

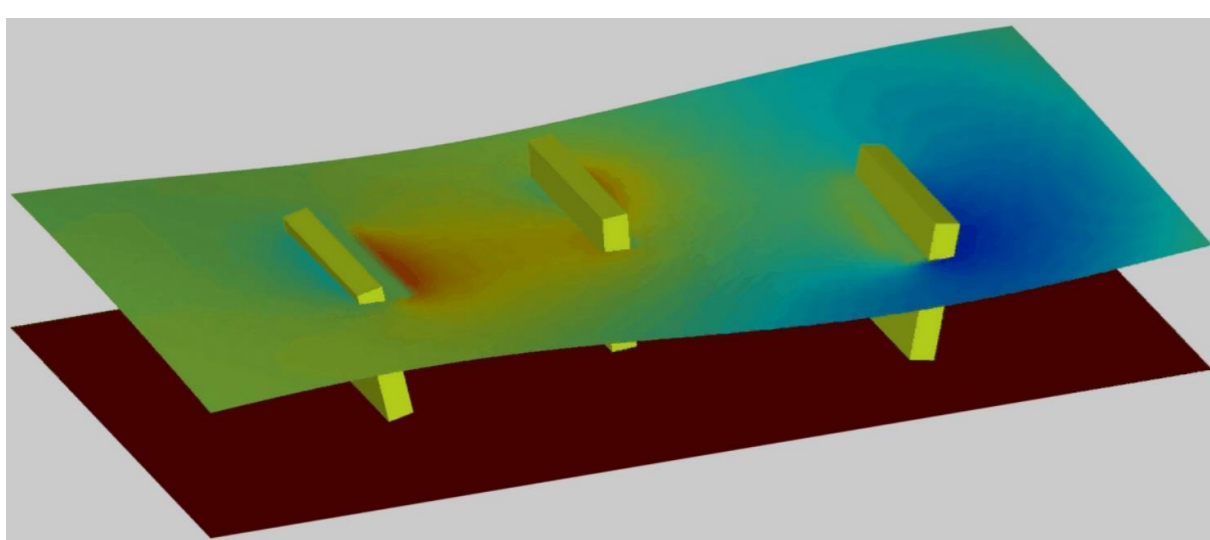
# OceanEd

## Open-Source Software for Modelling WEC Arrays

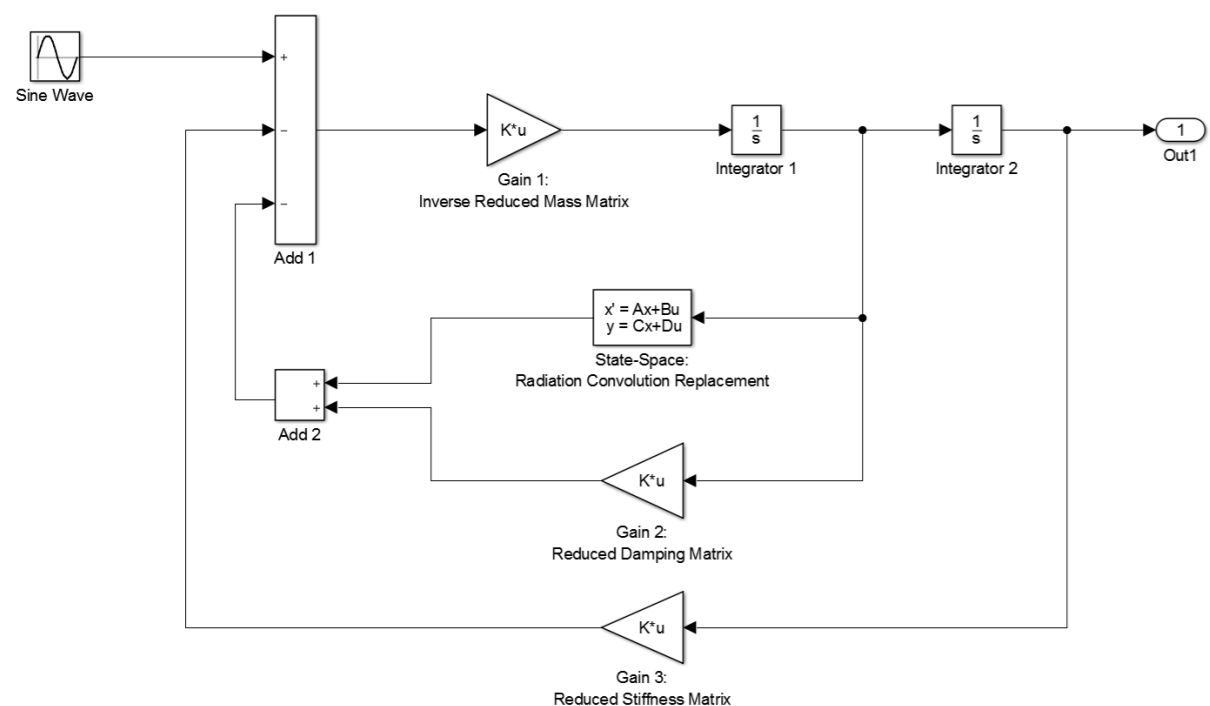
### Introduction

The OceanEd software is a suite of MATLAB and Simulink software codes for creating and testing hydrodynamic time-domain models of arrays of rigid-body WECs. The resulting time-domain models:

- Take into account *all* the hydrodynamic interactions (i.e. *all* the radiated and diffracted waves) between *all* the converters.
- Can model tens of devices, with *any* hull shape, in *any* array layout, in *any* sea, with each device moving in up to all six of its degrees of freedom.
- Can model *transient* behaviour and can incorporate *nonlinear* external forces.
