PACCAR
Tank Sloshing Simulation

Introductions

Gavin Chan
Mechanical Engineering
gkwc@uw.edu

Katherine Butler
Mechanical Engineering
keb333@uw.edu

Karissa Anderson
Mechanical Engineering
kbostic2@uw.edu
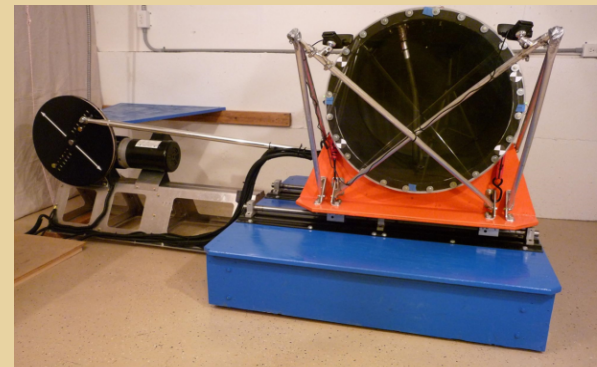
MECHANICAL ENGINEERING
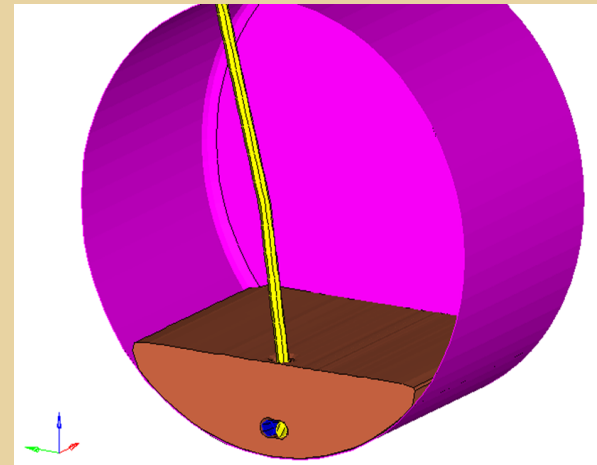
UNIVERSITY *of* WASHINGTON
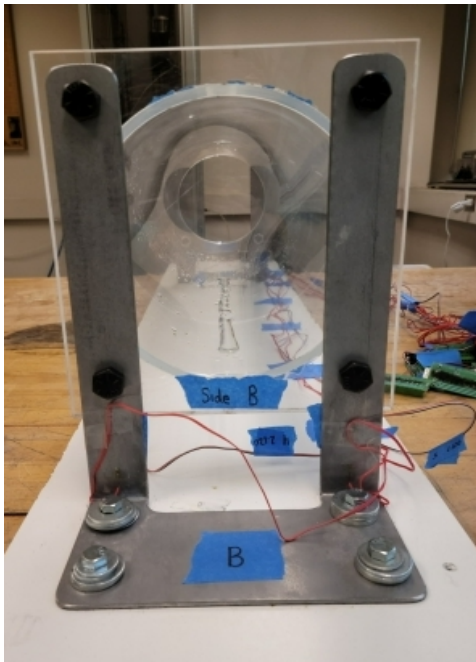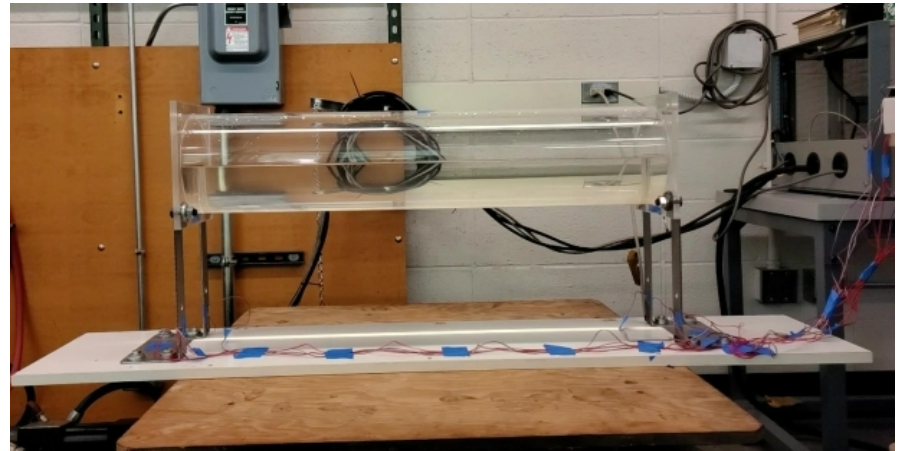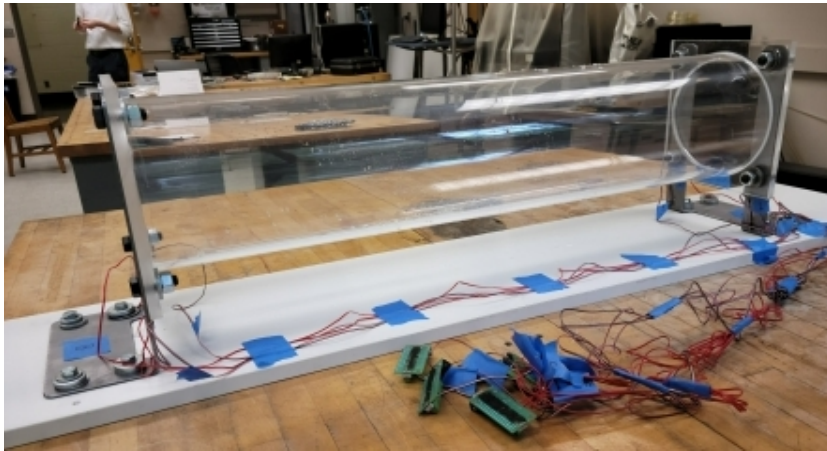
W

