Fortissimo Success Story

Cloud-based optimisation of a multi-body wave energy device

Fortissimo Experiment Facts:
- Industry Sector: **Maritime, Civil Engineering**
- Country: **United Kingdom**
- Software Used: **OpenFOAM**

ORGANISATIONS INVOLVED

Zyba is a UK registered SME with expertise in digital and numerical modelling. Since 2014, Zyba's primary goal is to engineer beautifully simple systems that work with nature. Together with BioRock Technology, Zyba is harnessing wave energy to protect coasts from erosion, enhance coral reefs and deliver sustainable power. HPC resources and expertise in this experiment were provided by Arctur.

THE CHALLENGE

Waves are the primary cause of erosion, yet they carry a readily accessible supply of energy. Zyba's core product, CCell, is a curved wave energy converter designed to be efficient, light, and simple to assemble and operate. CCell moves with the waves to simultaneously extract their energy and reduce their impact on the beach, while generating electricity.

BioRock reefs are wire mesh frames that can be built in any shape or size. Secured to the seabed, they use the safe, low-voltage electrical charge from CCell, to form limestone rock from seawater minerals. These reefs provide a habitat for corals to grow at an accelerated rate, creating an active breakwater to protect shores from erosion and enhance beaches.

Optimisation of the CCell device for each site is heavily dependent on the local wave resources and bathymetry. However, modelling waves is a computationally intensive task, requiring computational simulation in excess of most SMEs' budgets. Physical testing is a potential alternative, but it is also expensive and the limited availability of facilities constrains the rate at which tests can be undertaken.

THE SOLUTION

Simulations of the CCell device in different incoming wave conditions were carried out using OpenFOAM on an HPC machine. An easy-to-use GUI was developed which allows simulations to be set up quickly, with a series of scripts/tools written to streamline the workflow on the HPC system.

The increased computational power also allowed the whole CCell system to be modelled for the first time, including power-take-off hardware, software, and the intended control logic. This provided new insight into how the different pieces of the system work together.
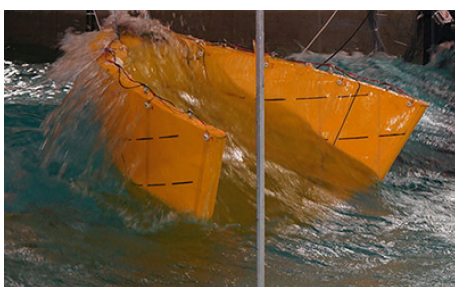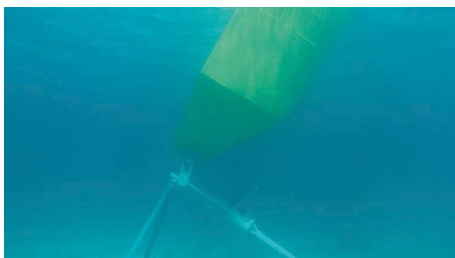
BUSINESS IMPACT

As a result of the experiment, Zyba has been able to increase its productivity, and deploy a series of pilots offshore. The automated and streamlined design process enabled it to rapidly optimize each design, reduce design costs and development time. With the new GUI, less experienced users can now complete design tasks, which empowers individuals within the team and increases the rate of innovation. Overall the new system has enabled Zyba to significantly speed up its market entry (saving perhaps 9-12 months), and will continue to facilitate the evolution of future products and service offerings.
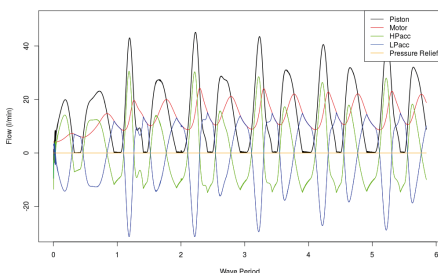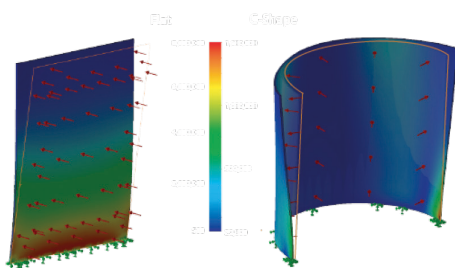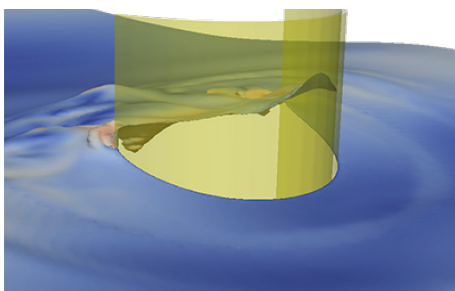
Provision of resources from an HPC centre transforms an imposing capital expense to a more manageable operating cost. Administrative tasks associated with IT management and upgrades are also effectively outsourced, alleviating pressure on a small SME team and reducing interruptions to design work.

BENEFITS

- Reduced simulation set up time from 2 hours to less than 1 minute.
- Mitigated use of phyiscal modelling, providing a ninefold reduction in cost.
- Reduced HPC costs from 0,09€/core-hour to 0,05€/core-hour as all software used was open source.
- Ability to concurrently run simulations improved productivity by a factor of 7

THE FORTISSIMO PROJECT

Fortissimo is a collaborative project that enables European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure. The project is coordinated by the University of Edinburgh and involves more than 100 partners including Manufacturing Companies, Application Developers, Domain Experts, IT Solution Providers and HPC Cloud Service Providers from 14 countries. These partners are engaged in over 90 experiments (case studies) where business relevant simulations of industrial processes are implemented and evaluated. The project is funded by the European Commission within the 7th Framework Programme and Horizon 2020 and is part of the I4MS Initiative.