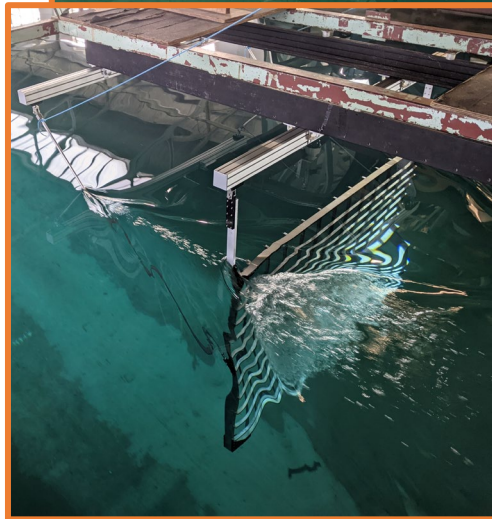
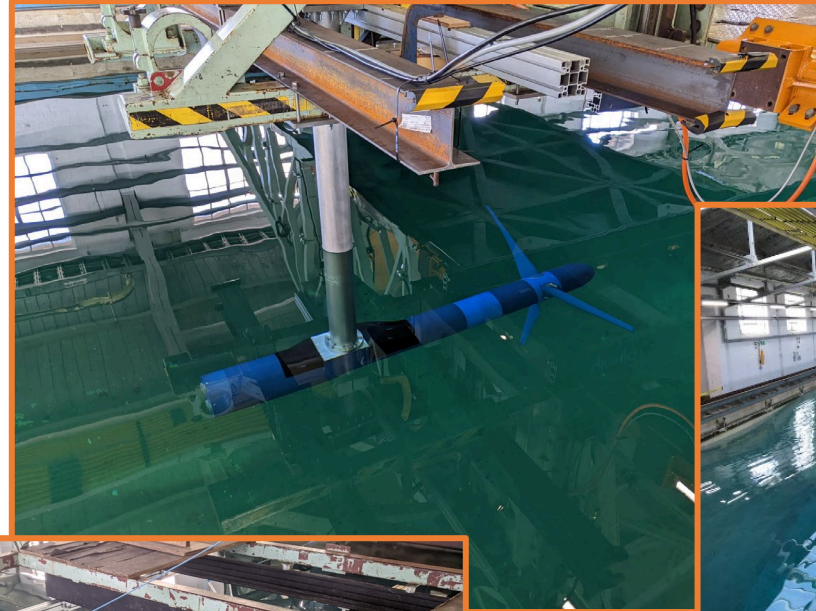


Tidal Turbine Benchmarking Project

- ***Unsteady loading and the inability to confidently predict unsteady loading and / or quantify errors drives unnecessary redundancy and design conservatism.***
- **Objectives:**
 - i. improve accuracy, confidence and define errors for modelling techniques,
- **Approach:**
 - i. Conduct a large laboratory test of a highly instrumented tidal turbine in waves and turbulent current to provide underlying data,
 - ii. Conduct a series of community wide (academia and industry) blind prediction exercises with staged data release, leading to an open access dataset

Pioneering pan-community project to accelerate modelling convergence and fidelity



