

Assessing the accuracy of boundary element method codes for wave energy converter simulation

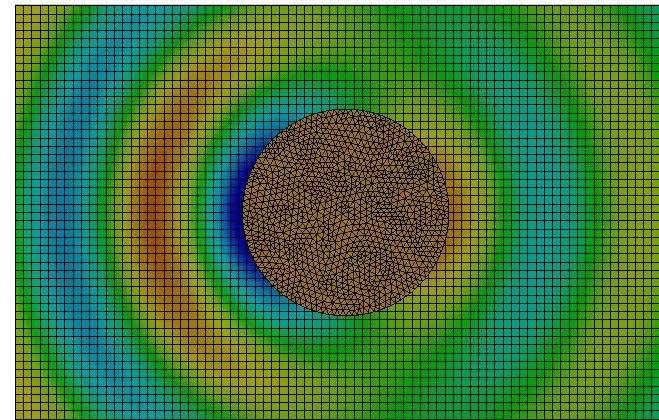
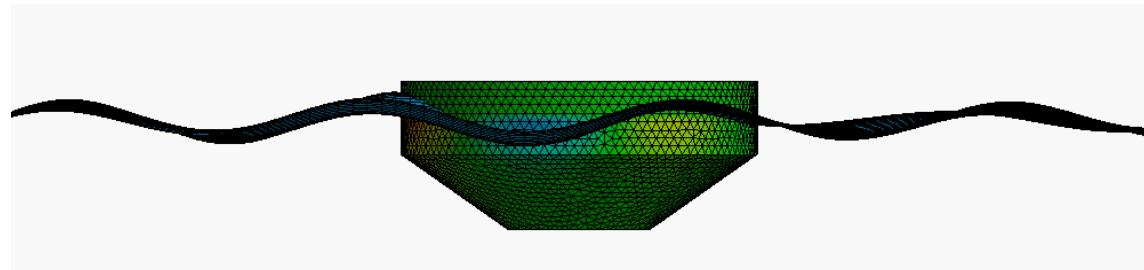
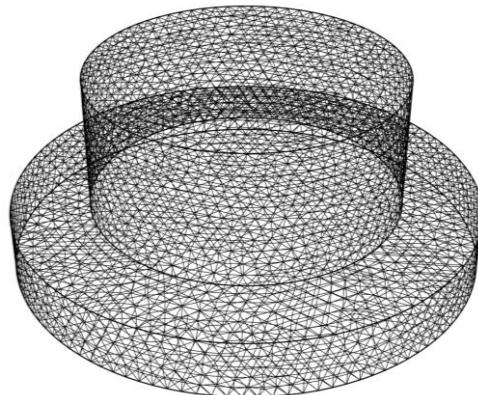
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Boundary Element Methods

$$\nabla^2 \phi = 0$$



Images:

<https://www.wamit.com/>

<https://capytaine.github.io/stable/#>

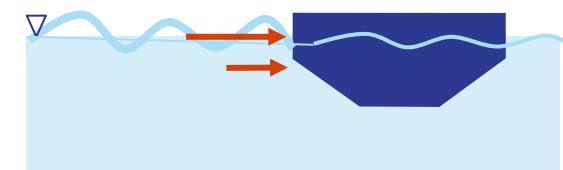
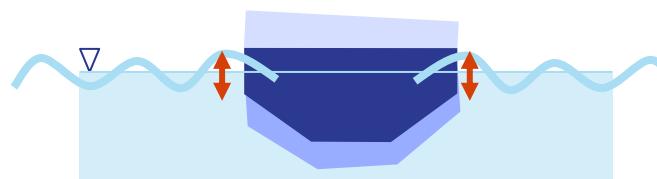
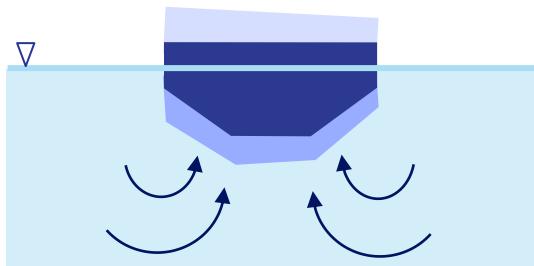
WEC Hydrodynamics

$$(-\omega^2(M + A(\omega)) + i\omega B(\omega) + K)\hat{X} = \hat{F}_{exc}(\omega)$$

