MANCHESTER 1824

UNIVERSITY OF BATH

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SUPERGEN UKCMER

SuperGen Marine Energy Grand Challenge Assembly 2015

STEP-WEC: **STEP** CHANGE FOR **W**AVE **E**NERGY **C**ONVERSION THROUGH FLOATING MULTI-BODY MULTI-MODE SYSTEMS

.

People

Manchester	Bath	Oxford
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Tim Stallard		
RA	RA	Consultant
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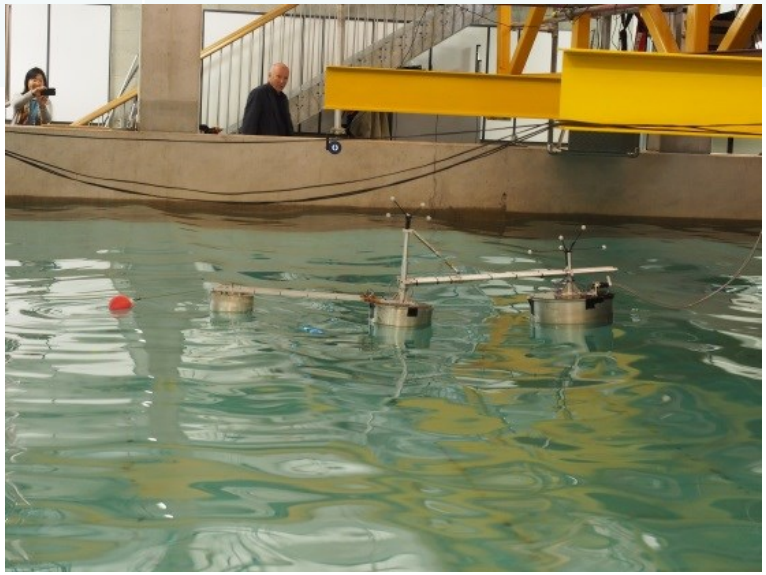
Hanbin Gu		



Content

- Experiments – two scales – rounded base for improved power capture
- Models – frequency domain, time domain
- CFD – STAR CCM
- Extreme focussed waves
- Arrays – preliminary row of 3 and 5

M4WavePower

Moored MultiMode Multibody

M4

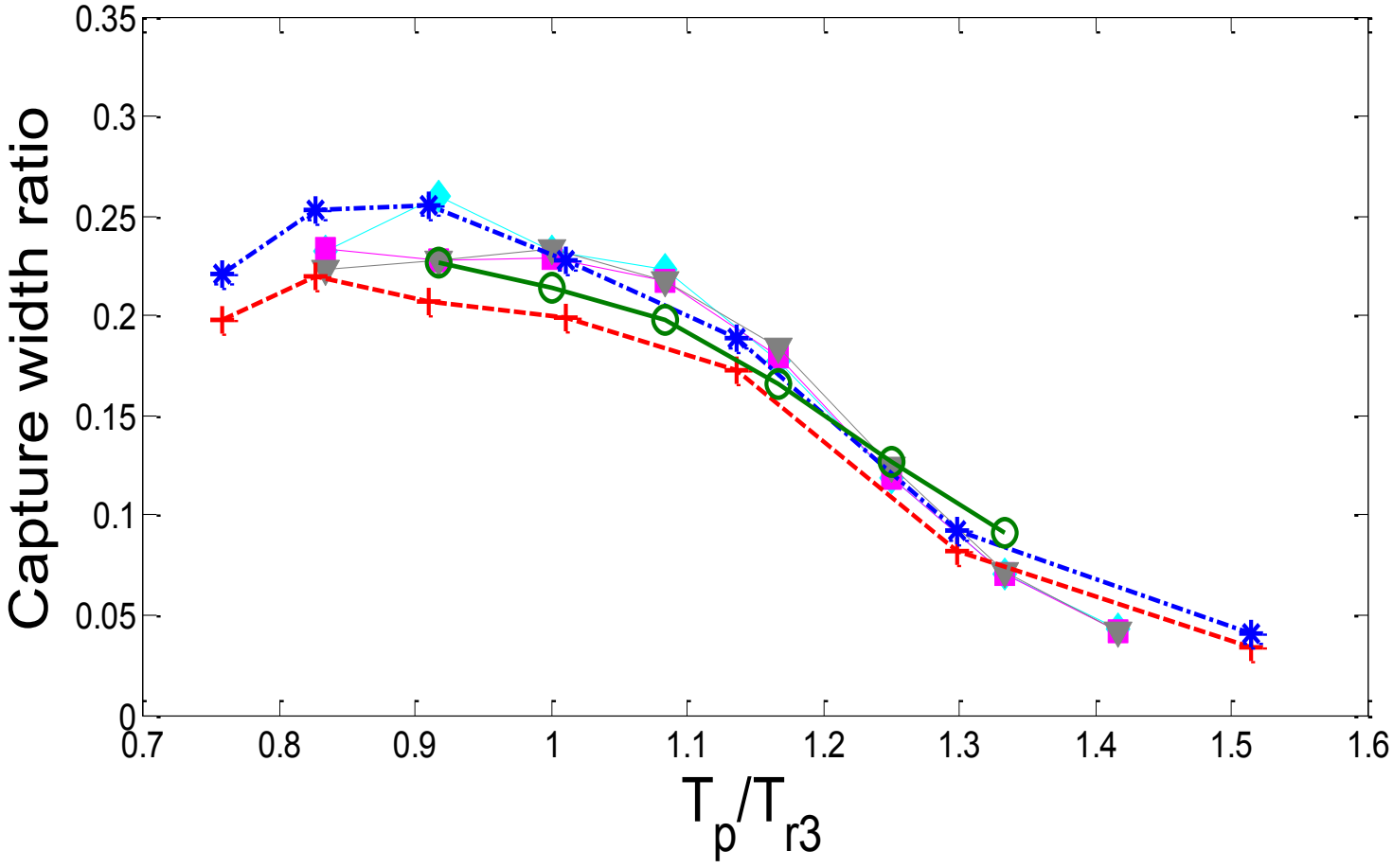
- Multi – body (3) for variable resonance
- Multi-mode (heave, surge, pitch) for high capture width
- Broad band across typical range of wave periods
- Moored for ease of deployment
- PTO above deck for maintenance at one hinge point

