EPSRC Marine Wave Energy Programme
Mooring analysis and design for offshore WEC survivability and fatigue (MoorWEC)

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PDRAs in bold

Big picture

- Multi-float/mooring/wave interaction – need fast nonlinear time domain model

- Start point : Cummins method with linear excitation, added mass, radiation damping, and 2nd order sum/difference frequency forces with simple mooring

- Swop linear Froude Krylov force with nonlinear force from any wave predictor taking account of float immersion, also accounting for nonlinear restoring forces

- Models for nonlinear irregular waves without bodies: 2nd order, potential flow (OceanWave3D, QALE_FEM), CFD (OpenFOAM), SPH potentially with aeration option (new), including breaking in extremes.

- Mooring models: simple elastic to nonlinear FE for synthetic cables following general advances in other areas

- Computing platform called OREGEN

- Question : how accurate and fast is OREGEN, compare Orcaflex and Proteus_DS

- Question : how far may snap loads and fatigue be reduced with elastic cables

- Aim: extreme load and fatigue prediction for moorings.

Work split (15 people)

- OREGEN computational platform – set up with linear waves and general wave input for FK forces (Qangqiang Li, Peter Stansby)

- Wave basin testing – waves alone data from Plymouth (COAST) and Edinburgh (Flowave) completed (Tom Tosdevin, Tom Davey) – contributed freely.

- Wave basin testing with multi-float WEC, first set undertaken, three to go (Peter Stansby, Gangqiang Li, Sam Draycott)

- Wave modelling:

  1. Oceanwave3D, uni-directional done, spread to do (Sam Draycott, Peter Stansby)

  2. QALE-FEM to start (Shiqiang Yan, Qingwei Ma, Yi Zhang)

  3. OpenFOAM to start (Qing Xiao, Xiang Li)

  4. SPH to start (George Fourtakas, Steve Lind)

- Mooring design and analysis ongoing (Lars Johanning, Phil Thies, Chenyu Zhao)

- System identification for mooring forces to start (Long Zhang, Xuefei Wang)

Photos of wave basin tests in Plymouth 12-16 Sept

3 line elastic mooring

H_s=10m
T_p=11.5 s
Full scale

Non Linear!

Papers so far

- Peter Stansby, Sam Draycott, Gangqiang Li, Chenyu Zhao, Efrain Carpintero Moreno, Ajit Pillai, Lars Johanning, 2022 *Experimental study of mooring forces on the multi-float WEC M4 in large waves with buoy and elastic cables*, Ocean Engineering, under review

- S. Draycott, P. K. Stansby, M. L. McAllister, T. Davey, L. Jordan, T. Tosdevind , M. Hann 2022 *The numerical re-creation of experimentally generated nonlinear irregular wave fields using a time-reversal approach*, Applied Ocean Research, under review

- Gangqiang Li, and Peter Stansby, 2022 to appear *A general computing platform for offshore renewable energy systems (OREGEN),* 5th Int. Conf. on Renewable Energies Offshore (RENEW 2022)

- Zhao, C., Li, G., Stansby, P., Johanning, L., 2022. To appear. *Comparison of the full dynamic mooring simulation and wave basin test of a multi-float WEC*. 5th Int. Conf. on Renewable Energies Offshore (RENEW 2022)