# Time Domain Modelling of Array Interaction

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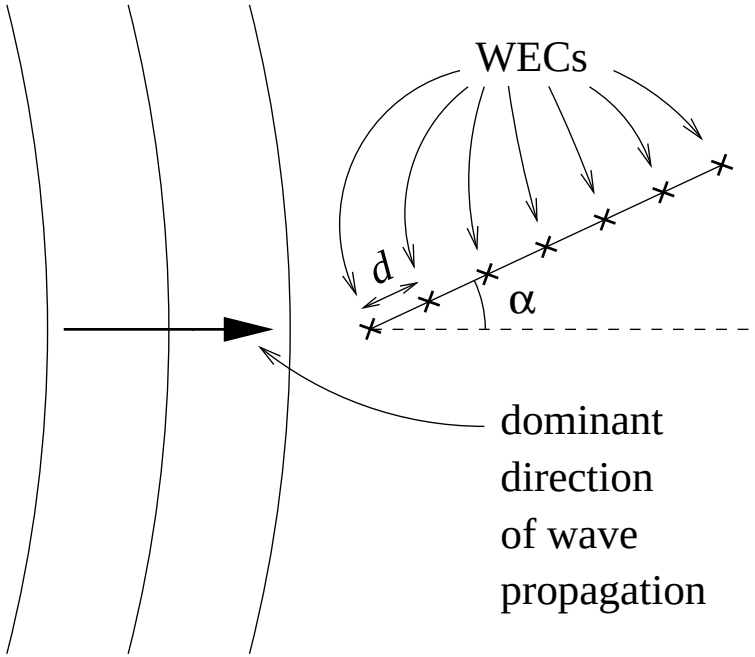
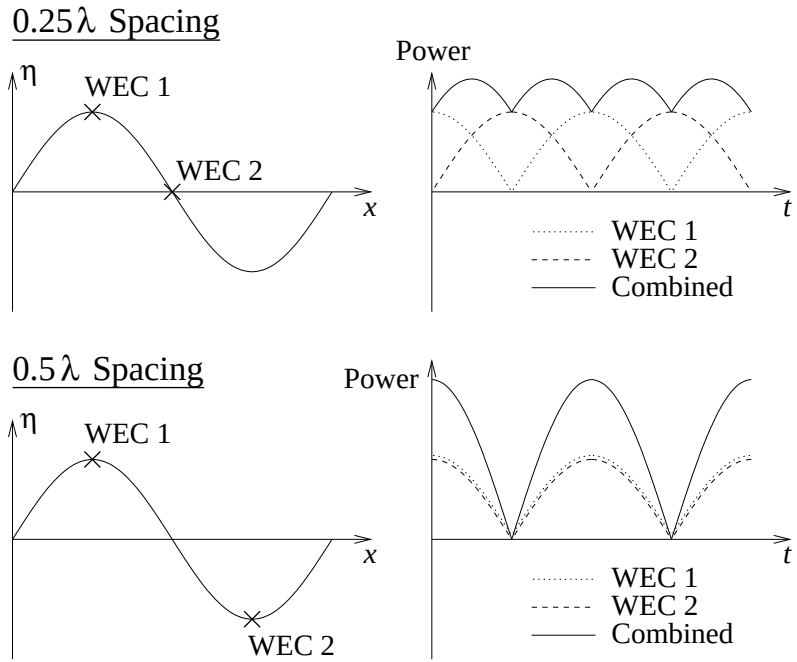
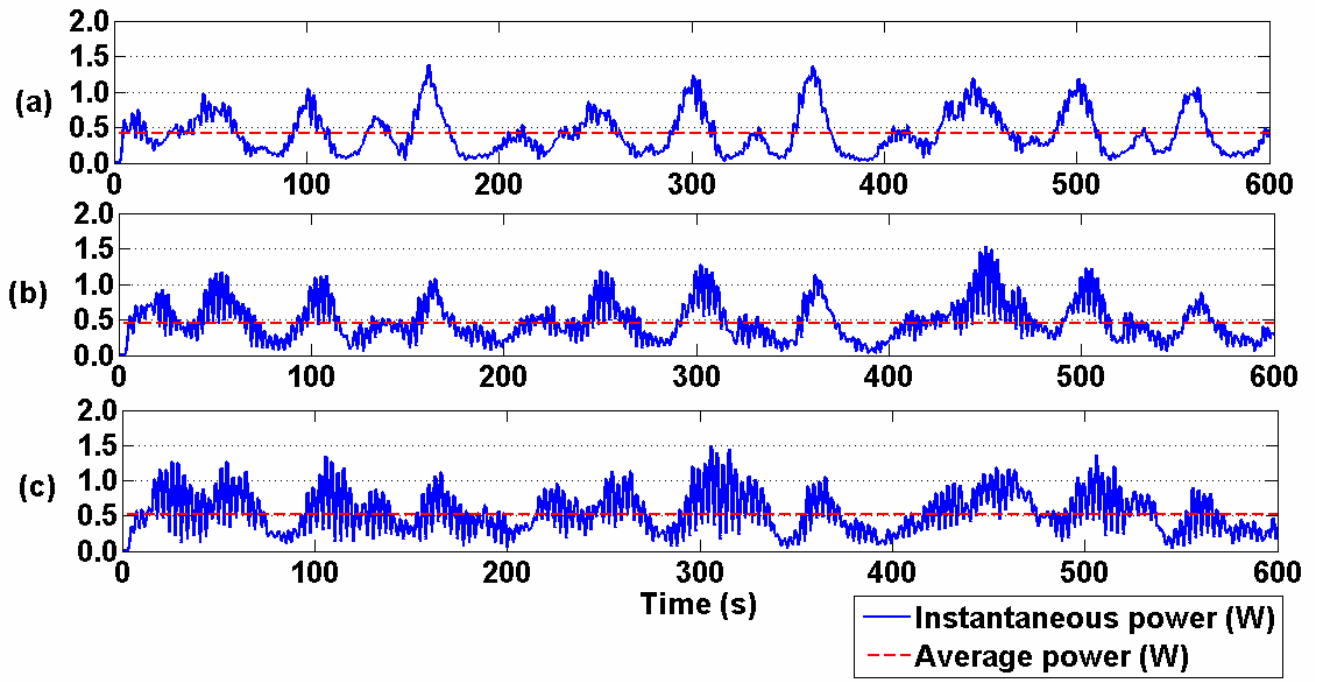
# Initial Array Modelling