Stansby.P. , Carpintero Moreno, E. , Stallard, T. & Maggi, A. (2015a) Three-float broad-band resonant line absorber with surge for wave energy conversion. Renewable Energy 78, 132-140.

Irregular wave video

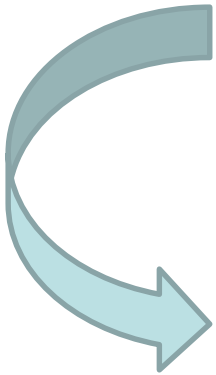
Irregular_PTOon.mp4

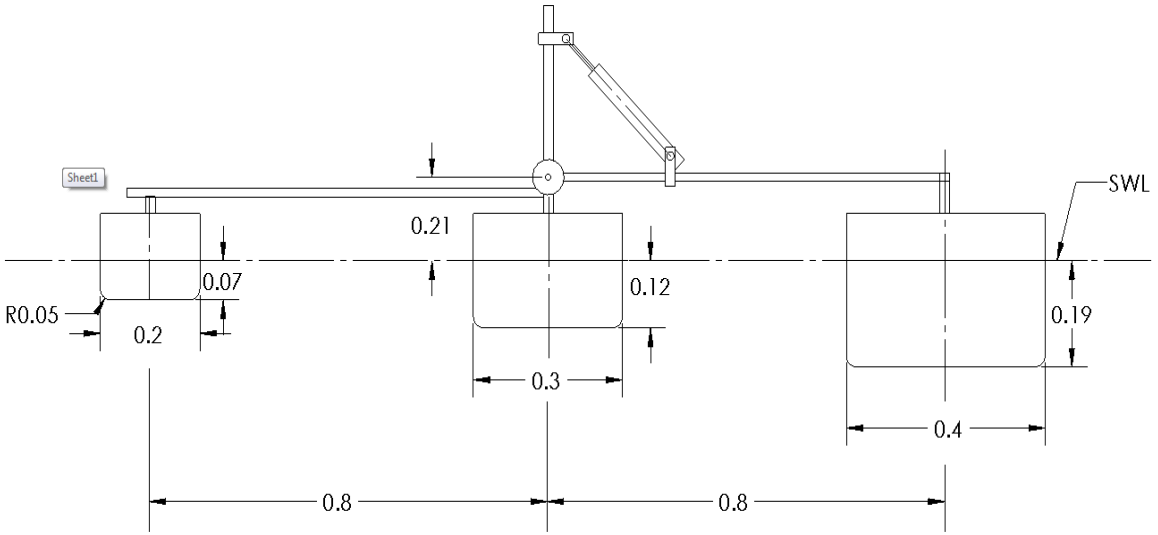
Flat base floats at 1:40 and 1:8 scales in irregular waves