Added Mass [kg]
~ acceleration

Radiation Damping
[N-s/m] ~ velocity

Excitation Force [N/m]



Goals

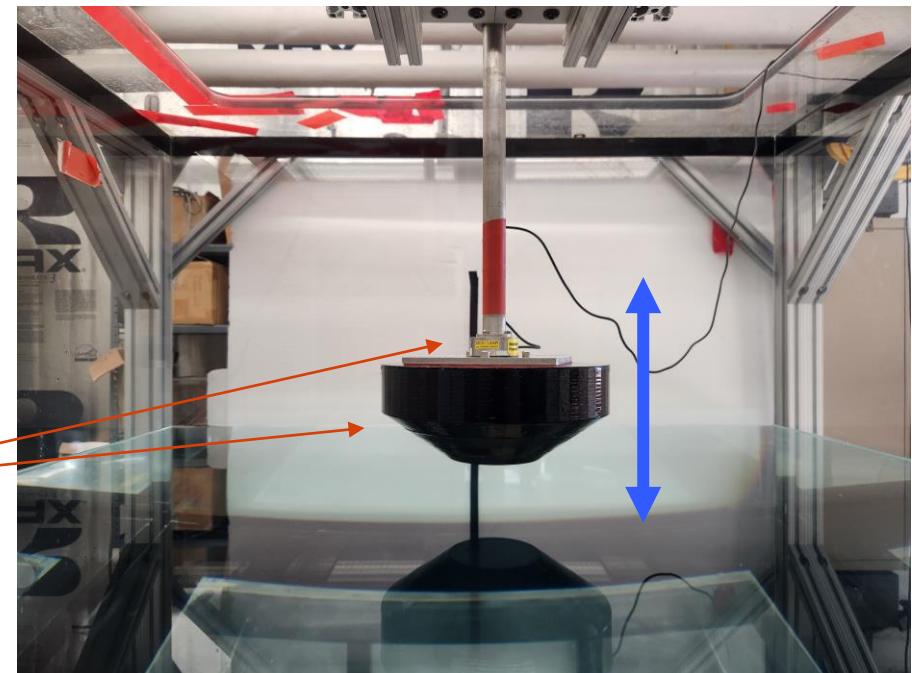
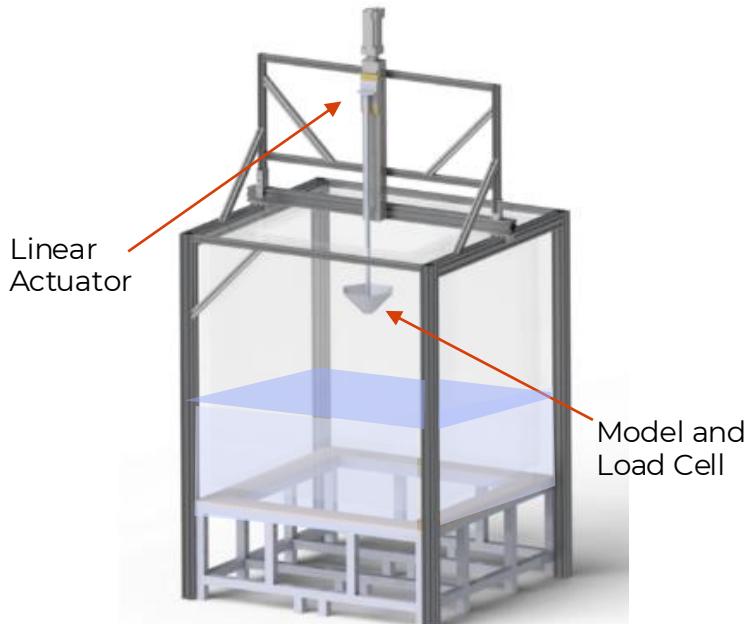
Characterize the hydrodynamic coefficients from BEM for various WEC floats and assess the impact of geometric variation across BEM codes and against experimental results.