Problem Definition

Aim: Improve models of fluid sloshing in tanks. Focus on the structural effects on tank & mounting frame

Building on Speirs' study
- Explore other methods versus Eulerian-Lagrangian (7 hours to compute 1 second)
- Investigate longitudinal motion
- Focus on tank and frame instead of draw/return tube

"A Study of Fluid Sloshing in a Cylindrical Fuel Tank with Laser Scanning to Capture Fluid Motion and Coupled Eulerian-Lagrangian Simulation", Ben Speirs, 2013
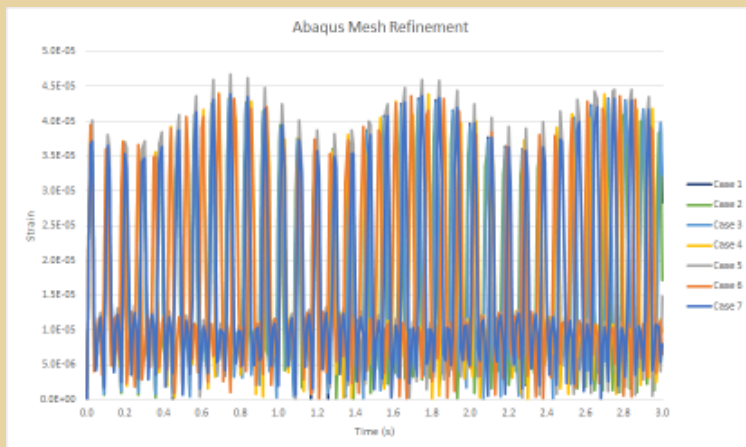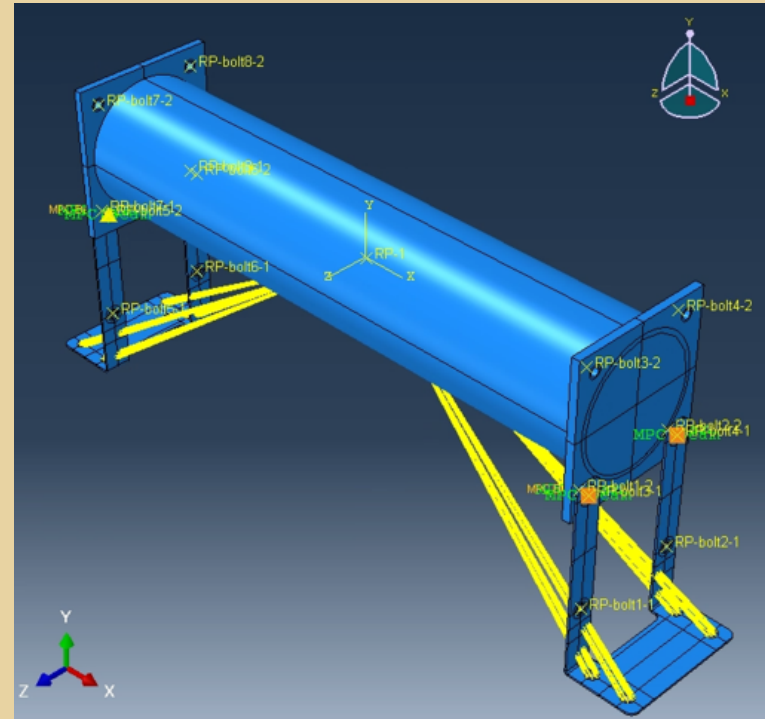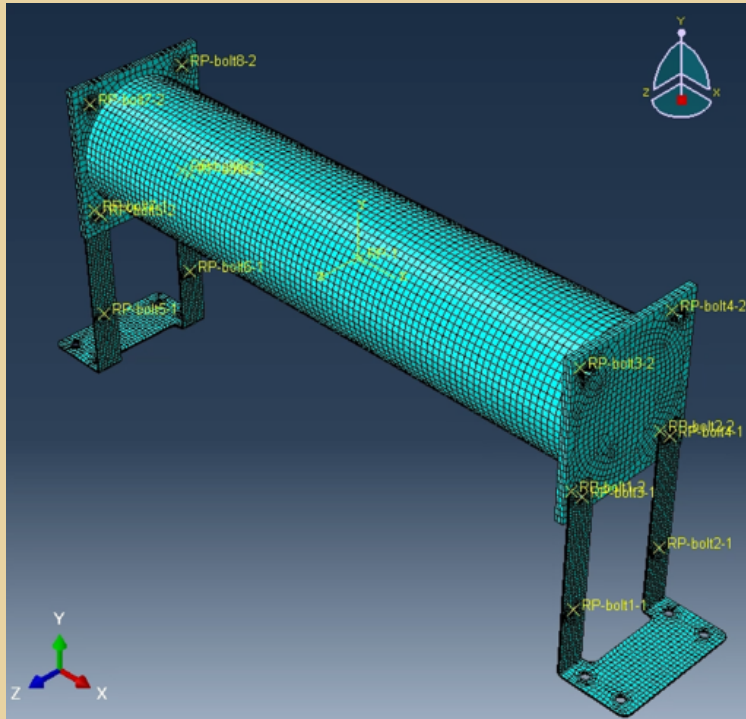
Experimental Setup