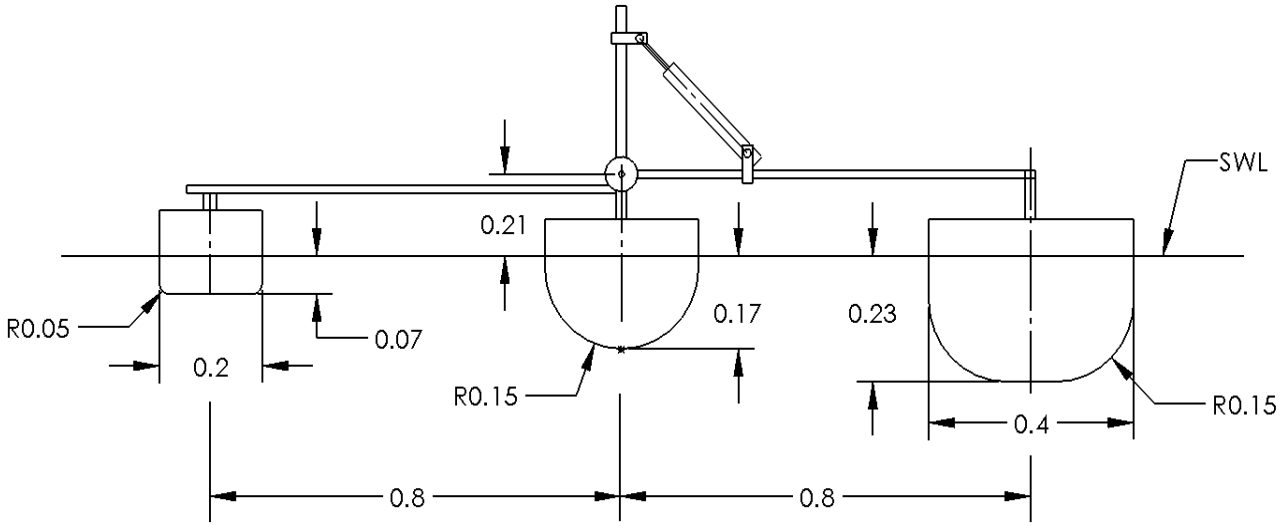


Froude works !

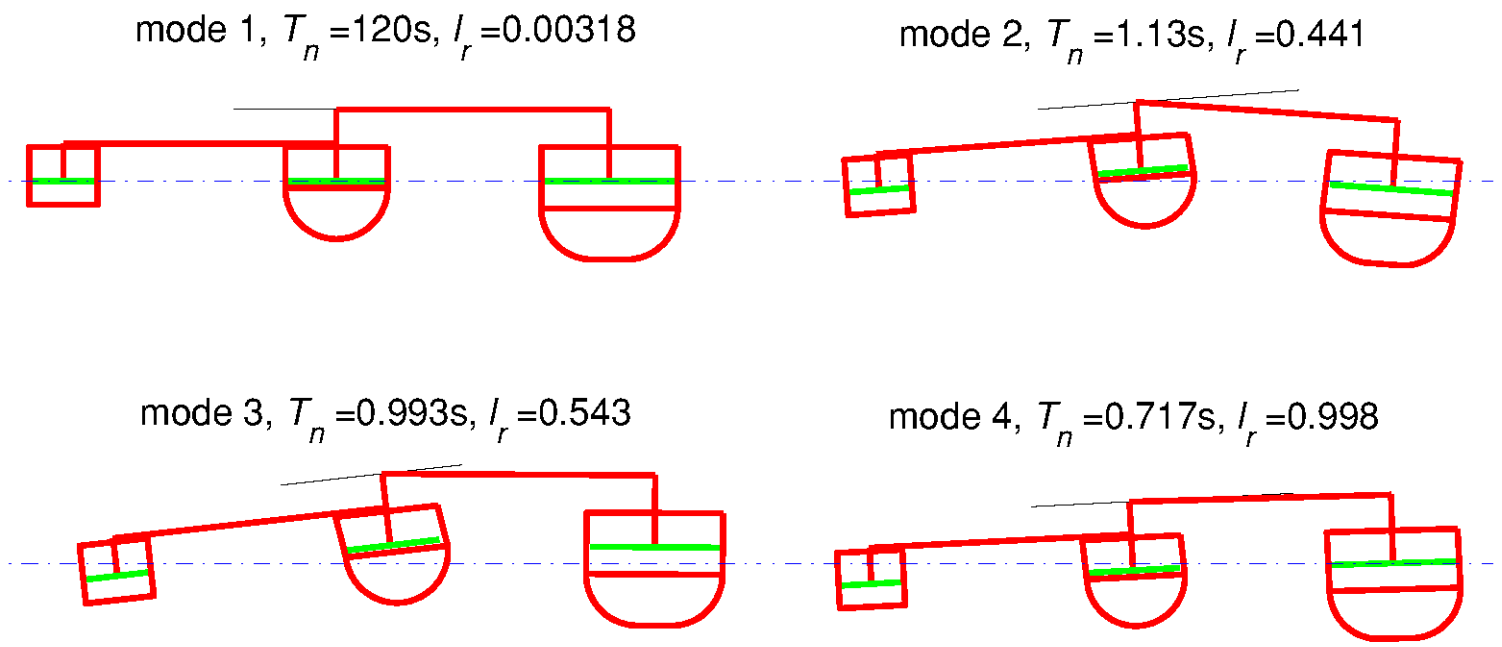
To reduce C_D use rounded base shapes: tested 1:40 scale





