



HPE Discover 2024
The Sphere, Las Vegas

**Accelerate
innovation with
world-leading
supercomputing**

18th June



Trish Damkroger

SVP of HPC & AI
HPE



Dr. Prith Banerjee

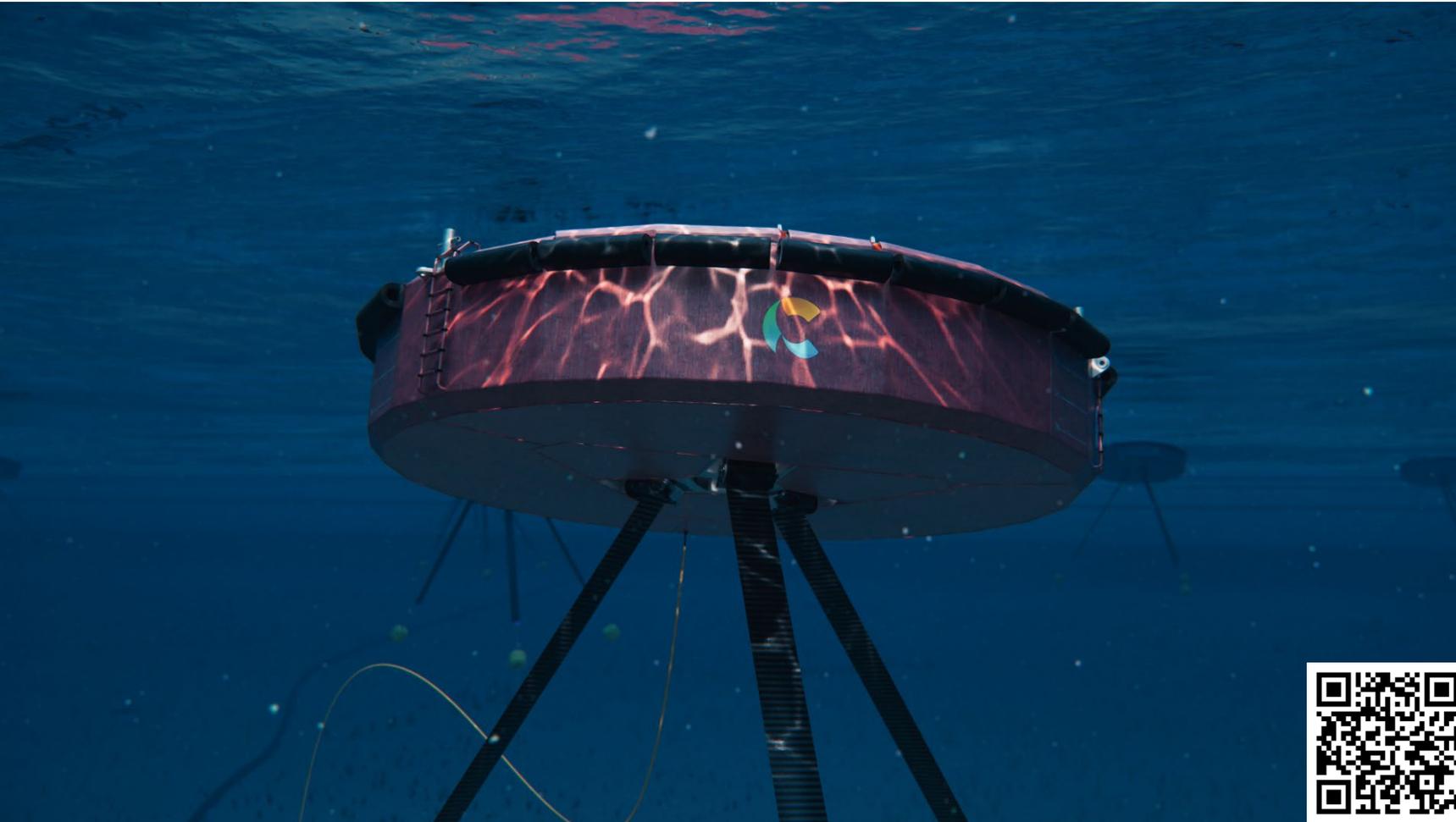
CTO
ANSYS



Jonathan Fievez

CEO
Carnegie Clean Energy

CETO – Harnessing Ocean Waves



Our core technology is unique and avoids known issues

- Water in waves move in an orbit. The buoy is forced to move in the same motion



- This kinetic energy is transformed by the three Power Take-Offs within the buoy
- CETO operates fully submerged, avoiding issues of visual amenity and damaging forces from breaking storm waves
- Artificial intelligence helps us capture more by adapting to every individual wave that passes

