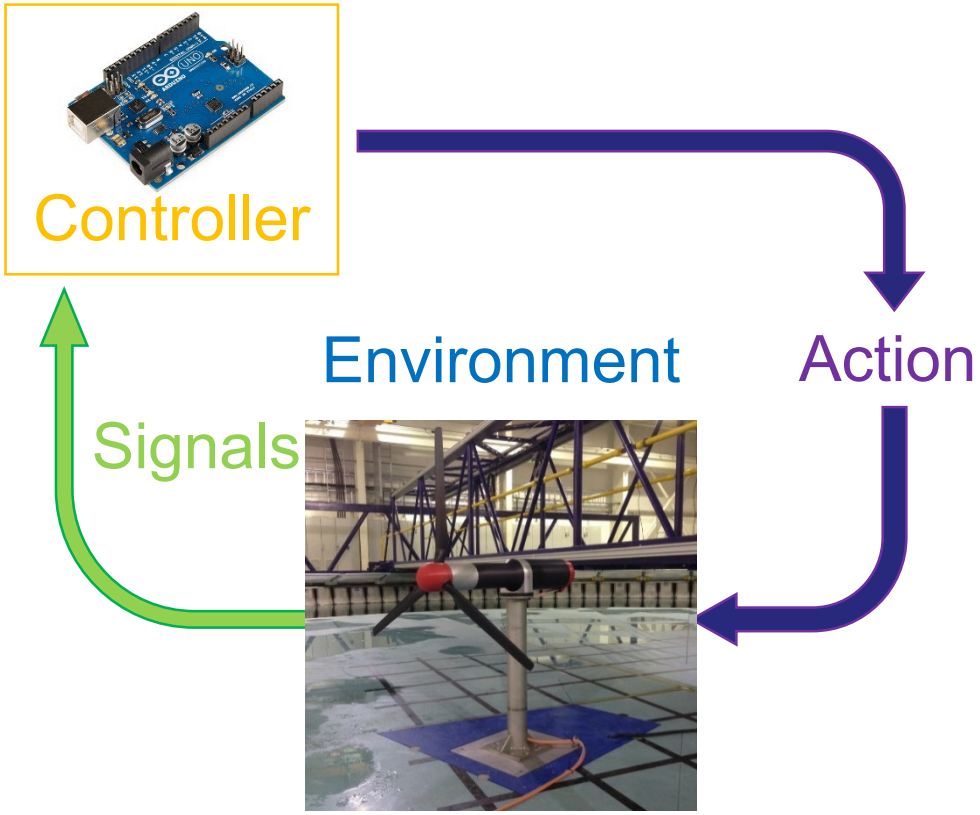

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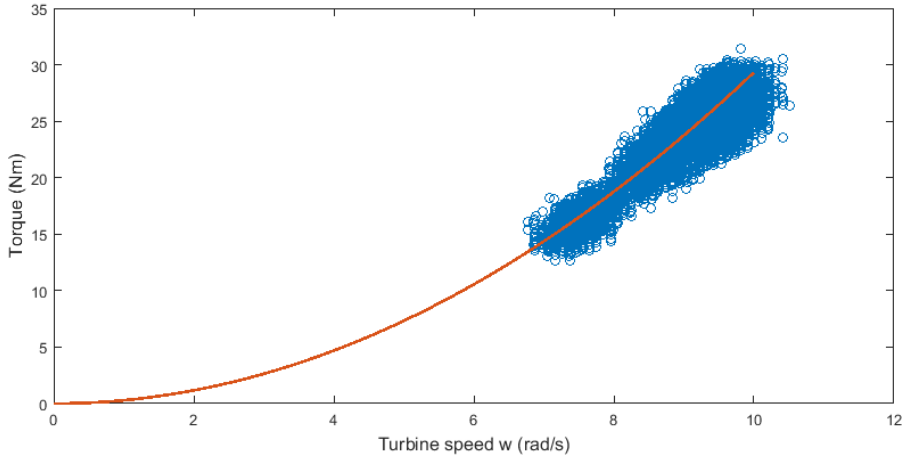