Time domain model of an array of individual buoys with aggregated power output – adjustable spacing, wave direction and spectra.



# Aggregate Mechanical Power from Array in Irregular Seas



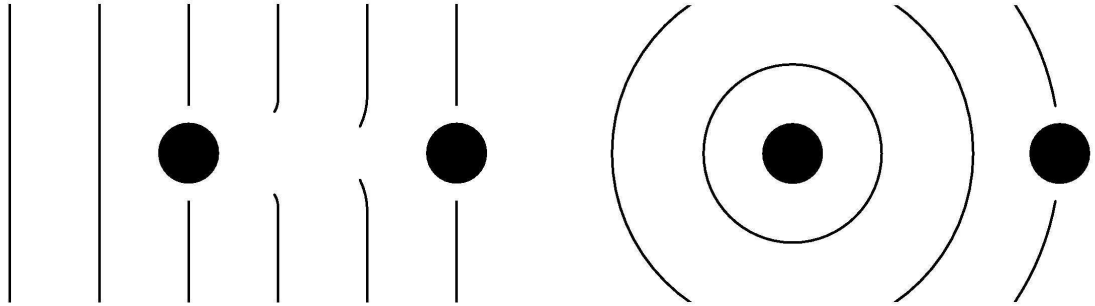

(a) $d = 0.25\lambda_{peak}$

(b) $d = 0.375\lambda_{peak}$

(c) $d = 0.5\lambda_{peak}$

Limitations:

No hydrodynamic coupling between buoys … neither



Diffraction, nor … Radiation

# Time Domain Array Model with All Hydrodynamic Interactions

Most existing array models are frequency domain.

To fit into an overall model, including control systems, we needed to develop a time domain model.