▪ [CLICK TO SEE ANIMATION](#)

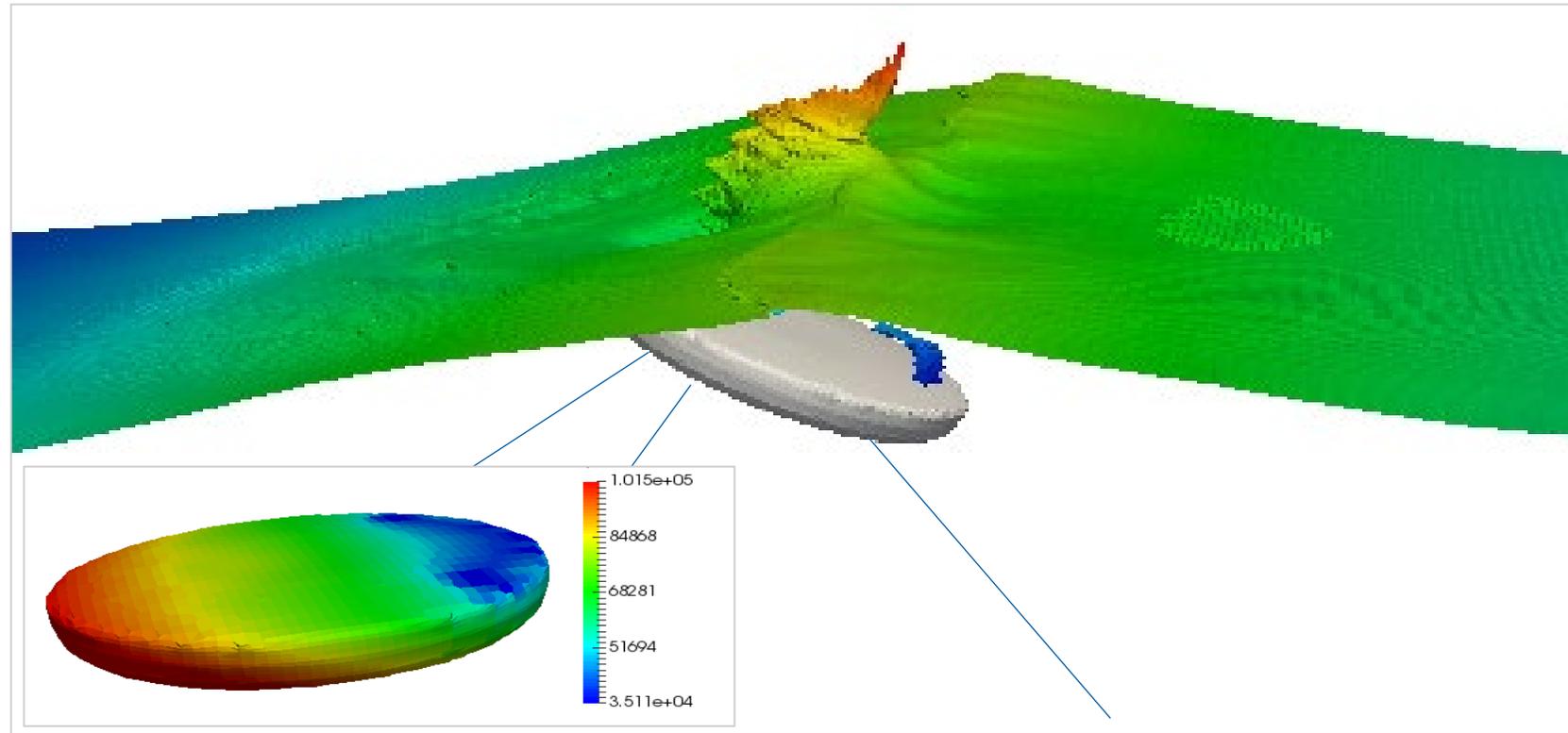
Waves are complex but we have answers

- Waves are complex and somewhat non-linear
- To engineer WECS we need to know the forces, especially damaging ones



