

Reflection Measurement of Beach Structures using DualSPHysics



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Who are we?



US Navy MASK test facility, Washington DC



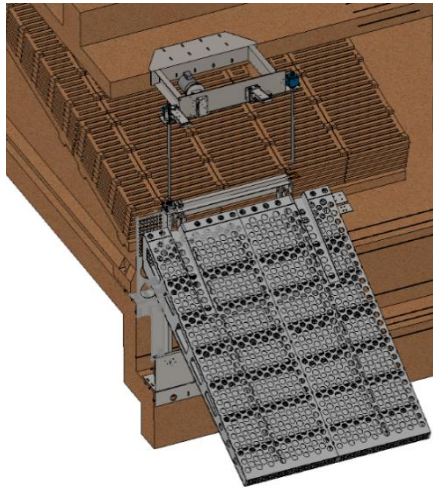
The Impossible Movie Set, Spain

- Spin off company from Edinburgh University Wave Power group in 1987
- Build wavemakers that use force based absorption
- Specialize in custom designs for unique situations, installed throughout the world
- Have worked with both the entertainment and film industry

Our interest in SPH



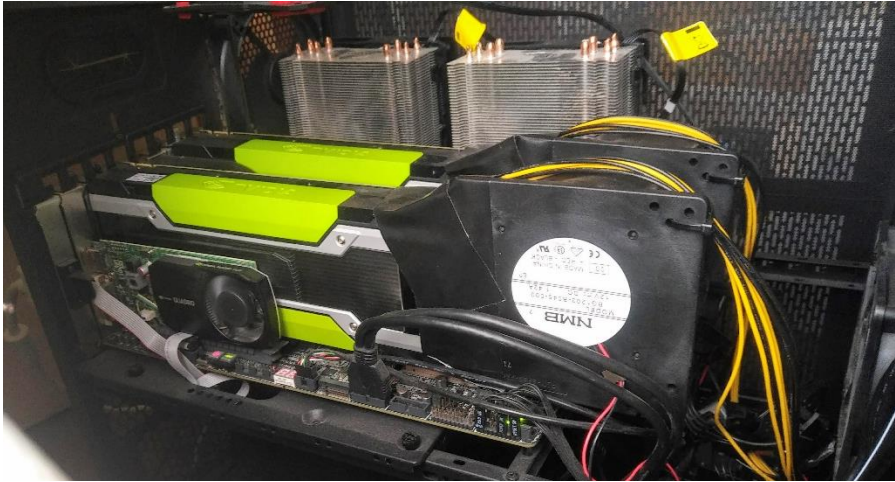
Short side beach above flow ducts



Deployable long side beach and section of lattice

