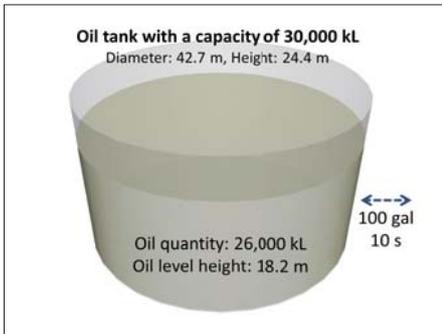


Sloshing in an Oil Tank

Sloshing in an oil tank is analyzed using scSTREAM

Case study: Analysis of an Oil Tank

Analysis Model



Oil reserves	26,000 [kL] (Density 740 kg/m ³ , viscosity 0.0026 Pa·s, surface tension coefficient 0.020 N/m)
Roll	<ul style="list-style-type: none"> • 100 gal (magnitude 5, acceleration 1 m/s²) • 10 seconds continuous • 5-second period as a long-period oscillation
Number of mesh elements	1,306,800 (structural mesh)

- Sixty seconds in real time are analyzed by MARS (Multi-interface Advection and Reconstruction Solver) method
- Time step is set automatically such that the Courant number does not exceed 0.9

Figure 1: Oil tank with a capacity of 30,000 [kL]

Consideration on Reduction in Computation Time

<p>(1) Symmetry plane setting The number of elements is reduced to 653,400 by applying a symmetry plane as shown in the figure above. Computation time is shortened by 52%.</p>	<p>(2) Parallel computation With 2-parallel computation, computation time is further shortened by 47%.</p>	<p>(3) Partial rough gridding Grid is made rougher below the oil surface at the time when its height difference is the maximum. The number of elements is reduced to 505,296, and computation time is reduced by 23%.</p>	<p>(4) 1-fluid setting One-fluid setting of Solver can be used. Computation speed can be improved by 30%.</p>
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Computation time reduced from **4 hours** to **0.5 hours**
 Reduction by **86%** from the initial setup

Analysis Results

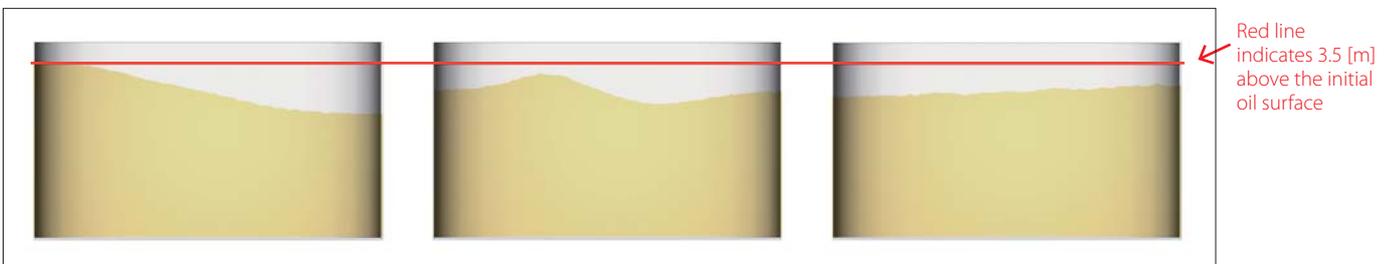


Figure 2: The maximum oil surface height. Left: 5 sec. period (t=13 [sec.]), middle: 4 sec. period (t=15 [sec.]), right: 2 sec. period (t=17 [sec.])

Notes

Figure 2 shows the analysis results with 100 [gal] roll and different roll periods. Figure on the left is the capture of the maximum surface height for the 5-second period case, in the middle is for the 4-second period case, and on the right is for the 2-second period case. It can be seen that a resonance occurs for the 5-second period case, which is close to the characteristic period of the sloshing.