Hydrodynamics require physics and compute power

- We divide up the ocean and structure into blocks.
- Can see the discretisation
- We use physics as the basis of our equations
- Then over to supercomputers to do the work

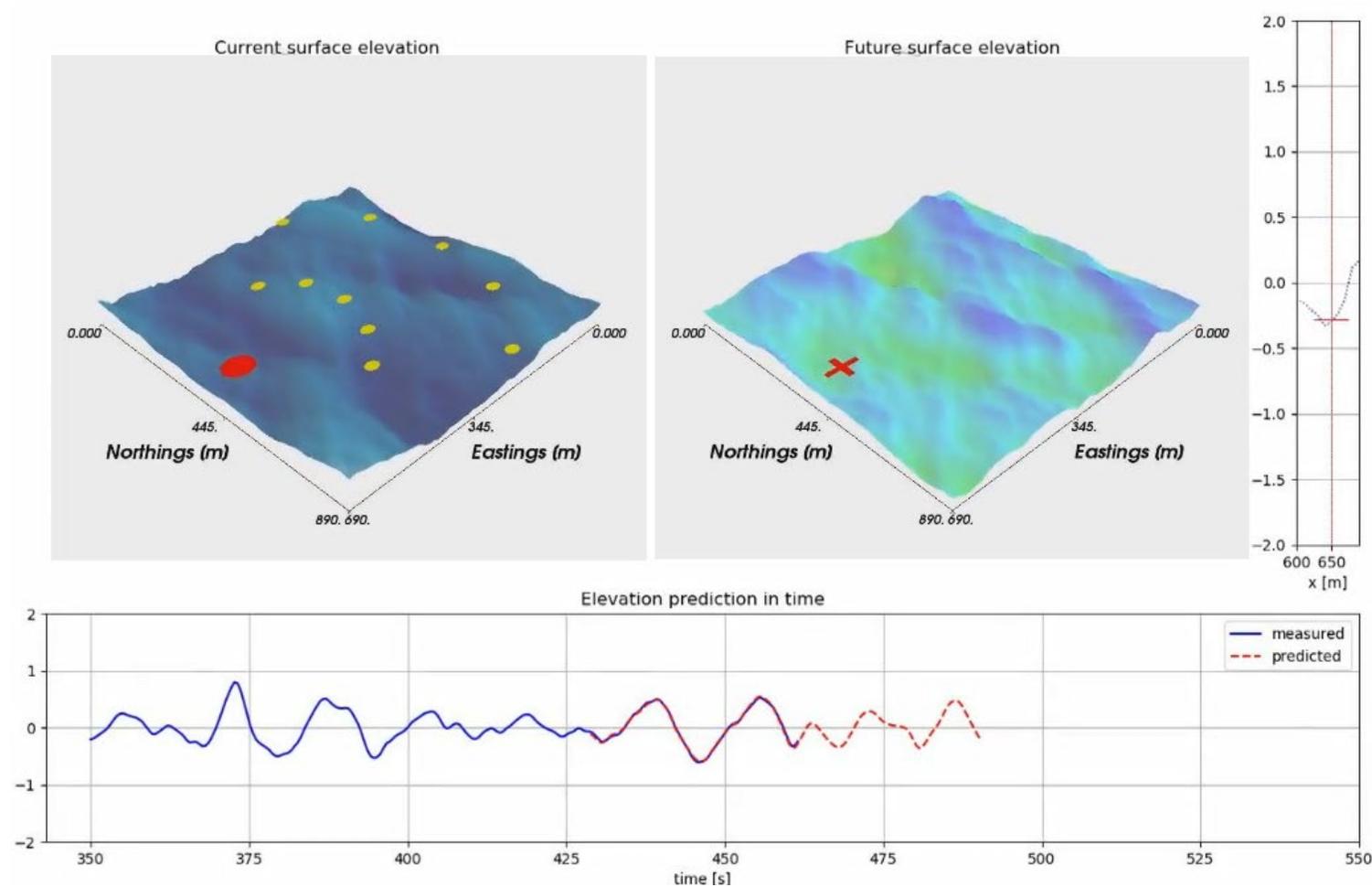


Supercomputer the Physics



- This is Setonix at the Pawsey Supercomputing Centre, in Western Australia, where we're headquartered, with its HPE Cray EX supercomputer
- But knowing hydrodynamic forces isn't enough, we need to optimise control (resistive forces) for power generation and survivability
- Remember we can only control the forces in each of the 3 mooring legs
- The best control decision can only be made if we know about the coming waves

