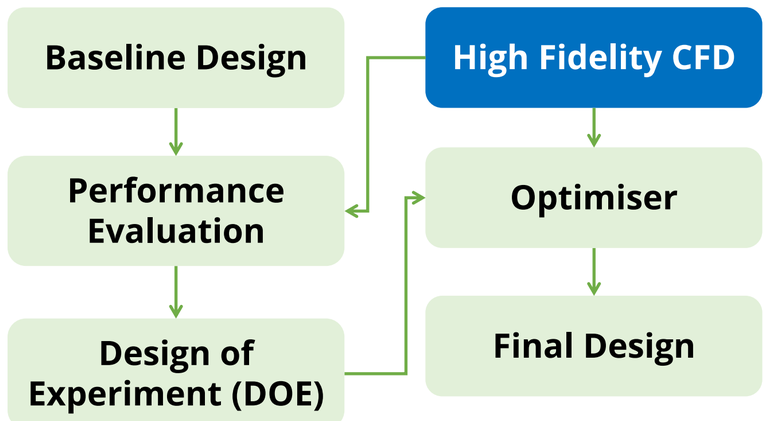
Bi-directional Tidal Turbine Design and Development

CFD-assisted Design and Optimisation Framework

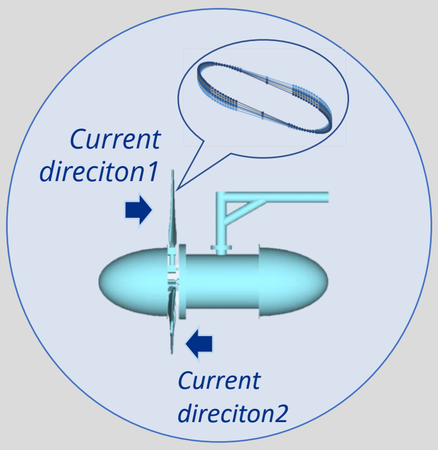
Starting from a baseline design, design of experiments (DOE) are carried out to optimise in order to maximise the turbine performance, at the same time, to minimise the vortex shedding and the wake zone, and avoid their effects on the structure health and turbine performance for energy harnessing.

Performance characteristics of a tidal turbine are analysed by physical tests which are costly. Numerical analysis using high fidelity **Computational Fluid Dynamics (CFD)** simulations could be an important and cost-effective alternative, as well as to provide more flow field details.

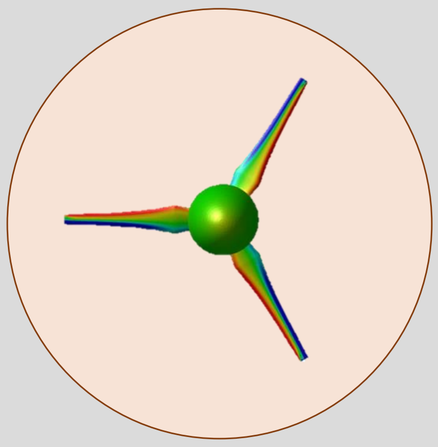


Workflow of CFD-assisted Design & Optimisation

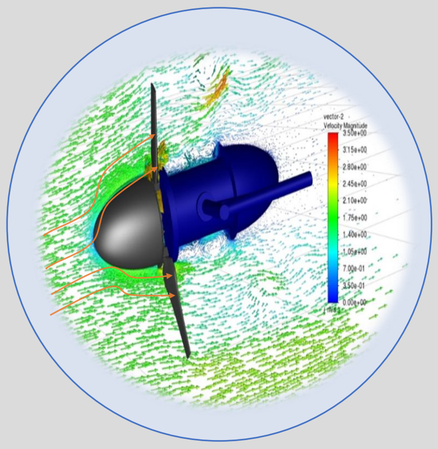
Bi-directional Tidal Turbine Design



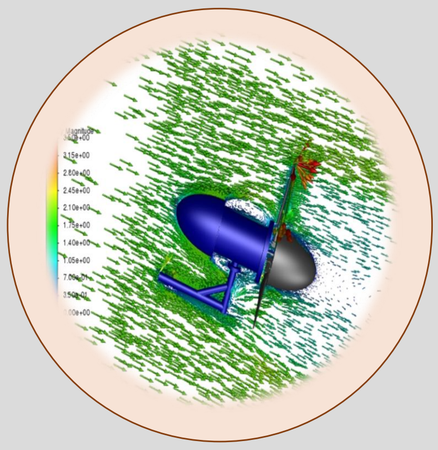
❑ Hydrofoils – Fully symmetrical to harness energy from both ebb and flood tides



❑ Blade design – Specifically designed to avoid any occurrence of mixing flow along the blade length

