



Flexible Responsive Systems in Wave Energy: FlexWave

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An origami design for the clam concept

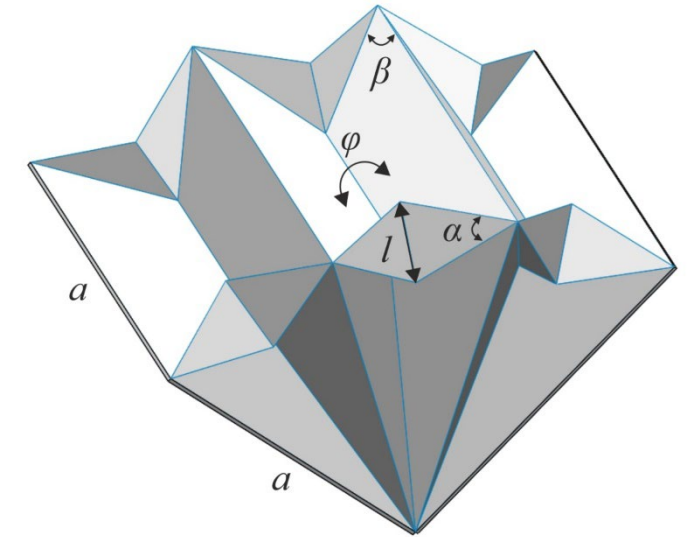
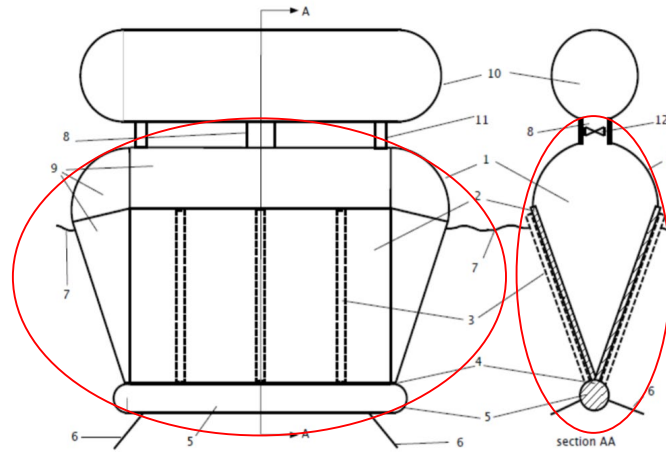
A clam model using **rigid panels** and **flexible membranes** that opens and closes in response to the wave.

Design Parameters:

- Side length of rigid panel a ;
- Sector angles α and β ;
- Dihedral angle φ .

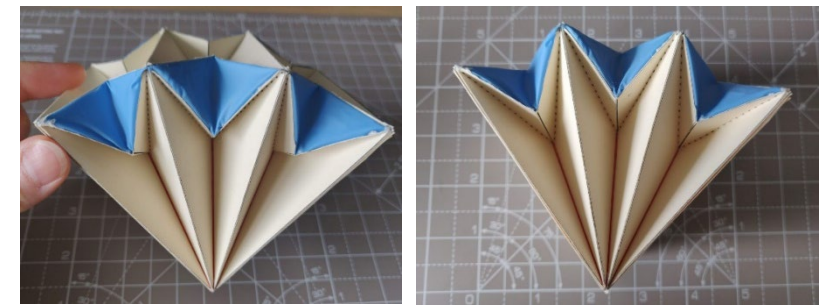
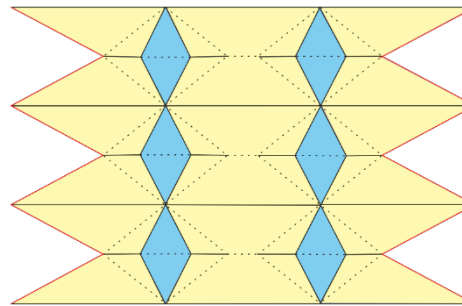
Potential Power Take-off (PTO):

- Dielectric elastomer generator (DEG);
- Air-turbine generator;
- Mechanical linear actuators.



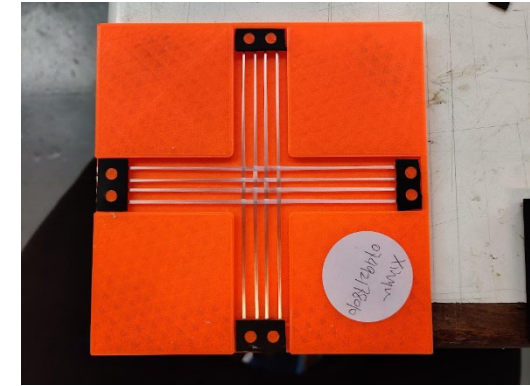
The crease pattern and a card model:

- Dotted lines: valley folds;
- Solid lines: mountain folds;
- Blue areas: elastic membranes;
- Yellow areas: rigid facets.

