Supergen Offshore Renewable Energy

EPSRC Marine Wave Energy Programme

Mooring analysis and design for offshore WEC survivability and fatigue (MoorWEC)

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Wave energy potential

- Global wave power similar to wind
- Multi-float systems like M4 can have similar capacity to wind platforms
- There is a widespread consensus in the wave energy community that mooring system design and modelling is a major challenge that needs to be overcome
- Efficient hydrodynamic multi-float-mooring models needed for design
- What is best mooring design

Extreme wave example (from Marinet2 tests)

Full scale

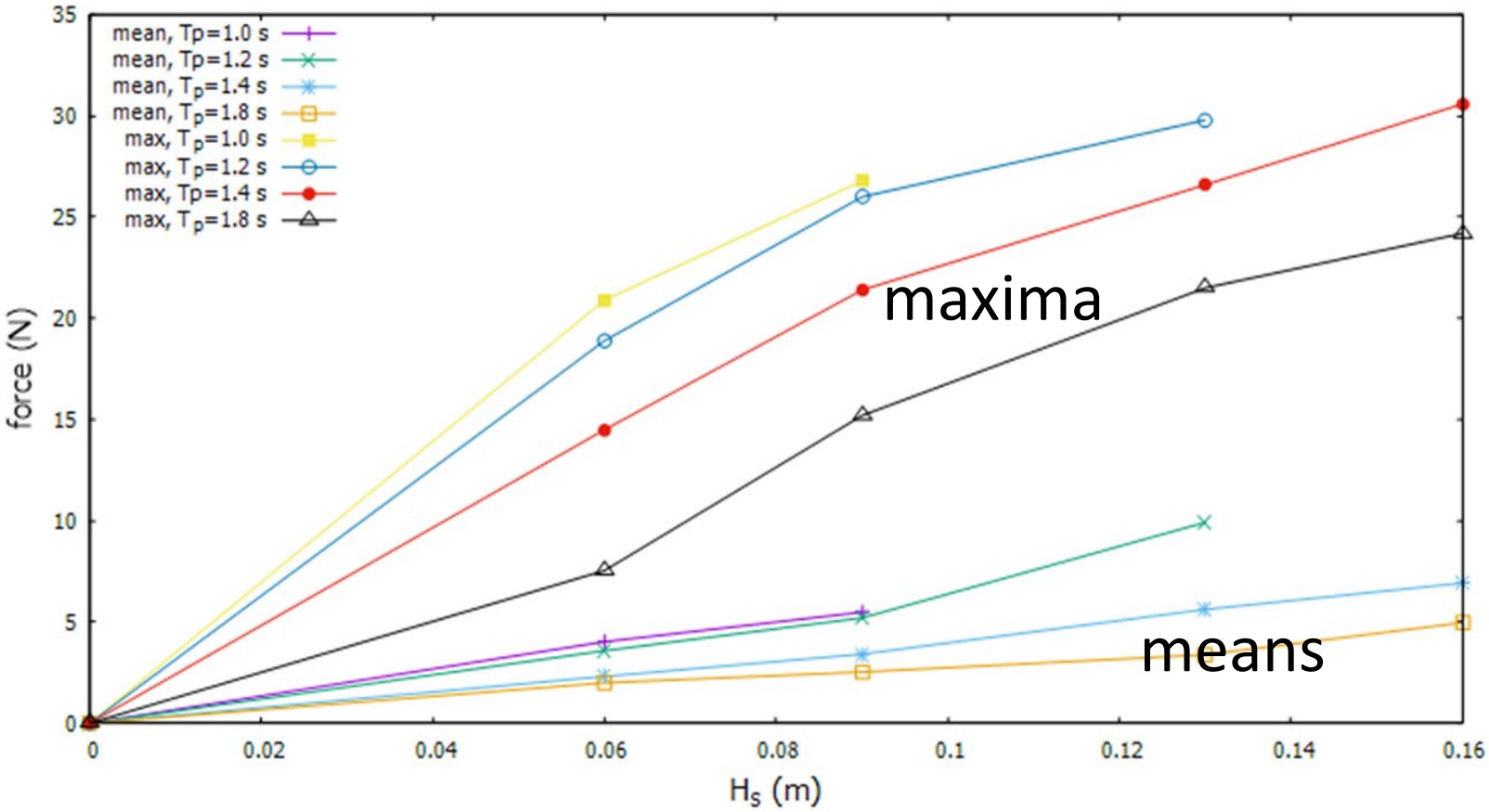
H_s=8 m

T_p=10 s

Aerial view

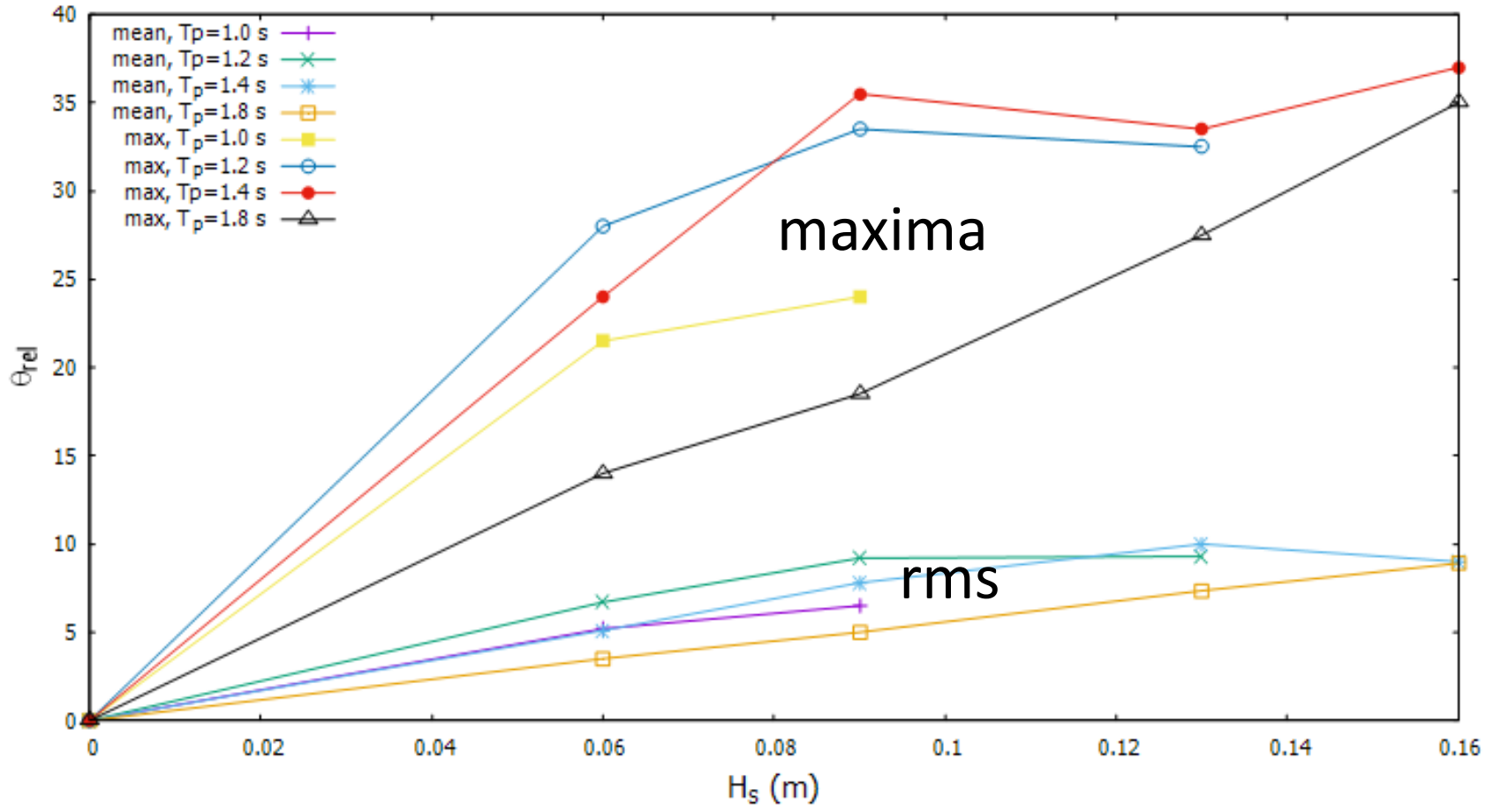
H_s=0.16 m T_p=1.4 s

Mooring forces at fairlead with elastic cable



Full scale maximum ~ 375 tonnes (5% total dry mass)

Relative angular motion between floats



Saturated around 37° , limited by overtopping/dunking

Approach

- Nonlinear wave modelling (Oceanwave3D, HOS, QALE-FEM, FOAM, SPH)
- Froude-Krylov multi-body modelling
- Linear added mass, radiation damping scaled and added
- Related 2nd order effects scaled and added
- Drag forces added
- System identification to improve formulations

- Nonlinear mooring lines including synthetic cables

- Experimental validation (Plymouth COAST and FloWave basins)

Mooring analysis

- Coupling of hydrodynamic force models and mooring analysis software for range of designs
- Integrated mooring analysis considering snap loads and fatigue
- Mooring system design optimization using multi-objective genetic algorithms

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Future extensions

- Floating wind platforms
- Floating marine turbine platforms

Thanks and questions