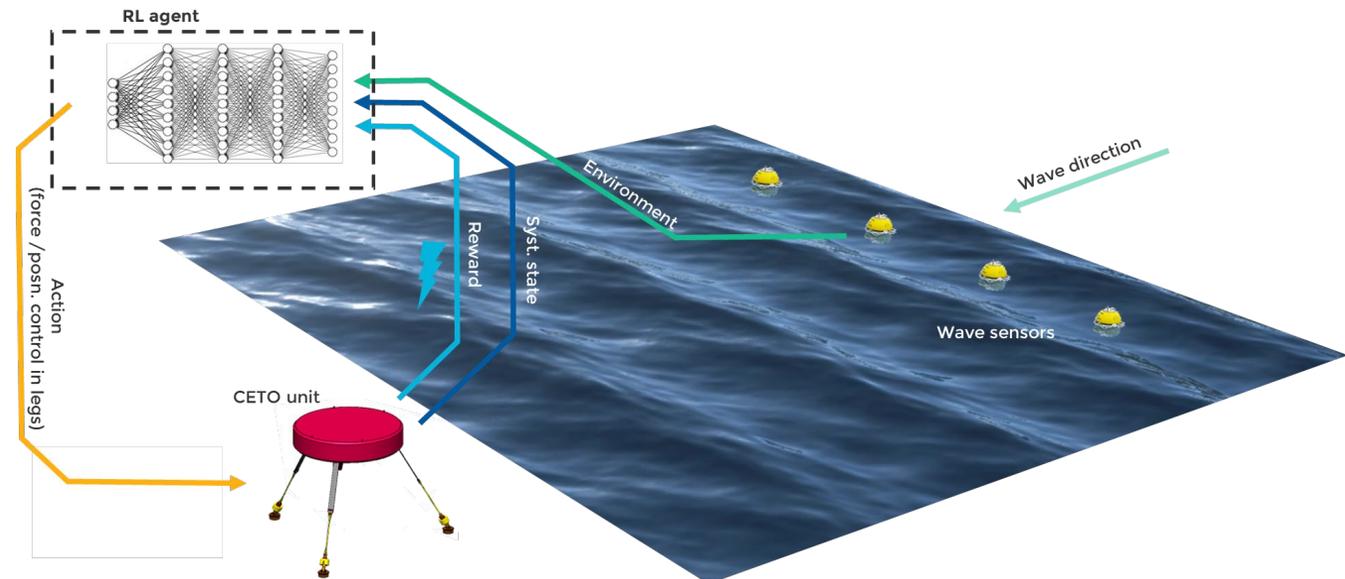
Predicting waves with AI



- We developed a wave predictor using Machine Learning and tested it a wave tank
- It uses sensors measuring the surface position that are up-wave/further out from the point of interest
- We see an excellent match between measured and predicted
- The controllers that we had to use for this prediction are good but are limited to model fidelity and don't improve

Building a controller that learns

- Through conversation with HPE we were introduced the experts at HPE labs and together we developed an RL controller
- Controller reads wave prediction + system state and decides on forces in PTOs
- It is rewarded for the electricity produced
- Throughout its life it adapts and improve
- Reward can be more elaborate like avoiding damage from extreme waves, fatigue and wear
- At array level, learns from its array sisters and helps them
- Can even cooperate to boost overall output even if that means sacrificing individual performance



What's next?

World first deployment of RL in wave energy converter



- HPE Services in Spain is helping implement the RL in CETO's first European deployment as part of the ACHIEVE Programme
- Next year we'll deliver the world's first use of Reinforcement Learning in large scale wave energy converters



**Be part of the innovation that will unlock the
power of the world's oceans**