- Are *fast* because they use state-space techniques to approximate the difficult to compute radiation forces.



**Figure 1:** Array of interacting bottom-hinged flaps. The colour-map on the free-surface indicates all the radiated and diffracted waves.

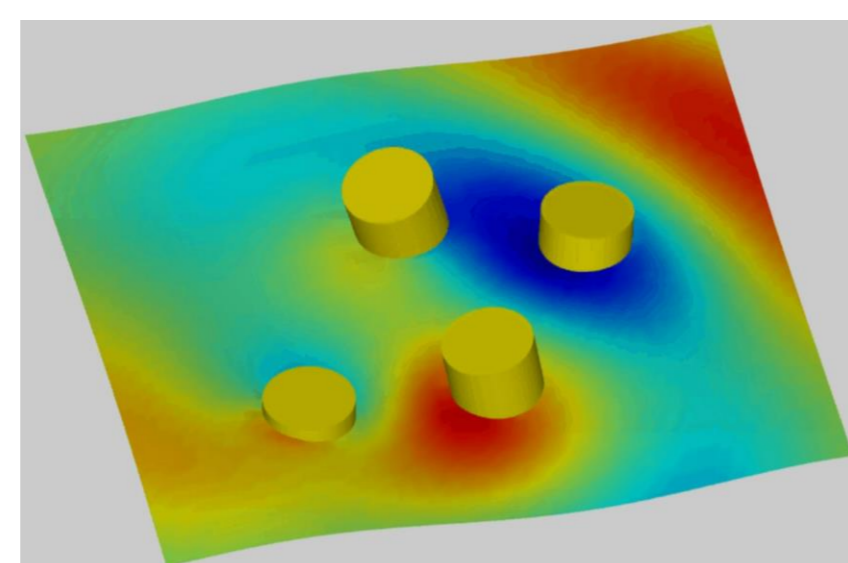


**Figure 2:** Single Simulink diagram which models ALL arrays, whatever their size.

### Applications

Some of the applications of the OceanEd software are:

- Array *control* studies.
- Array *layout* studies.
- Array *impact* studies.
- Array *interactions* studies.



**Figure 3:** Array of interacting buoys. The colour-map on the free-surface indicates all the radiated and diffracted waves..