The time domain model being developed:

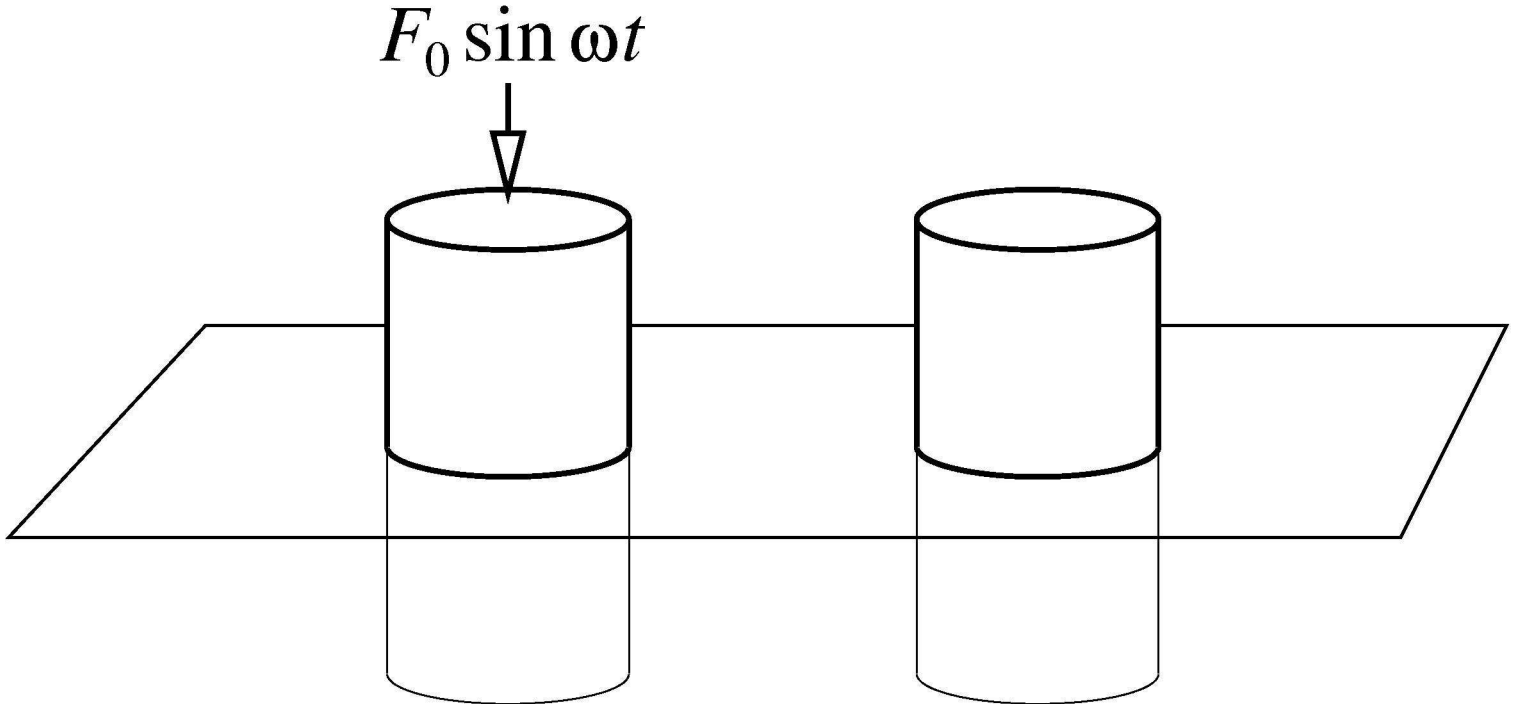
- Takes hydrodynamic coefficients from one frequency domain simulation.
- Embodies them in fully mathematically and physically rigorous equations of motion.
- Solves equations simply and quickly within time-steps for control simulation.