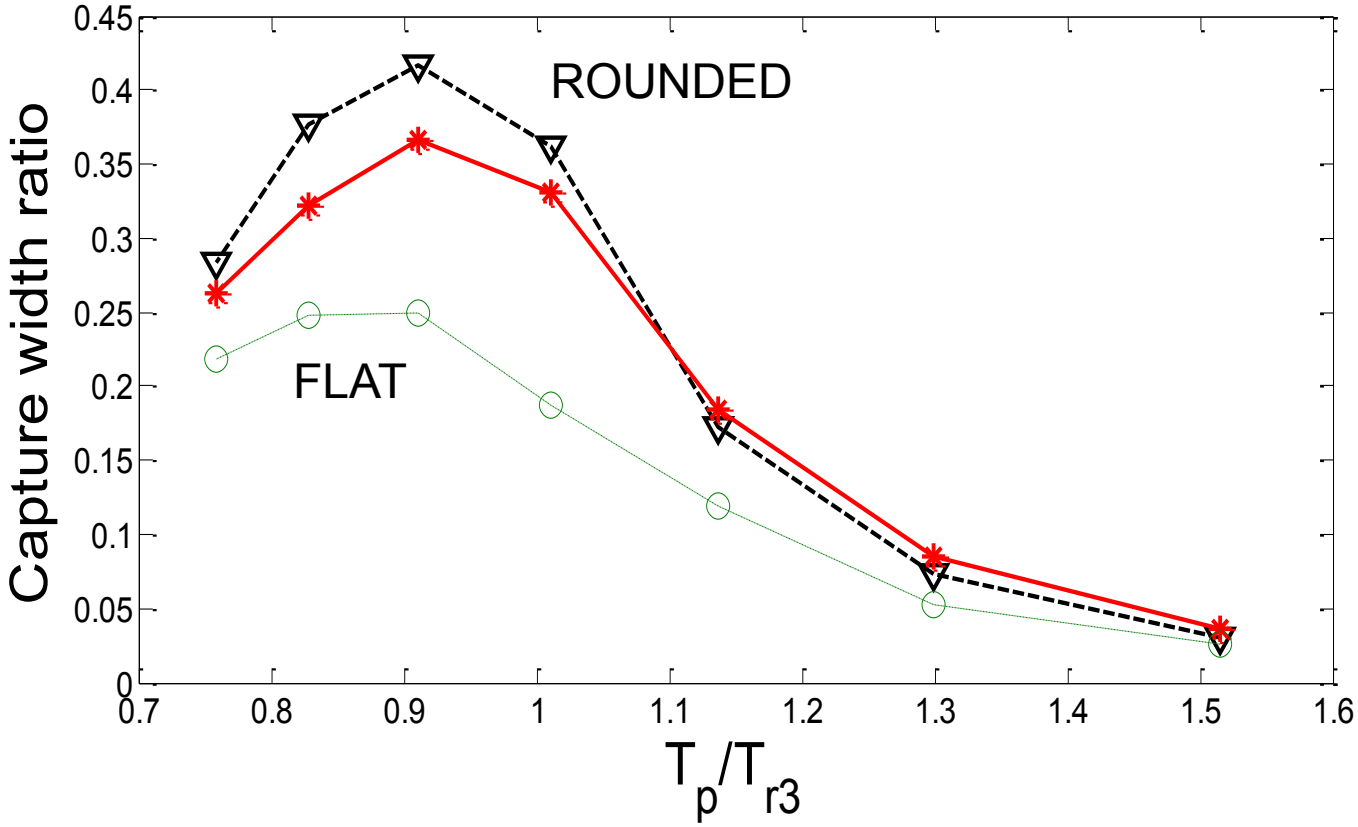


Eigen modes



Eatock Taylor, R., Taylor, P.H., Stansby, P.K. 2015 A coupled hydrodynamic-structural model of the M4 wave energy converter, in review