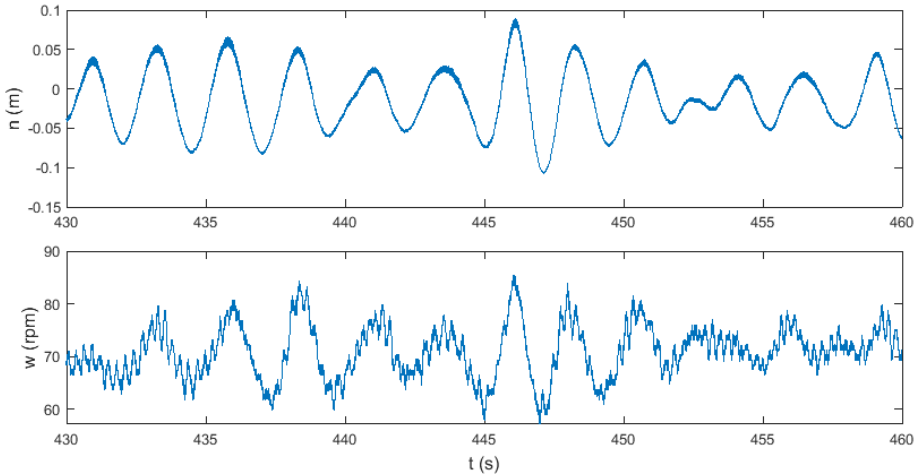

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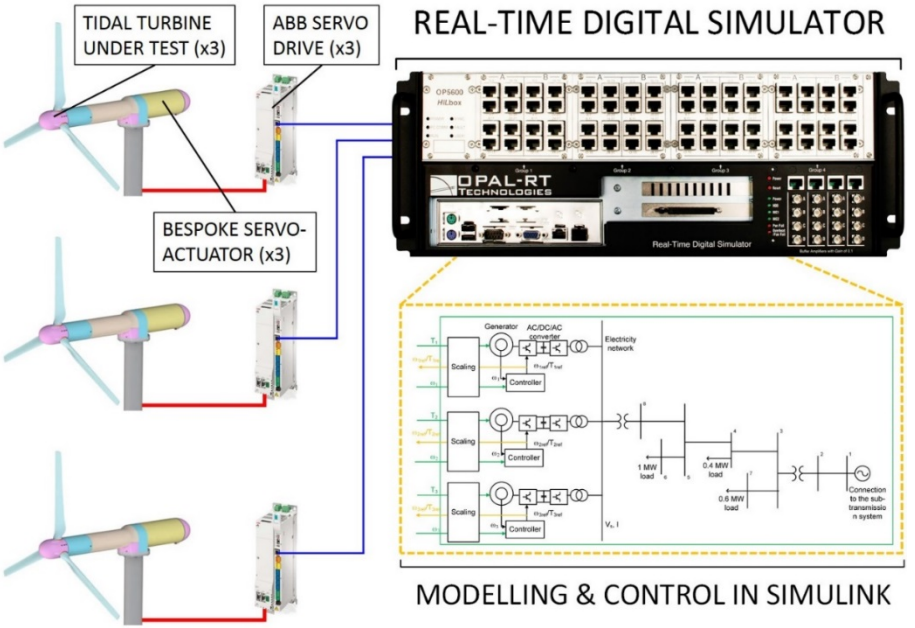

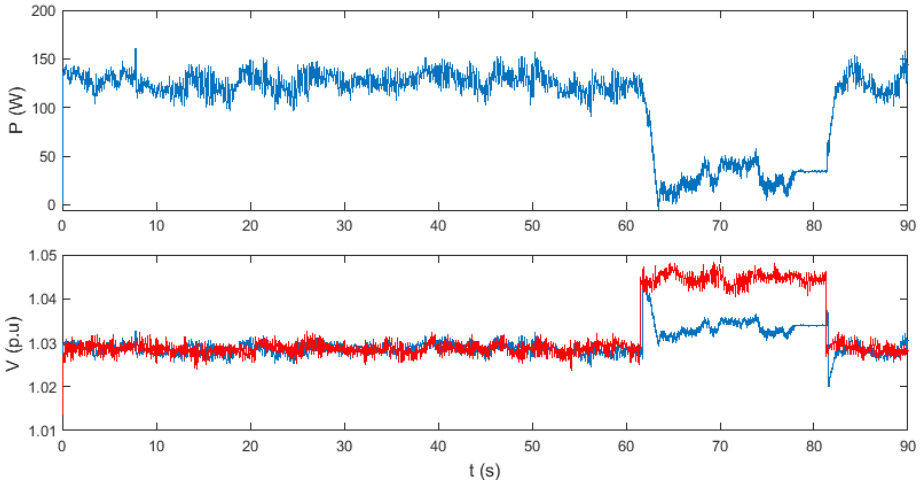

Summary and opportunities

Data of turbine loads and performance under a range of flow conditions, including in waves

Detailed inflow and wake maps for single turbine, two-turbine and three-turbine arrays

Three turbines and associated hardware available – possibility for use within other projects

Real-time controller allows the exploration of other control schemes