- Evaluate changes in hydrodynamics between BEM codes for each geometry
- **Compare BEM with experimental results to estimate potential inaccuracy**

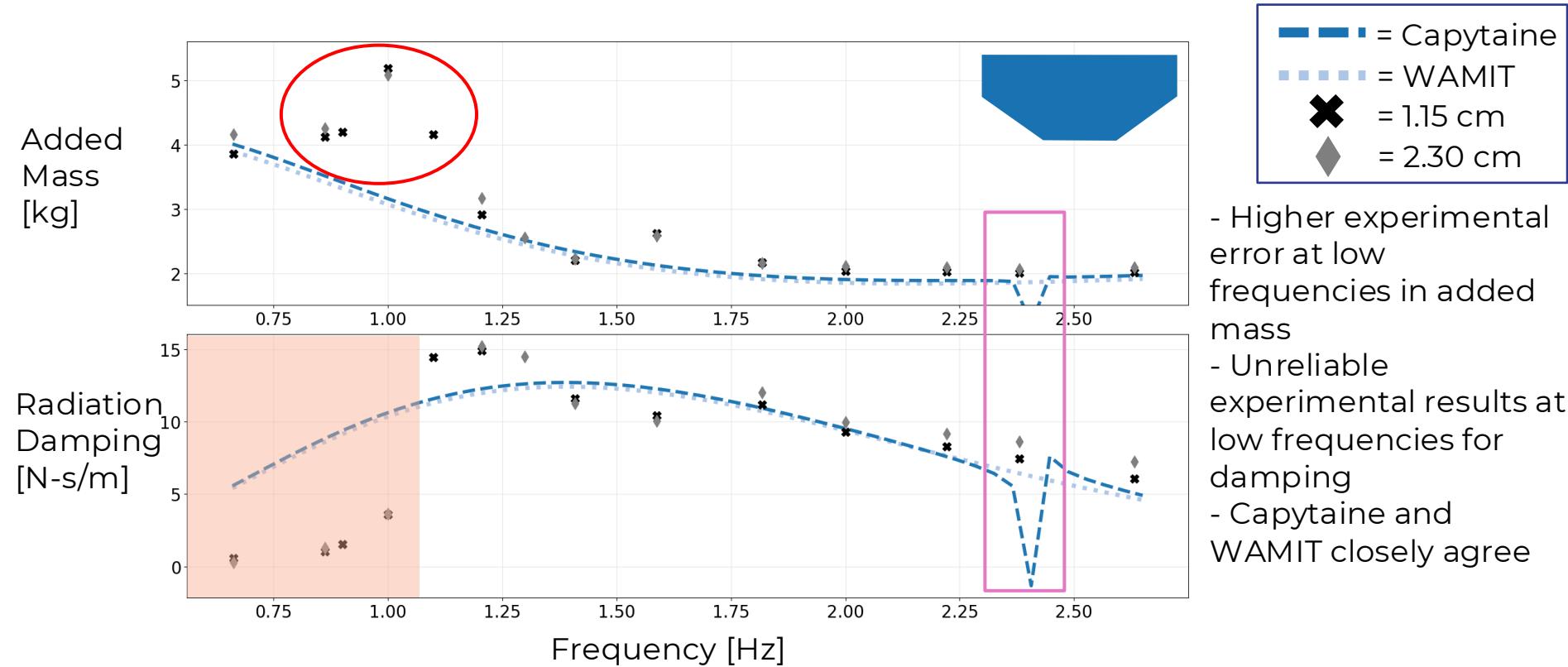
Float Geometries

Shape	Description
WaveBot	 Benchmark case: 1/7th scale of Sandia National Labs WaveBot experiments