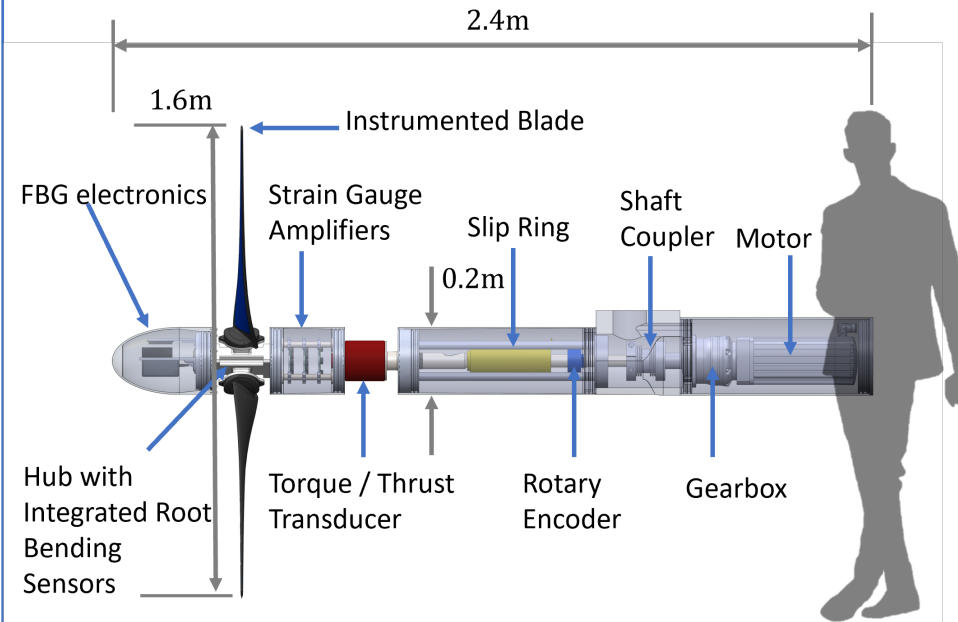
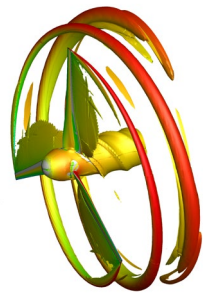
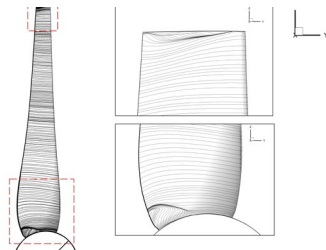
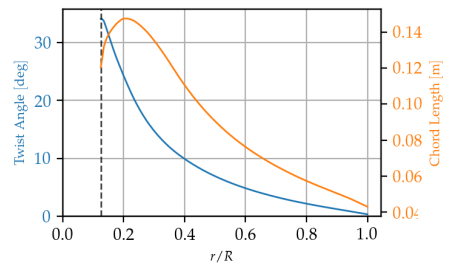
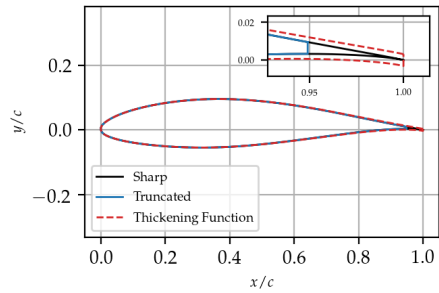
Experiments at QinetiQ, Haslar, Portsmouth UK:

- **Uniform flow**
- **Uniform flow + Grid generated Turbulence**
- **Uniform flow + Waves**

Benchmarking Project: Design and Experiments

Careful rotor hydrodynamic design.

- Uniform and well-defined profile.
- Post-critical blade $Re > 280k$.
- RANS-BE design and RANS MRF validation.

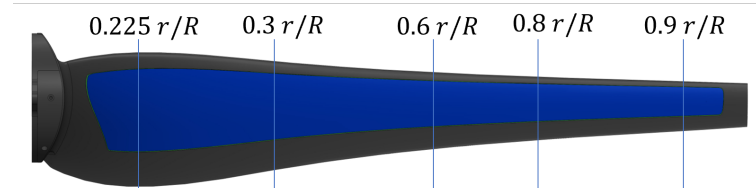
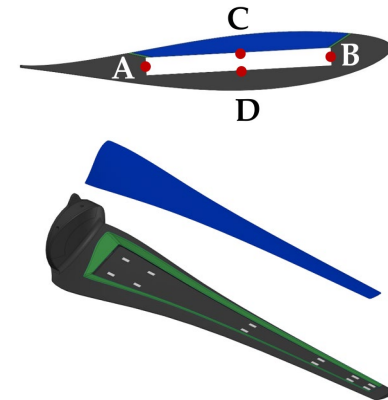


Design and experimental results published for blind prediction exercise.