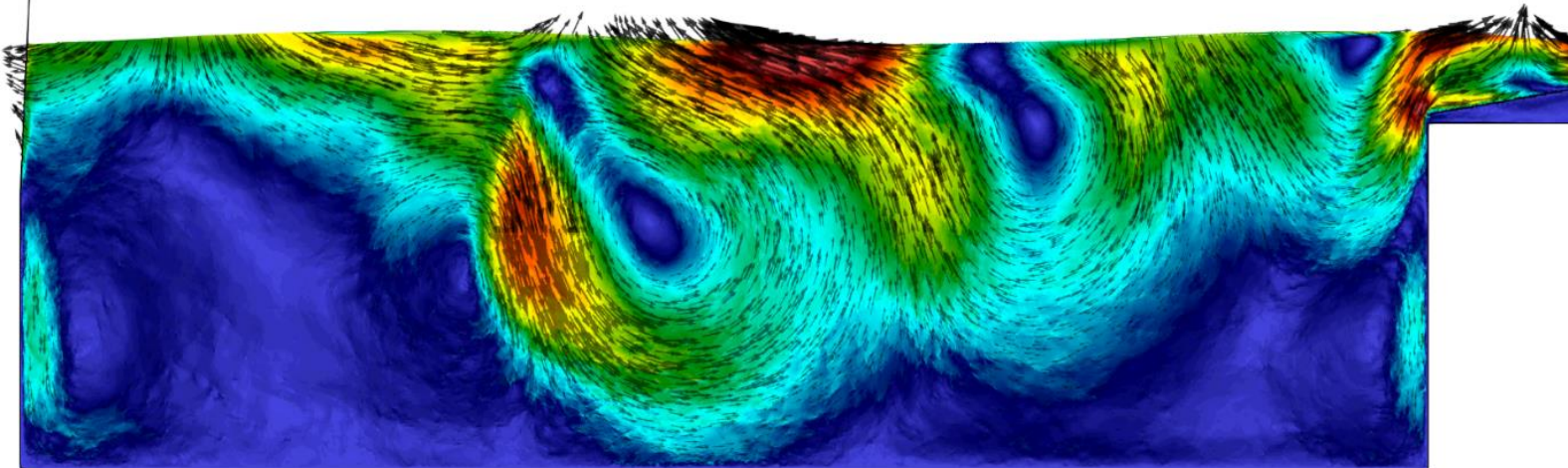
- We are building a large research test facility in Singapore. This requires beaches fitted within the rest of the structure and integrated with flow system
- Are using a combined shoaling and absorbing beach design as used in the MASK basin
- Upper section tested in a tank but we can't test the deep water sections this way so need to simulate the design

Getting SPH running



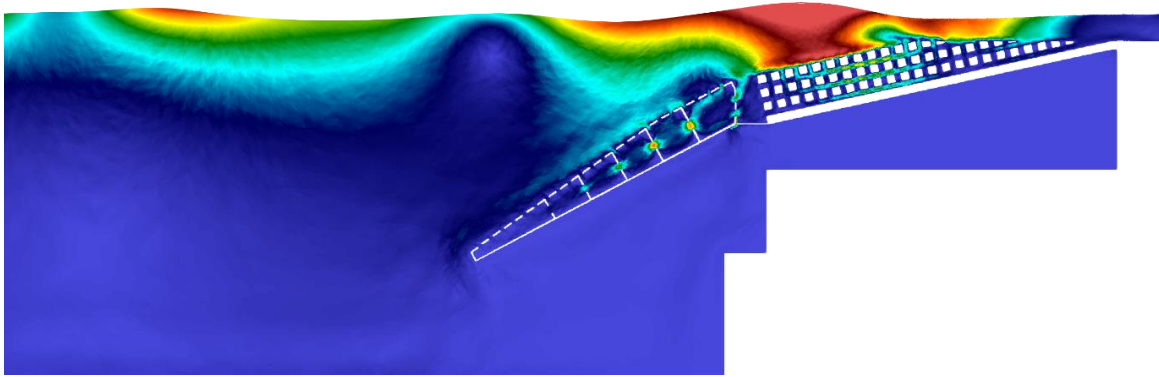
Two Tesla K80 cards in dual processor computer

- Using two Tesla K80 cards (bought on Ebay) with added fans in dual processor motherboard
- Solved instability problem with smaller particle size by setting DeltaSPH to near zero