Rounded and flat base comparison

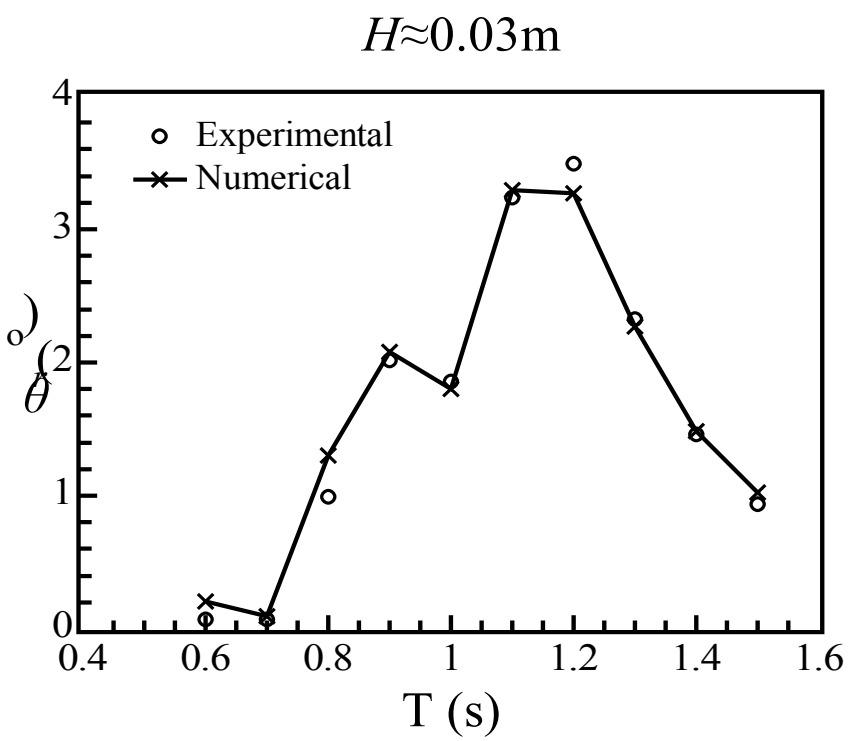


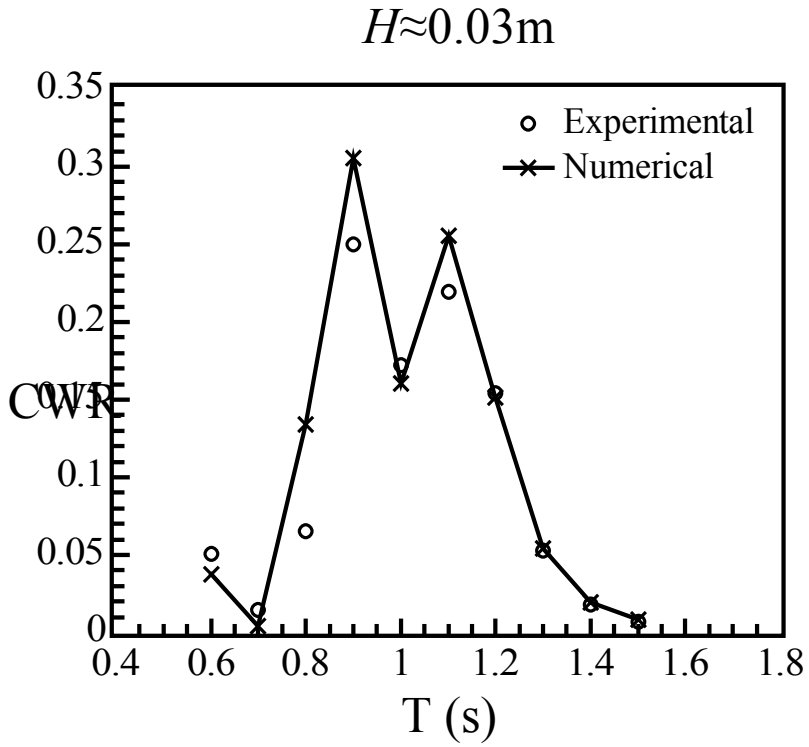
Stansby,P., Carpintero Moreno,E., Stallard,T., 2015b Capture width of the three-float multi-mode multi-resonance broad-band wave energy line absorber M4 from laboratory studies with irregular waves of different spectral shape and directional spread, J. Ocean Engineering and Marine Energy, 1(3), 287-298.

DIFFRACT (Bath/Oxford)

- Frequency domain linear diffraction
- 2nd order forcing
- Multi-body model
- Regular waves to date – relevant to swell and shows sensitivity of optimum damping to frequency