### Accessing the Software

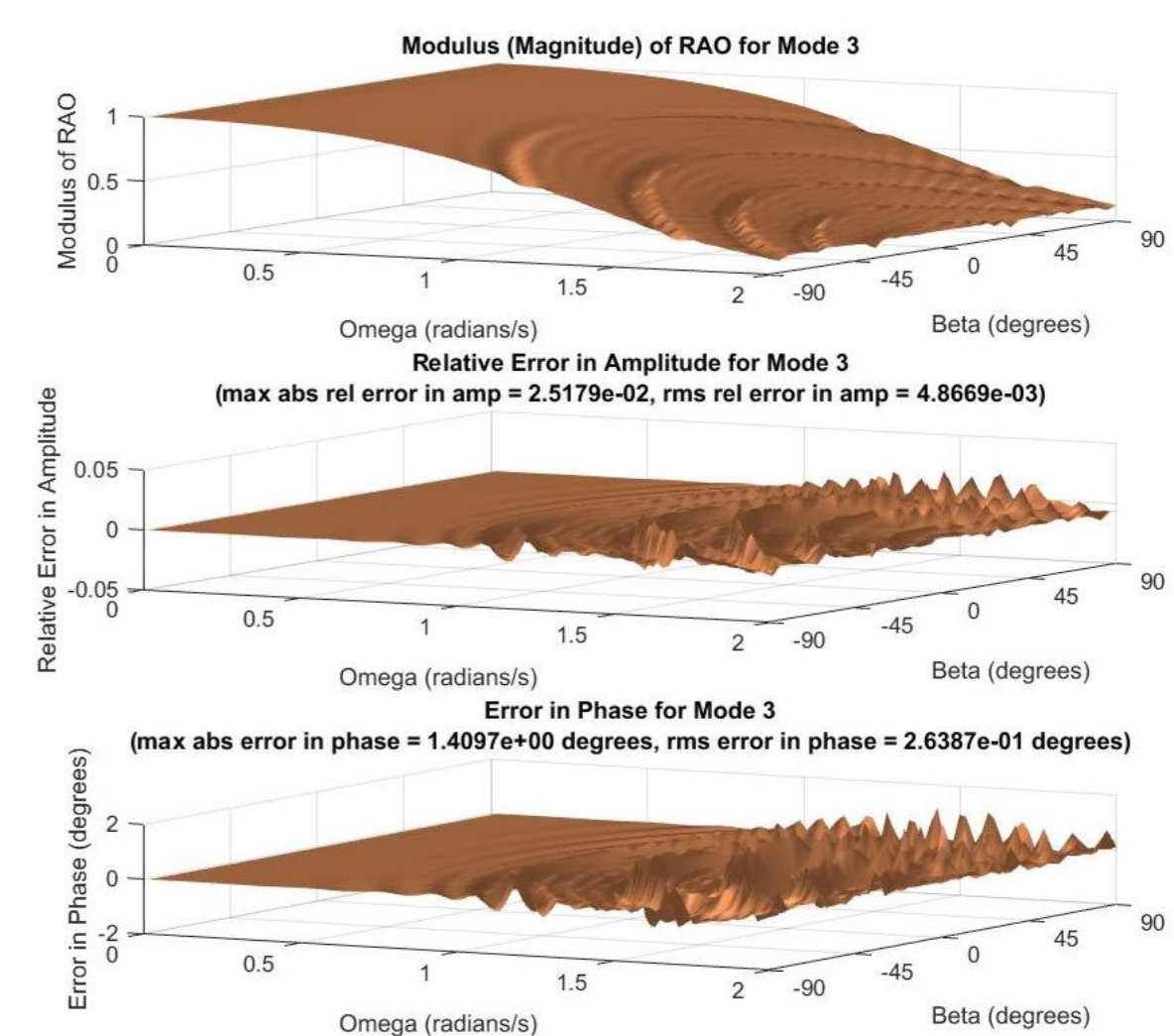
The OceanEd software is stored on the open-source hosting website GitHub and can be downloaded from:

<https://github.com/D-Forehand/OceanEd>

### Speed and Accuracy

The resulting time-domain array models are fast because they use a single radiation state-space model to approximate the complete set of radiation convolution terms (see Figure 2). It is very difficult to derive a numerically stable radiation state-space model and this code is designed to attempt to do this [1].