> Length: 36in

> Diameter: 7.5in

> 4 strain gauges to form a load cell

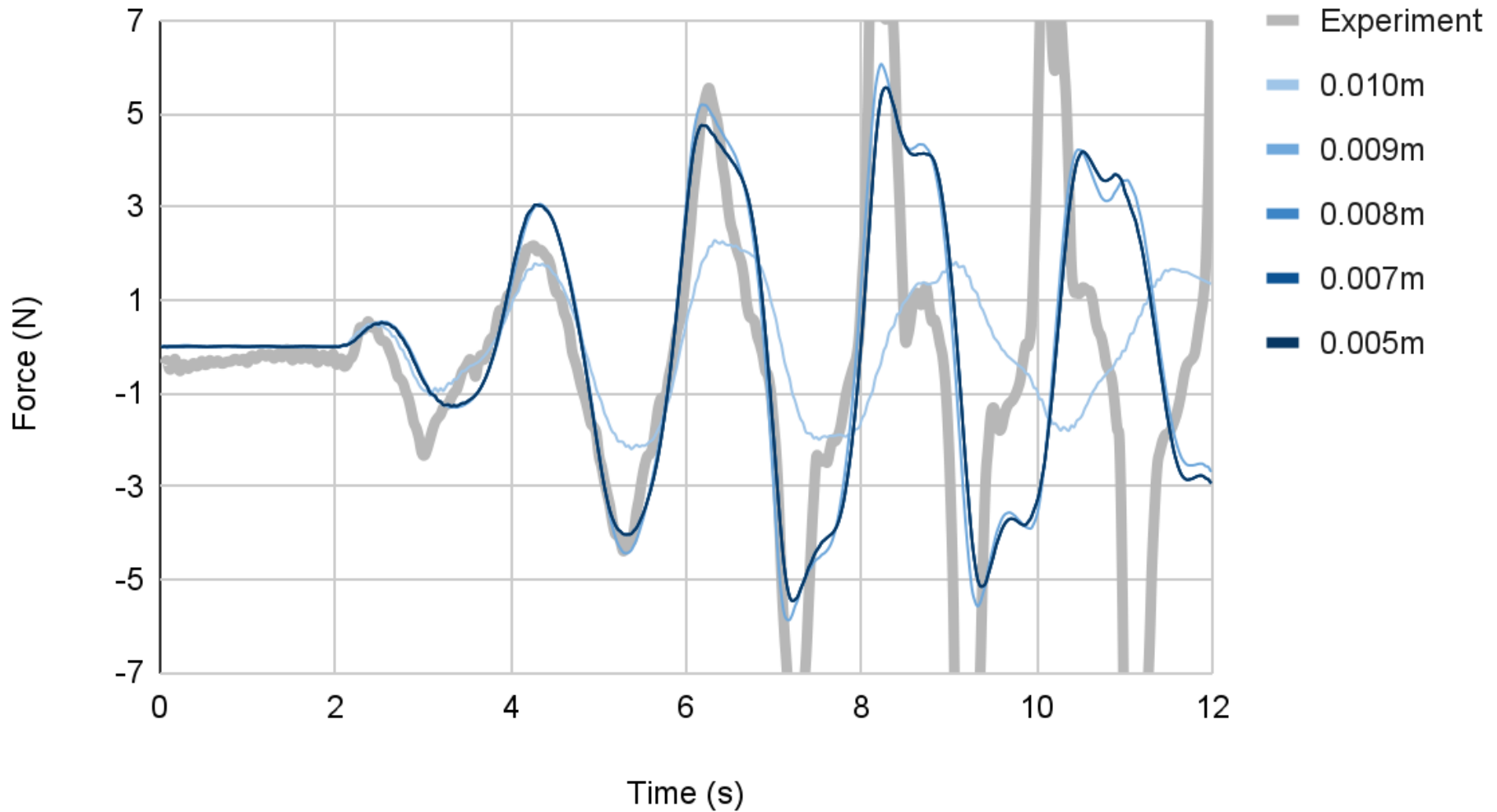> Moved tank up from initial design

W
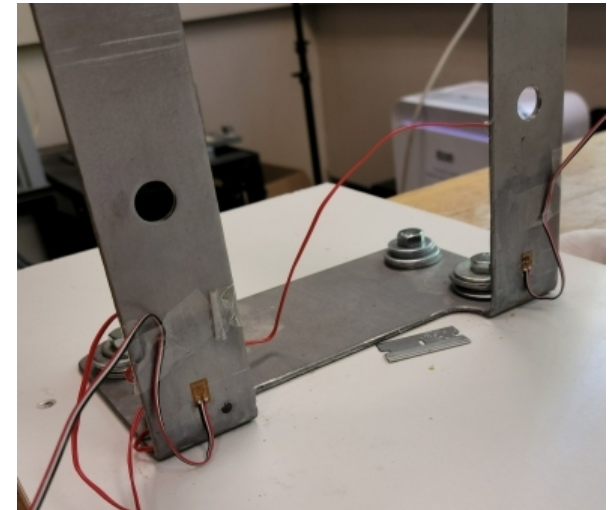
Abaqus

- Dynamic, Implicit
- Input file for co-simulation (BC, loads, co-sim region)