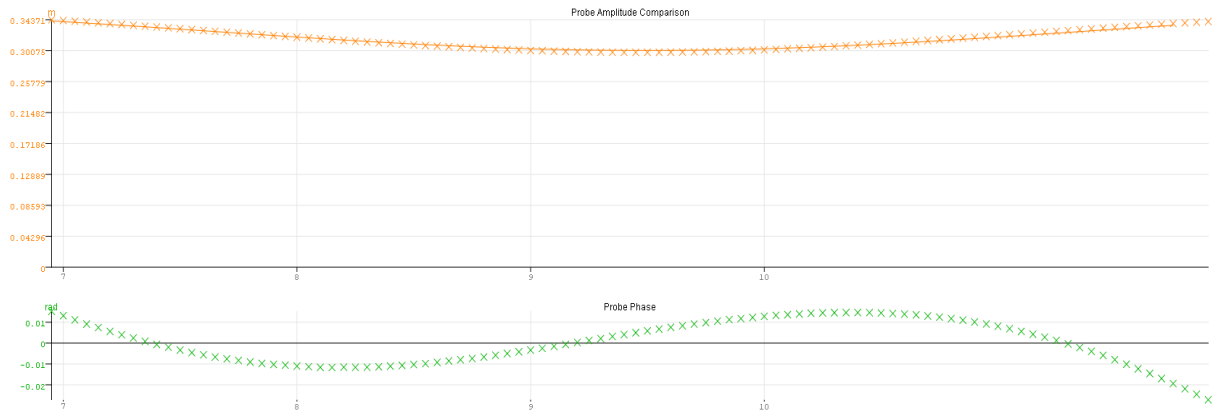


Unstable effect generating a sine wave towards a step change in depth

Measuring reflection



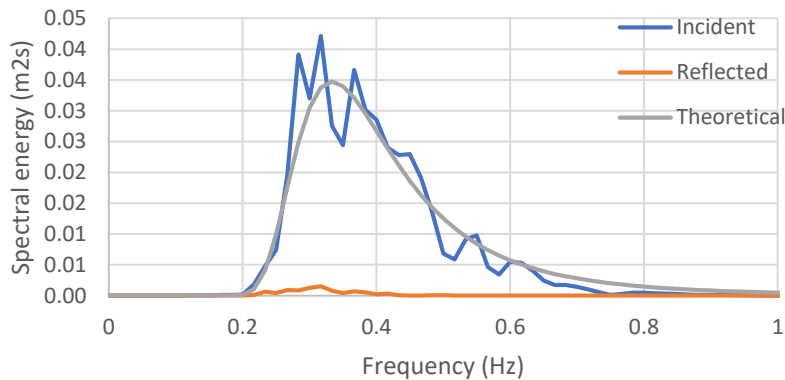
Wave running onto beach structure



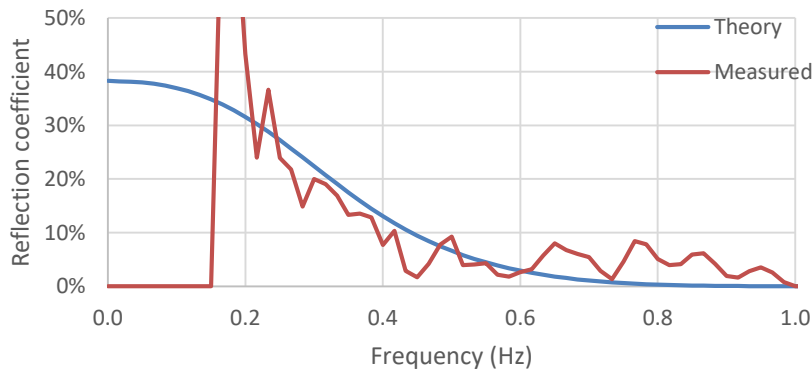
Comparison of measured and reconstituted first harmonic

- Synthesis tool
 - Generate paddle motion file
- DuaSPHysics
 - Run model with paddle motion
 - Extract height data for series of points
- Analysis tool
 - Apply least squares fit algorithm to data
 - Compare measured and extracted data (sine waves only)