<https://supergen-ore.net/projects/tidal-turbine-benchmarking>

Highly instrumented rotor

- Individual blade loads (flapwise and edgewise) measured by 100 strain gauges, 4 optic fibers.
- Torque and Thrust measured by shaft mounted transducer.
- Shaft rotary encoder for speed and position.

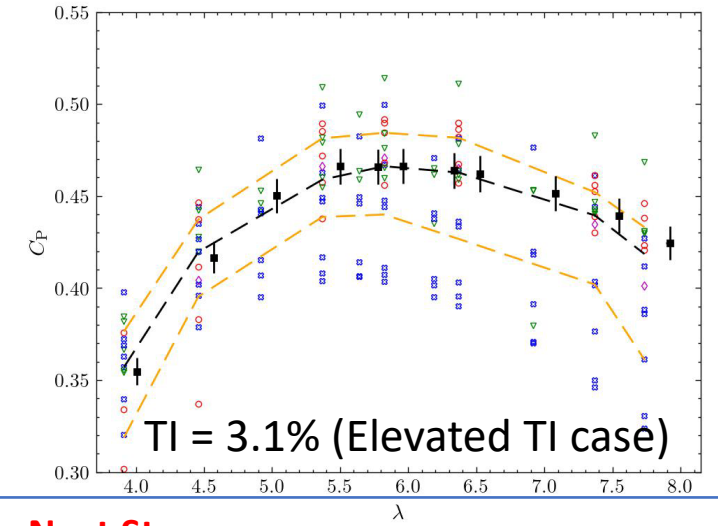
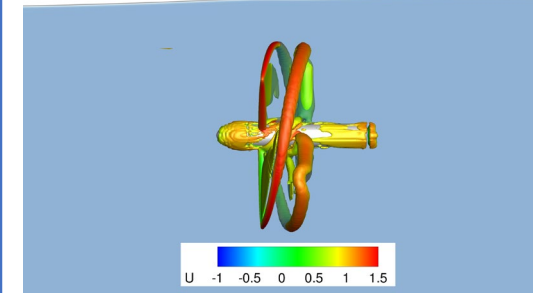
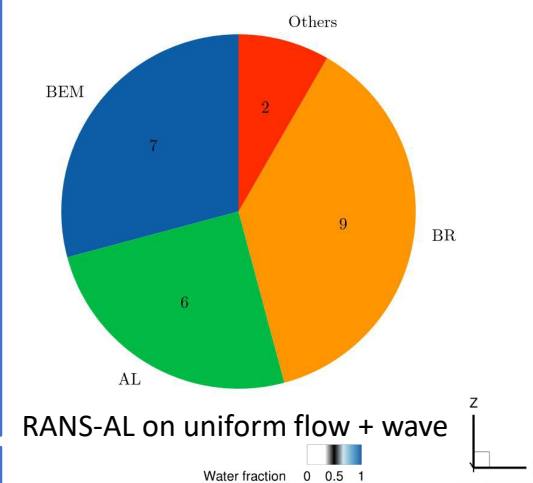


Benchmarking Project: Blind Predictions & Next steps

- 12 collaborating research groups
 - from across academia and industry
 - 6 countries: UK, France, Italy, Portugal, Brazil & USA
- 26 submissions from wide range of methods:
 - Blade Element Momentum (BEM)
 - Actuator Line (AL) (uRANS/LES)
 - Blade Resolved CFD (BR) (RANS/uRANS/DES)
 - Boundary Integral Equation Model (BIEM)
 - Vortex Method

➤ Achievements:

- Experiments and measured data are validated to be a **go-to data resource for future modellers.**
- Quantifiable **improved confidence** provided in simulation model application.
- **Better understanding** of effects of sub-models on simulation results.



➤ Next Steps:

- **Further experiments and blind prediction exercises** are to be carried out on cases of **uniform flow + waves.**
- Currently **2 cases with waves** are available.
- **Further experiments** booked in Dec 2024.

Project Timeline