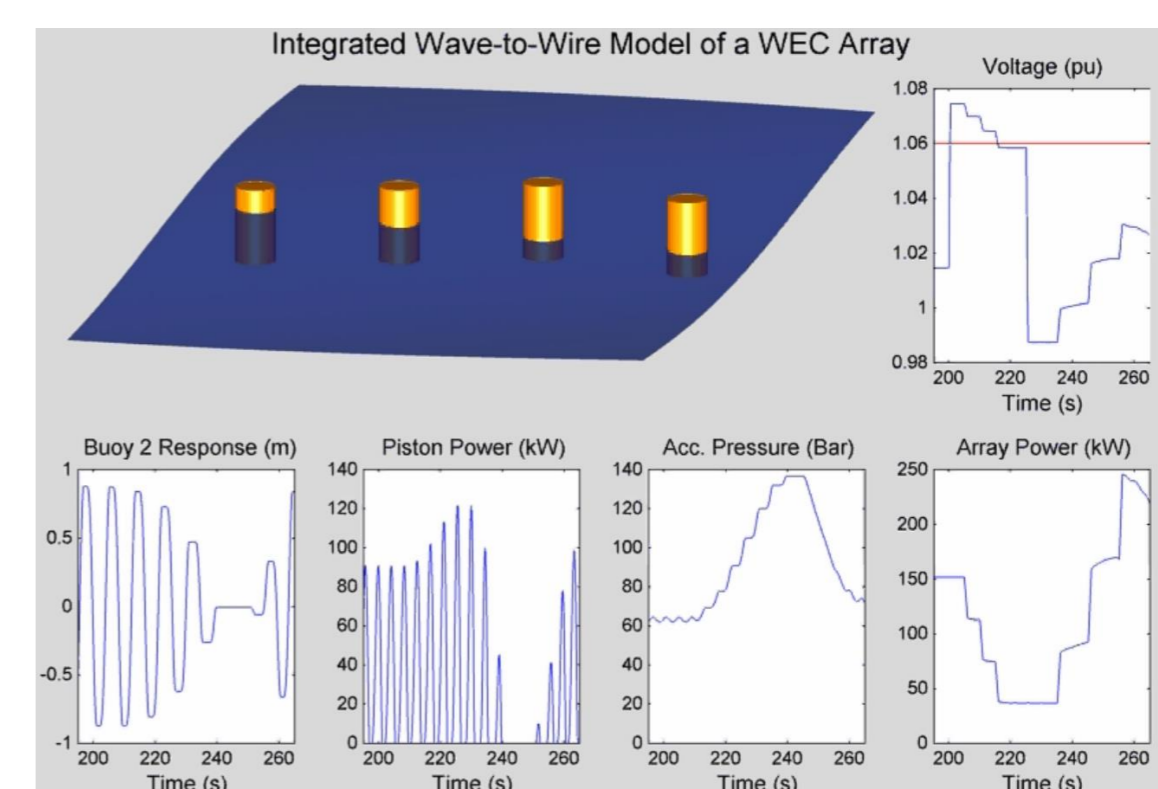
The OceanEd software also includes a post-processing code which checks the accuracy of the derived time-domain models (see Figure 4).



**Figure 4:** RAO and error surfaces for checking the accuracy of the time-domain model.

### Future Developments

The hydrodynamic time-domain WEC array model has been incorporated into a wider bi-directional wave-to-wire model. The rest of this wider wave-to-wire model is not yet open source but the plan is to make it open source in the near future.



**Figure 5:** The wider wave-to-wire model investigating an electrical network fault.

### References

- [1] Forehand, D.I.M., Kiprakis, A.E., Nambiar, A.J. and Wallace, A.R. (2016) "A fully coupled wave-to-wire model of an array of wave energy converters". IEEE Transactions on Sustainable Energy. Vol. 7, No. 1, pp. 118-128.