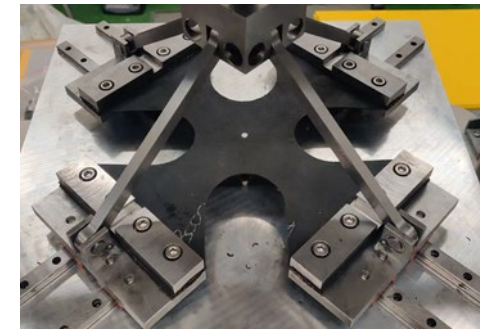


Assessment of materials manufacture & performance in flexible WECs

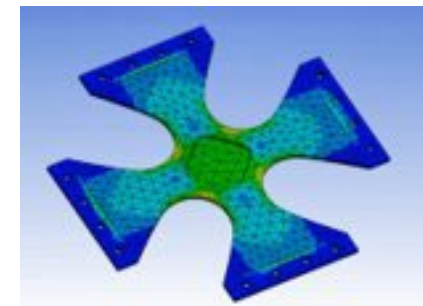
- Material manufacturing
 - This project explores **room temperature curing** elastomers to avoid using the conventional rubber vulcanising method
 - No high temperature, high pressure, and expensive vulcanising tooling are required.
- Material testing
 - Different combinations of **elastomers and reinforcements** have been studied. A preliminary **database** of their mechanical and fatigue performance has been established.
- Future work
 - Manufacturing of the **scale model** with selected materials with help of the FEA modelling and material database.



3D printed mould for sample making, more efficient and economic



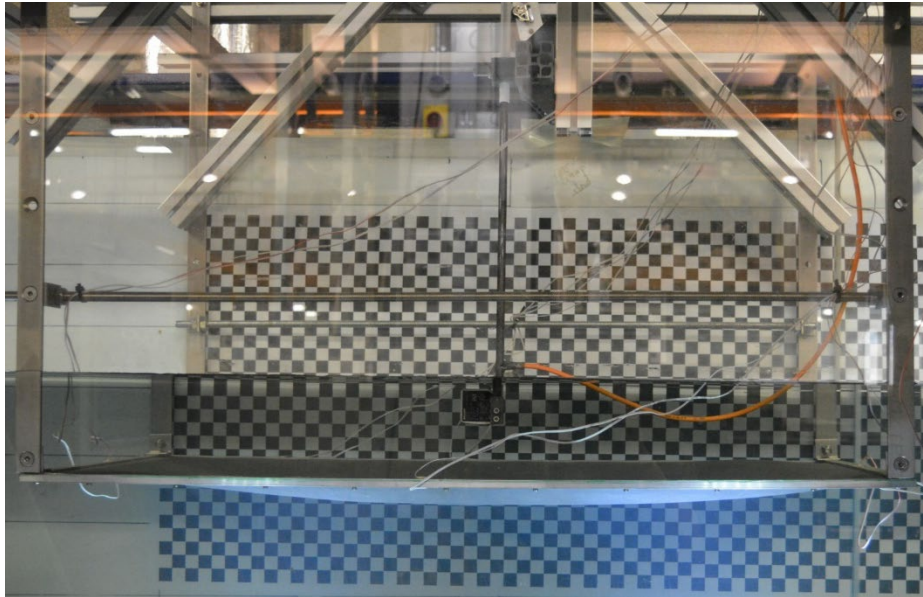
Biaxial Fatigue testing setup



FEA modelling of the Biaxial test

Hydro-elastic response of flexible membrane

Neoprene rubber fixed at four edges



Regular wave: frequency 1.75Hz & amplitude 0.01m

- Different polymer material sample (Neoprene rubber (NR), Reinforced NR, Silicone & Polyurethane) – tested in the wave flume facility at Coast Lab, UoP
- Strain and deformation measurements -using flexible strain sensors, underwater laser distance sensor, high speed camera

Project Progress

- Origami inspired flexible Clam WEC model is selected for further investigation
- A preliminary database of mechanical and fatigue performance of materials has been established
- Hydro-elastic response of Neoprene rubber material tested in the wave flume facility
- Numerical techniques to study the dynamics of flexible WEC explored

Future work

- Stress-strain analysis of the clam model when it is in motion
- Hydro-elastic tank testing on other polymer materials
- Scale model design of Clam WEC and fabrication of the model
- Hydrodynamic stability of Clam WEC