Experimental Methods

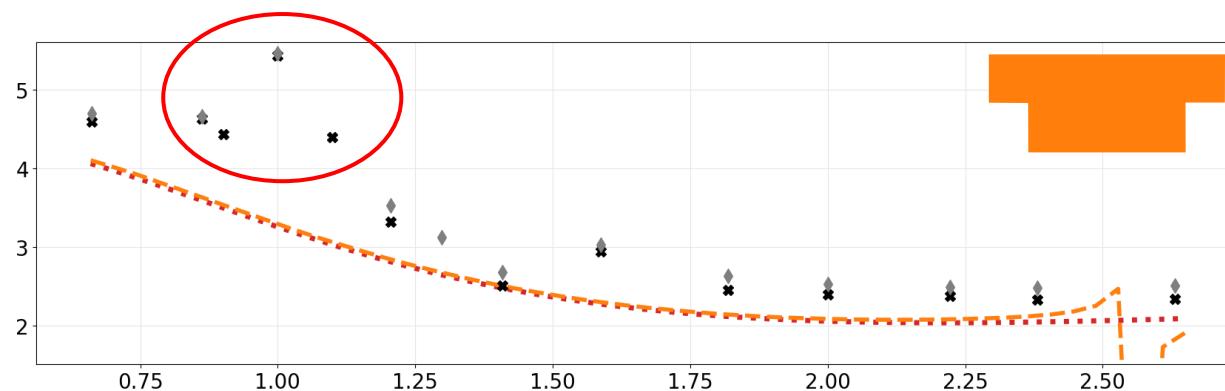


WaveBot BEM vs. Experiments

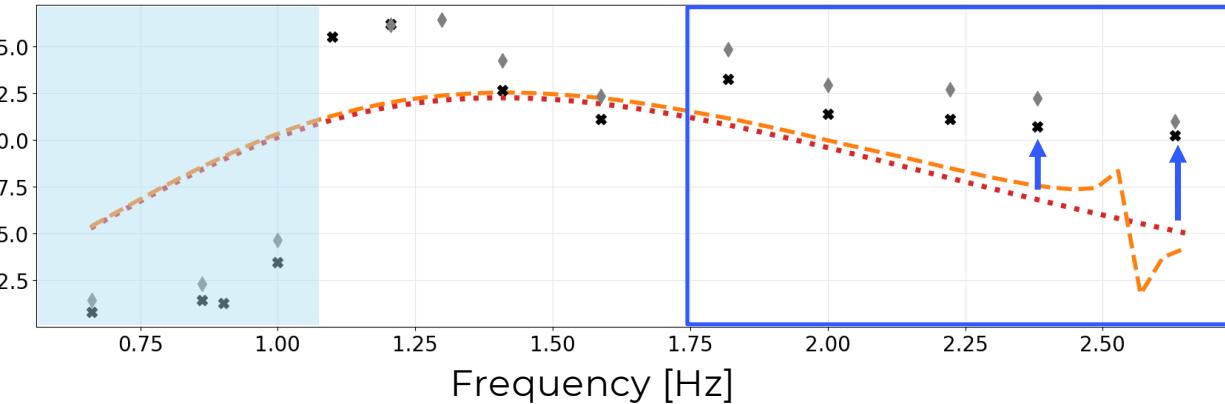


“T” BEM vs. Experiments

Added Mass
[kg]