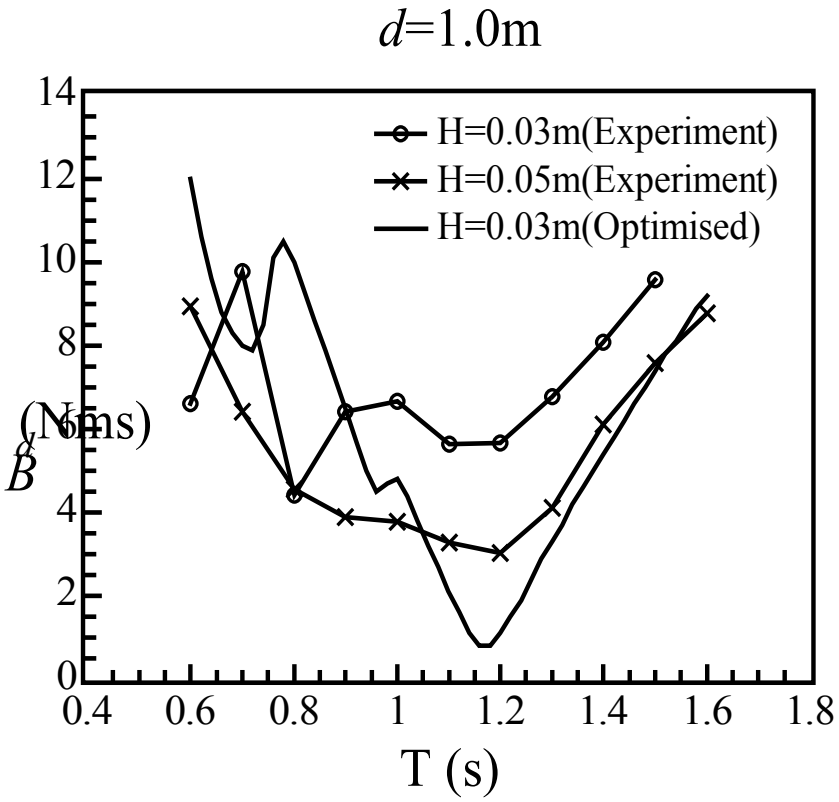
Experimental comparison regular waves

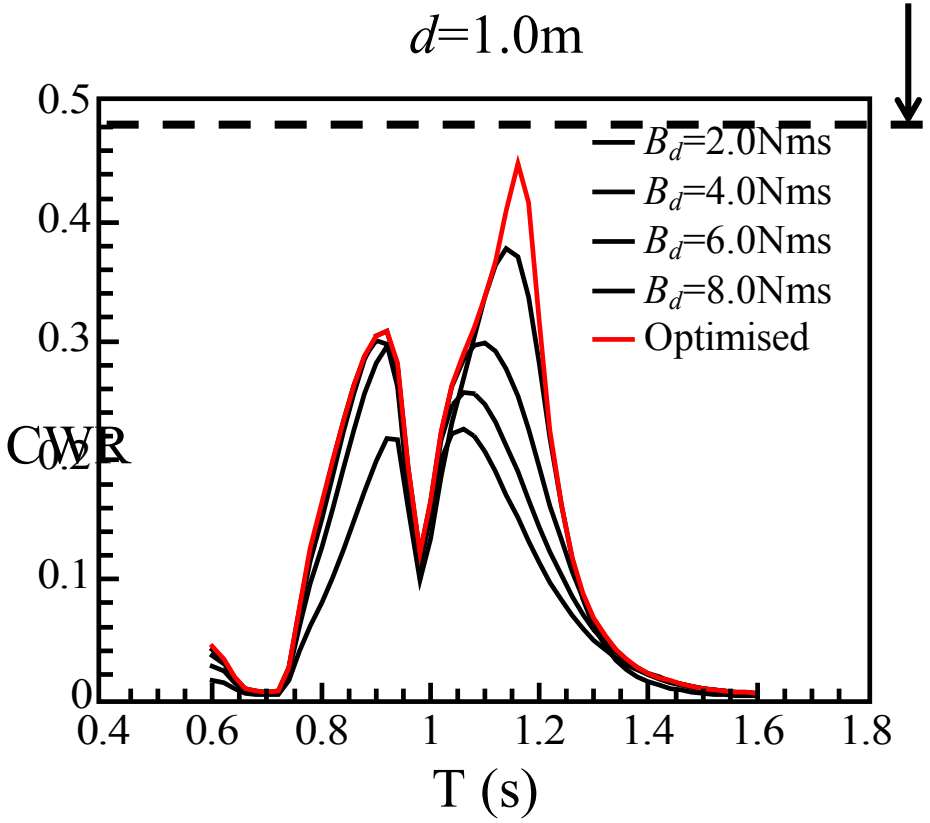




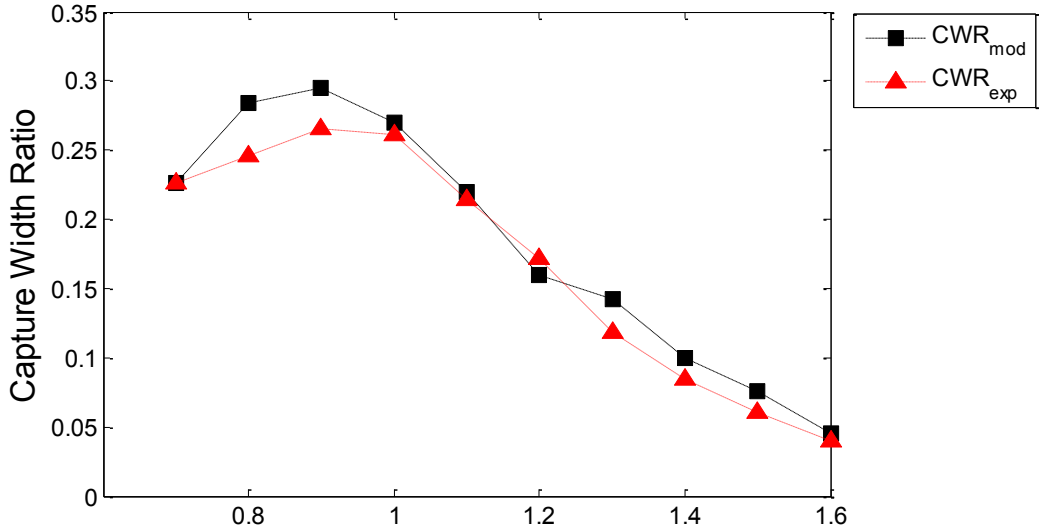
Optimised damping (linear)