Advantages:

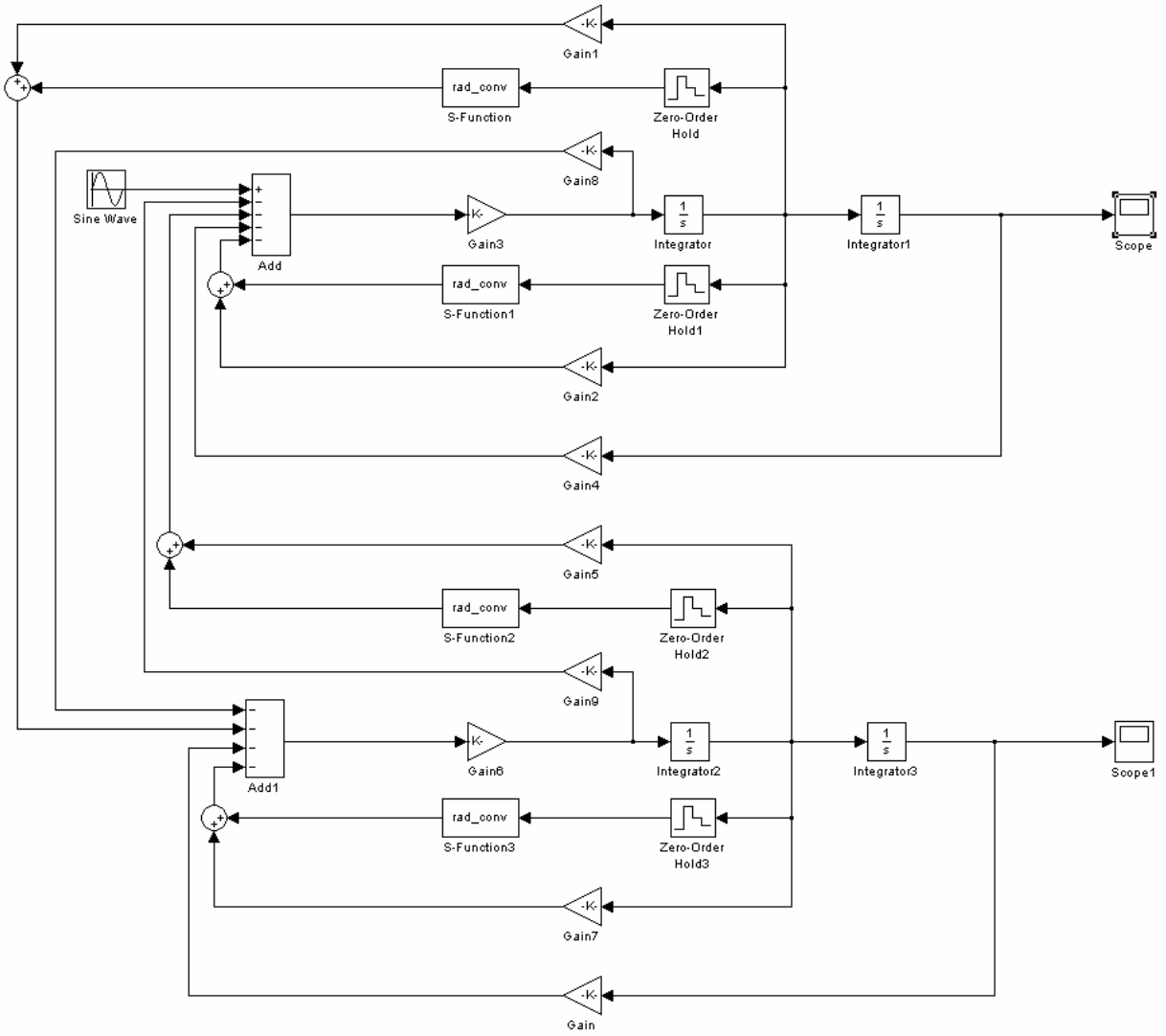
- Allows the implementation and testing of control schemes and algorithms.
- Can model transients.
- Can be extended to include non-linearities.
- Can explore coordinated control algorithms across array.
- Will be incorporated into the wave-to-wire model.