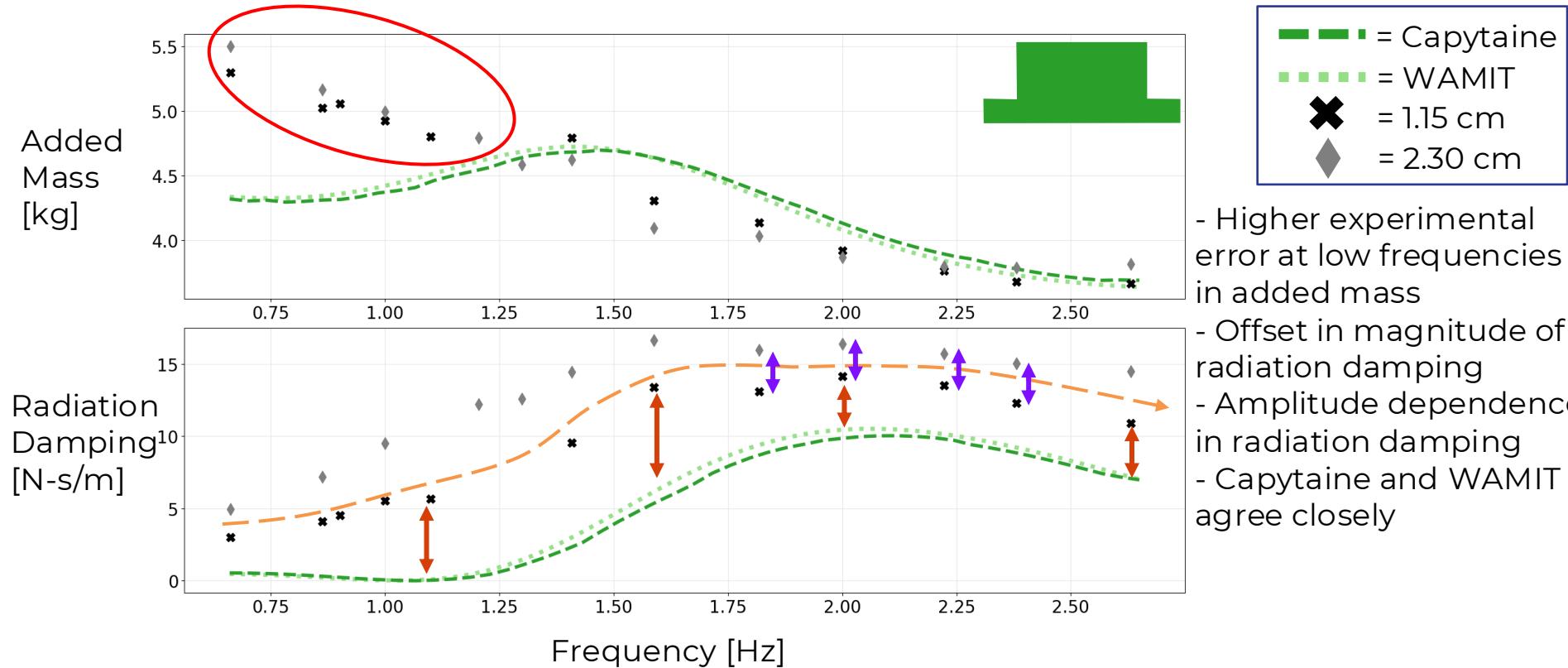
Radiation Damping
[N·s/m]