Theoretical Maximum

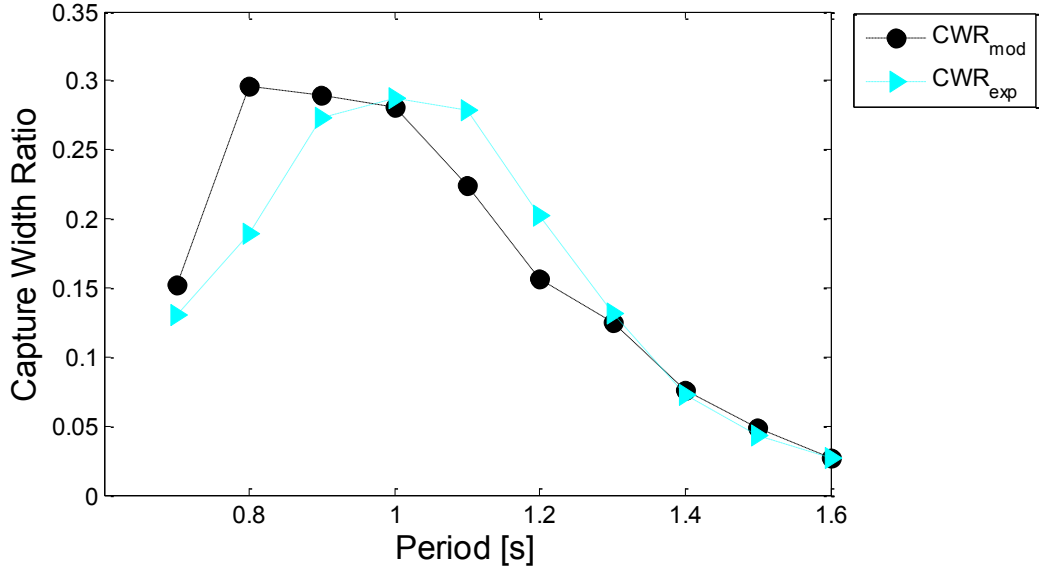




Time domain – Cummins method for control of PTO



Hs ≈ 4 cm
γ=1

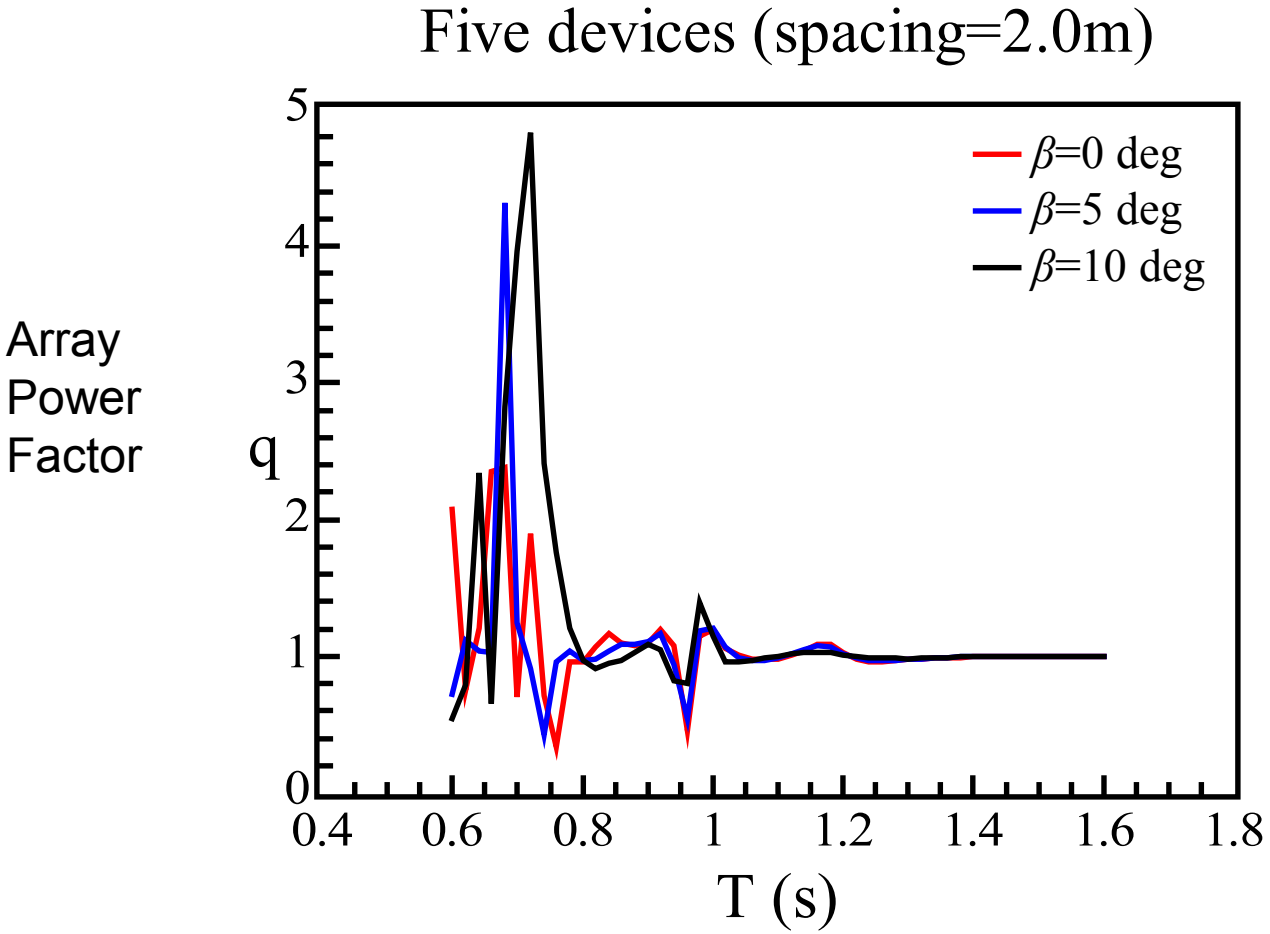


Hs ≈ 4 cm
γ=3.3

Extreme focussed wave
(full scale Hmax = 16 m)