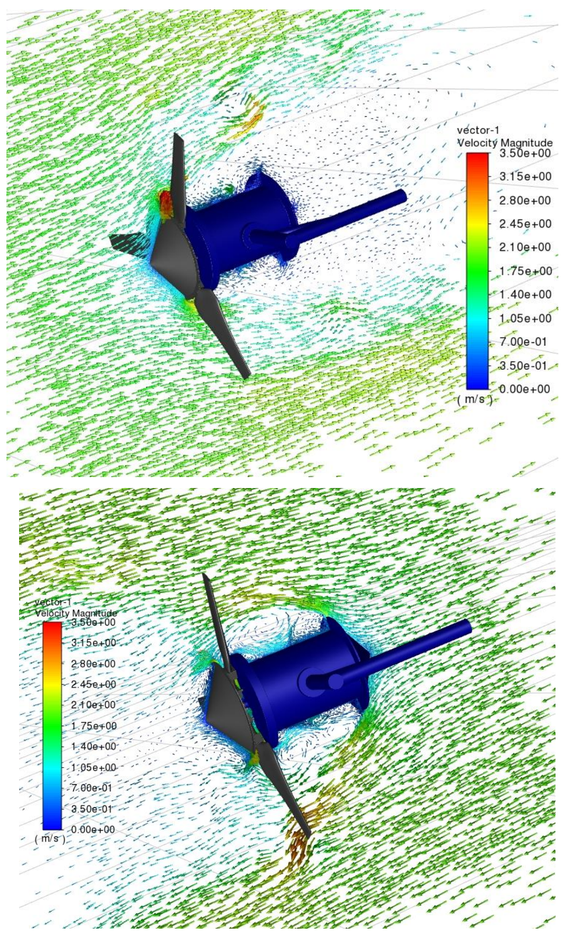


❑ Hub design – Streamlined shape to reduce the drag



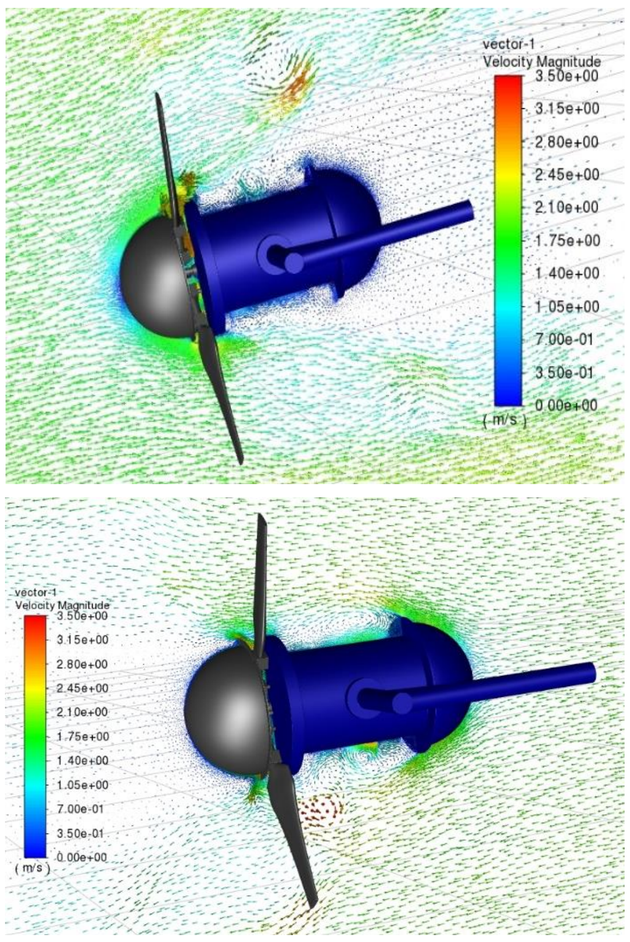
❑ Tail plug – Designed to ensure smaller wake zone with less unsteady vortex shedding

Cone Shape Hub/Tail-plug



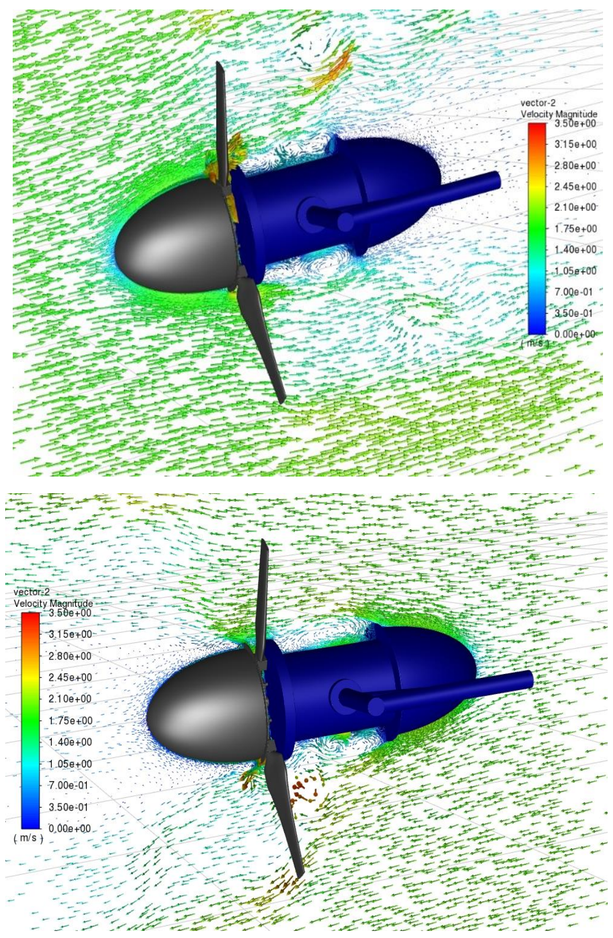
✓ **Compact**
– **Fluid flow turns outwards along the hub surface and causes the blades operating off-design attack angle**

Semi-spherical Shape Hub/Tail-plug



✓ **Fluid flow goes along the hub surface, and enters the blades plane parallel to the axial direction**
– **Big wake zone**

Semi-spheroid Shape Hub/Tail-plug*



✓ **Fluid flow goes along the hub surface, and enters the blades plane parallel to the axial direction**
✓ **Small wake zone**

*This tidal turbine is installed to supply clean tidal energy to the Raffles Lighthouse [https://www.straitstimes.com/singapore/environment/trial-to-power-up-parts-of-raffles-lighthouse-with-tidal-energy]

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Acknowledgement
This project is jointly developed by A*STAR's IHPC and Bluenergy.

Institute of High Performance Computing
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