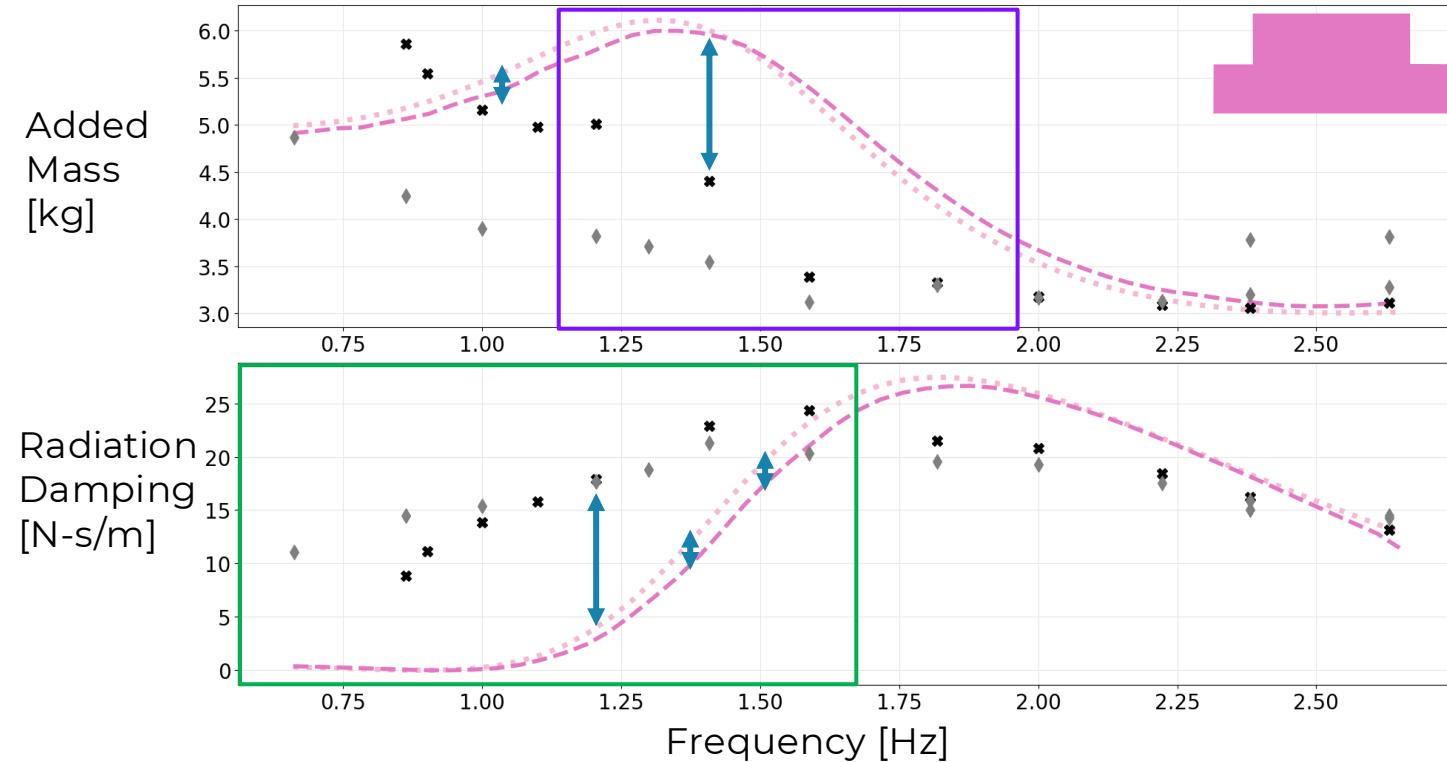
= Capytaine
= WAMIT
= 1.15 cm
= 2.30 cm

- Higher experimental error at low frequencies in added mass
- Unreliable experimental results at low frequencies for damping
- Experiments diverge from BEM at higher frequencies
- Capytaine and WAMIT closely agree

Thin Hat BEM vs. Experiments



Thick Hat BEM vs. Experiments



- BEM overpredicts added mass at middle frequencies
- BEM underpredicts damping at low frequencies
- Capytaine and WAMIT agree less closely
- This shape is difficult for BEM to model



Conclusions

- There is limited variation in BEM results from Capytaine and WAMIT for most geometries, especially **non-brimmed** geometries
- BEM and experiments agree in both magnitude and behavior for most frequencies for **non-brimmed** geometries
- BEM struggles to predict the hydrodynamics of a geometry with a brim near the free-surface



Questions?

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