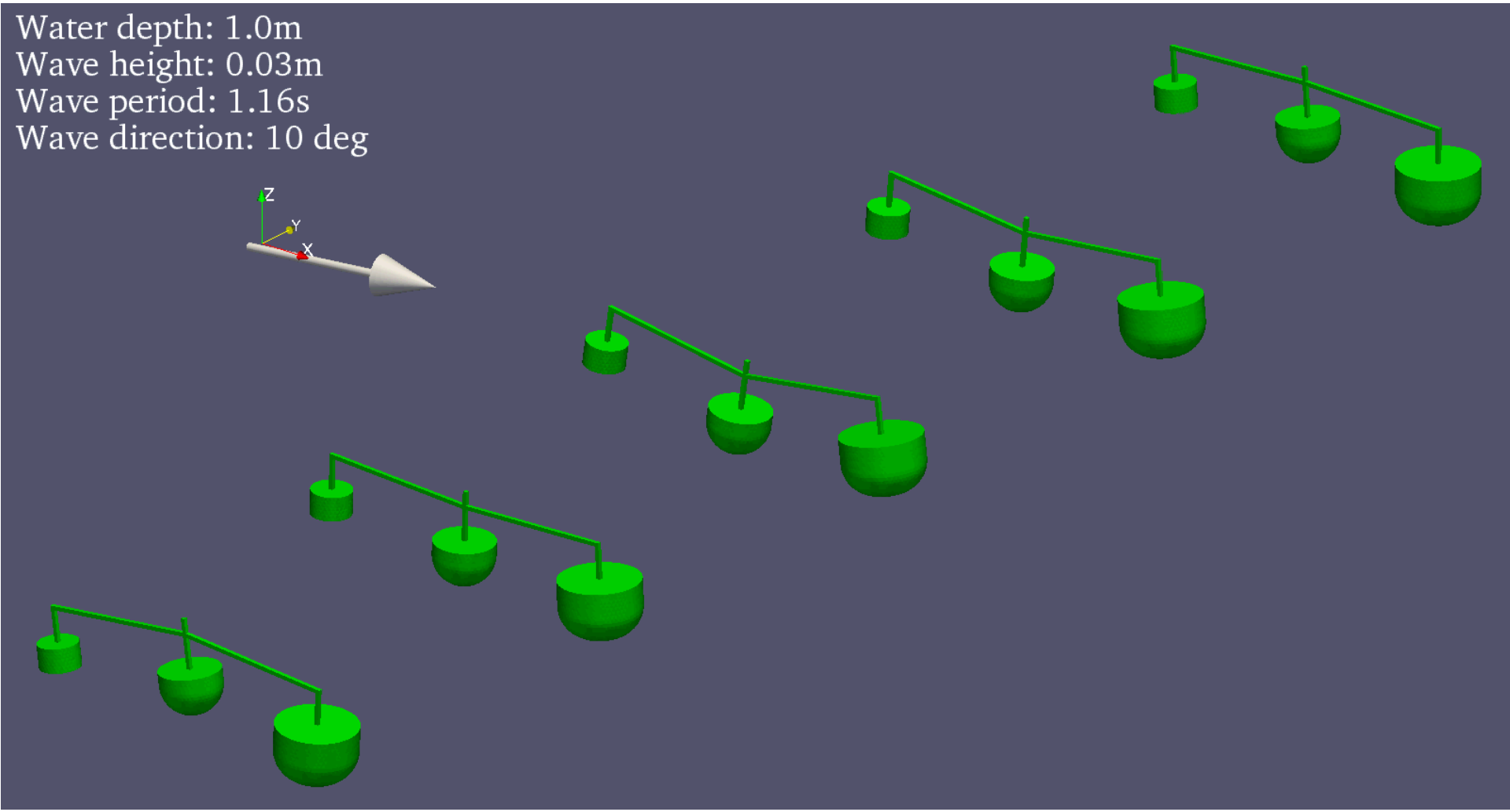
Focus PTOoff_Hs10cm_Tp1p2s equiz Hmax_16m.mp4

Row of 5 devices at different incidence (DIFFRACT)



Sun,L., Zang,J.,Stansby,P., Carpintero Moreno,E.,Taylor,P. 2015 Linear diffraction analysis and optimisation of three-float multi-mode wave energy converter M4 including small arrays for regular waves at varying incidence, to be submitted

Thanks and Questions



From DIFFRACT