Reflection off a step change with spectral wave



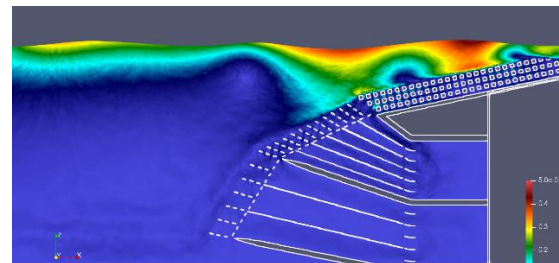
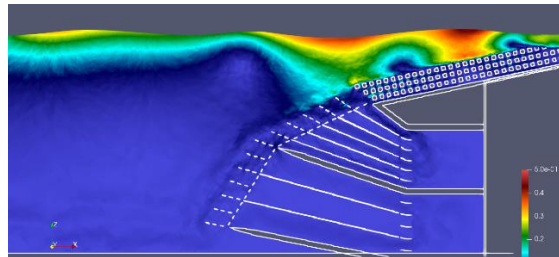
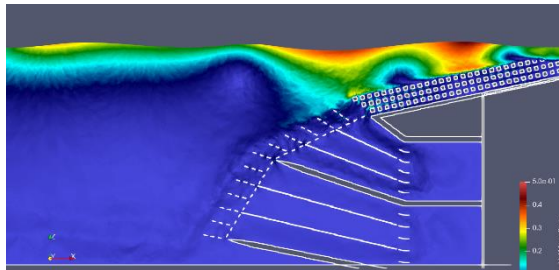
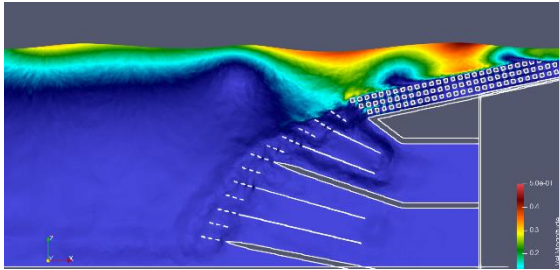
Incident, Reflected and Theoretical wave spectra



Comparison of measured and theoretical reflection

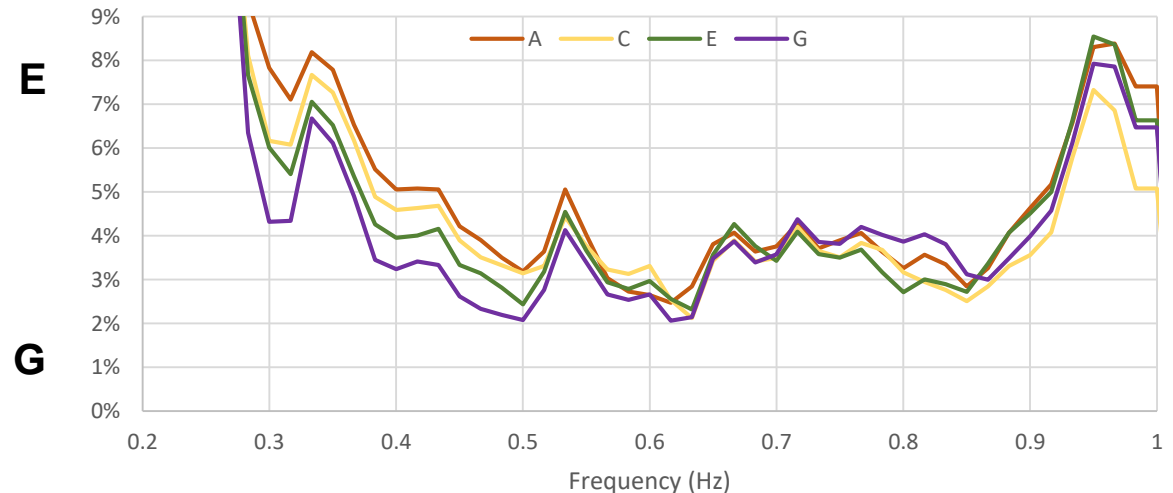
- Simple step in depth with change from 6m to 1.2m
- Resultant wave as in real tank – required frequency smoothing
- From Marshall & Naghdi:-
$$Reflection = \frac{K_2 - K_1}{K_2 + K_1}$$
- Good correlation from 0.2Hz to 0.6Hz between theory and SPH results

Short side beach design



- To make the flow ducts lock the wave out, long plates are included in them. This is augmented by screens and perforated slats.

- Designs of increasing complexity were tested with a 3 second PM spectrum with improved reflection capability at the lower frequencies



PM spectrum on beach