STAR-CCM+

Mesh Refinement Study

Results: Numerical

0.5Hz 15mm
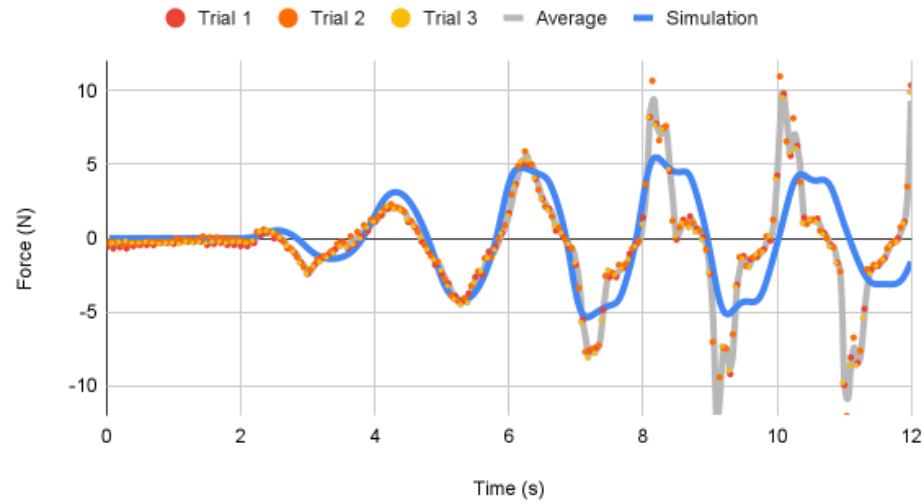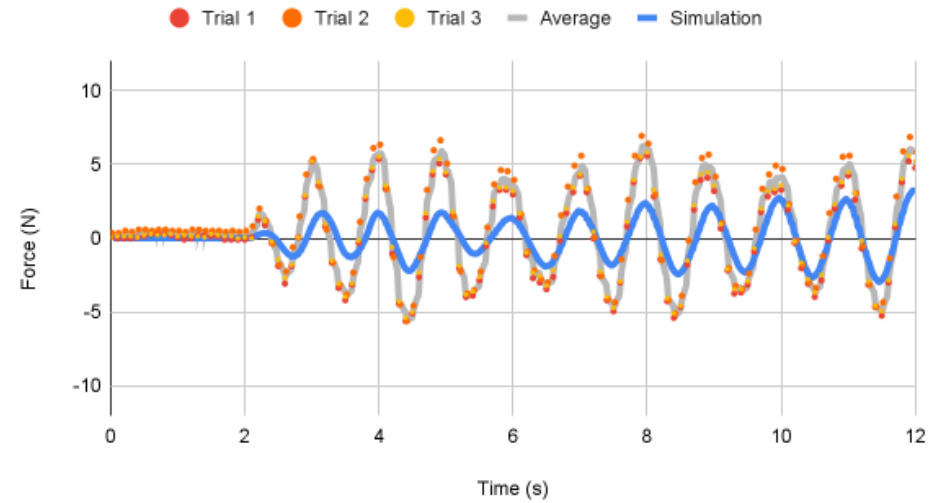
● Trial 1 ● Trial 2 ● Trial 3 — Average — Simulation

1Hz 15mm

● Trial 1 ● Trial 2 ● Trial 3 — Average — Simulation

2Hz 10mm

● Trial 1 ● Trial 2 ● Trial 3 — Average — Simulation

Co-simulation

Volume Fraction of Water
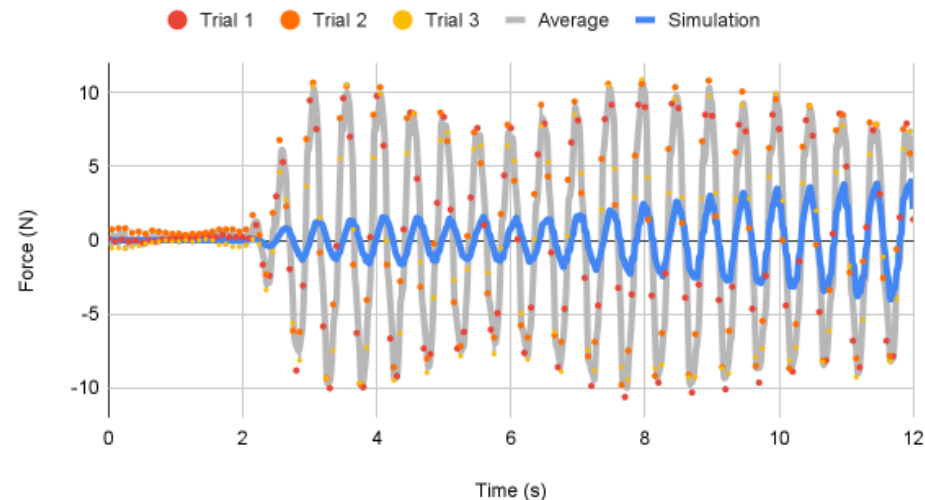
0.00   0.20   0.40   0.60   0.80   1.00

Results: Visual

Volume Fraction of Water

| 0.00 | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 |

Conclusion and Next Steps

> Experimental model
- Overall, Success!
- Could improve readings with narrower brackets

> STAR-CCM+
- Accurately predicts frequency
- Amplitude/decay rate not so accurate
- 20 minutes to compute 1 second

> Co-simulation
- Vibrations, unstable
- 50 minutes to compute 1 second, promising approach
- Could be improved with more time to iterate

Acknowledgements

Thank you to our mentors and PACCAR representatives!

> UW faculty mentors: Per Reinhall, Alberto Aliseda, Eli Patten

> UW technical mentors: Bill Kuykendall, Eamon McQuaide, Sari Barczay, Winston Shunsuke, Syed Faisal

> PACCAR mentors: Ben Speirs, Dave Pringle, Jonathan Chen, Aisha Gautam

We appreciate all your support throughout the project.

MECHANICAL ENGINEERING
UNIVERSITY *of* WASHINGTON

PACCAR
Tank Sloshing Simulation