# Interaction

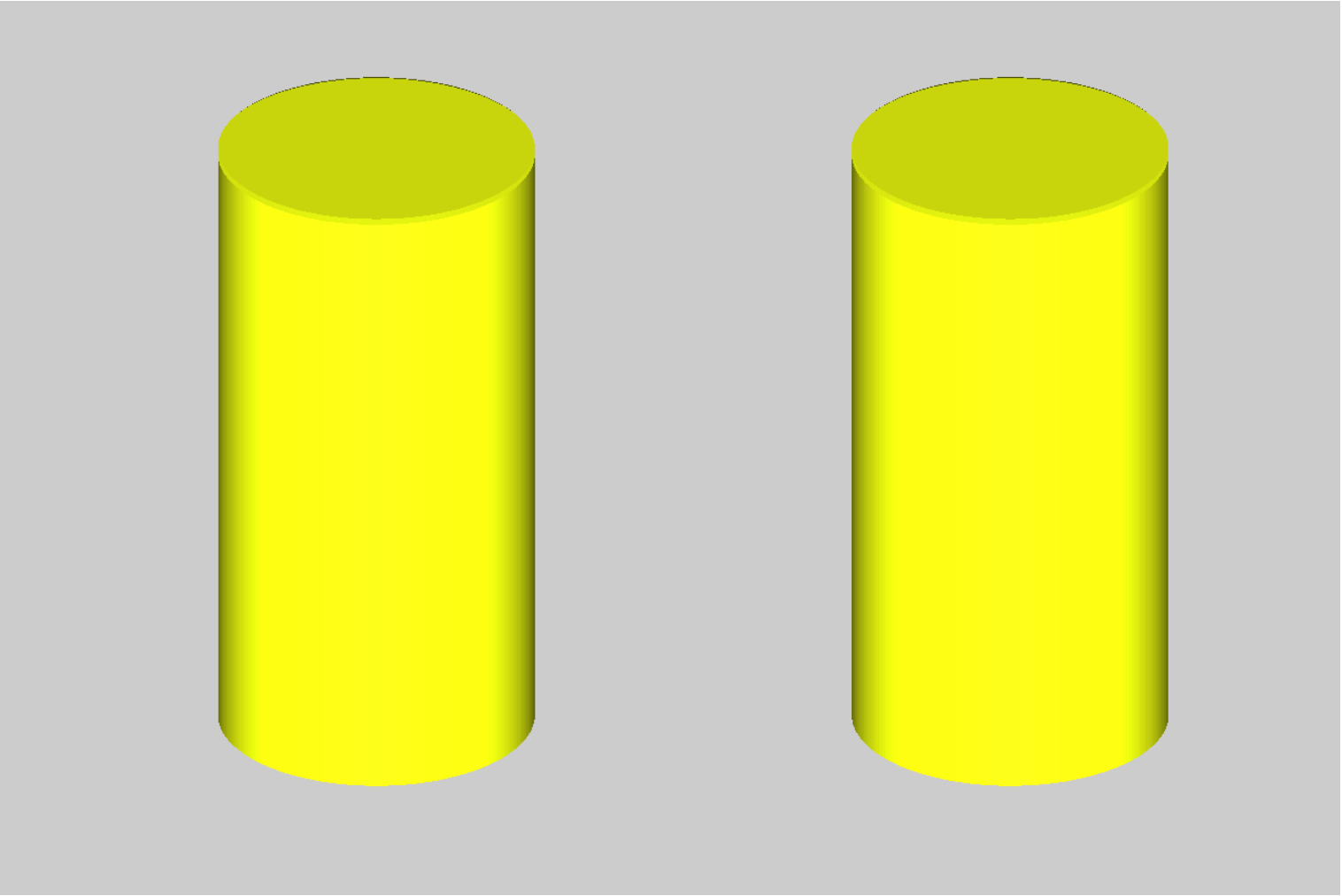
- We can have any number and shape of buoys (or other forms) in an array, with each moving in up to 6 degrees of freedom, but
- Begin with two freely-floating cylinders, constrained to move in heave:



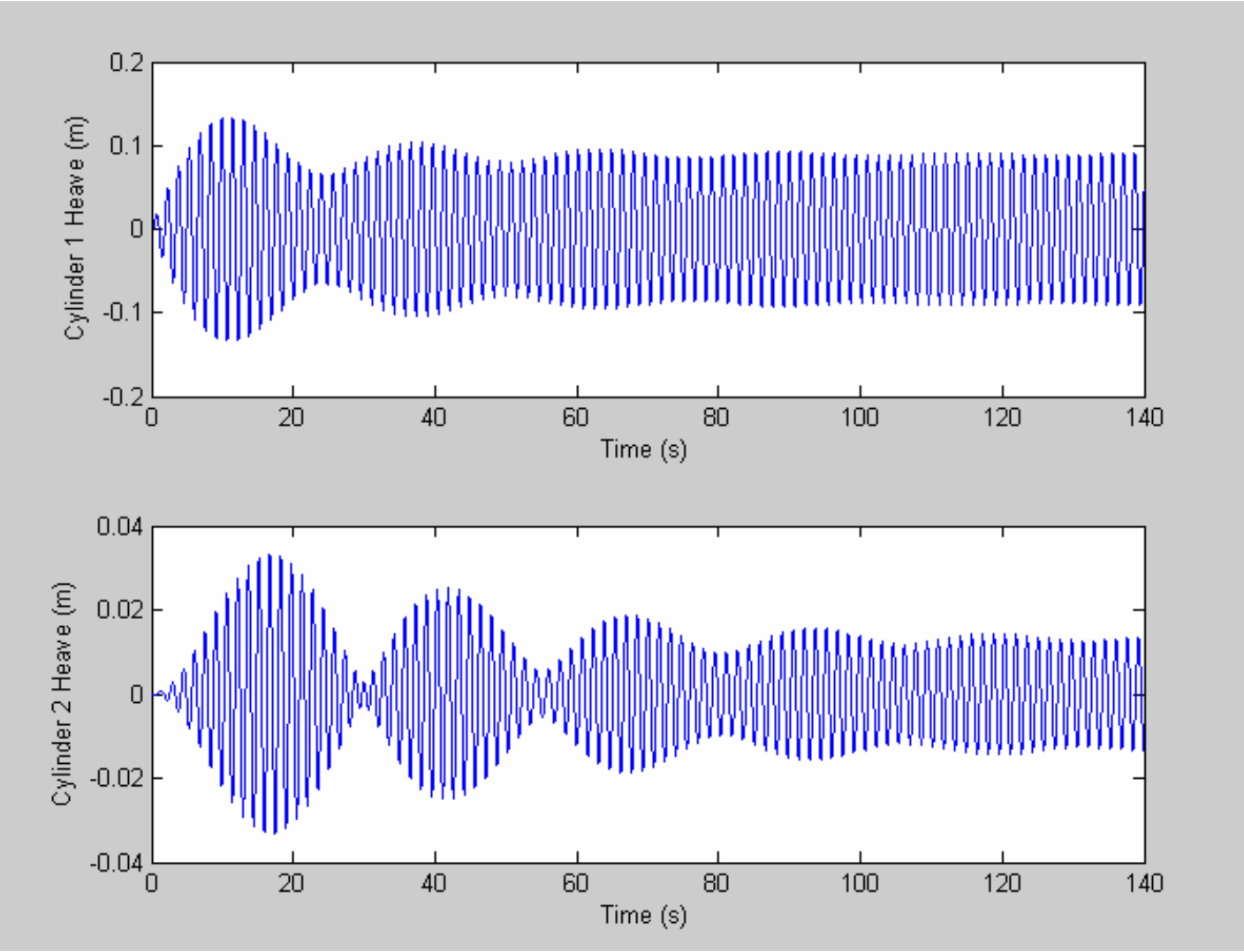
# Simulink Model of the Two Interacting Cylinders



# Animation of Interacting Cylinders



# Motion of Interacting Cylinders



# Conclusions and Further Work

- We are developing a fast and accurate hydrodynamic time domain array model.
- It will be embodied in a wave-to-wire model that integrates Lancaster control and Edinburgh generator models.
- Further work includes:

  incorporation of regular and irregular incident waves.

  testing of different WEC shapes and modes.

  inclusion of non-linear effects.