

Ship Half-Space Acoustic Scattering Case Study

30 m reference guided hull | FastBEM Acoustics V9.0 | 2 kHz soft half-space analysis

Boundary elements	Boundary nodes	Field points	Frequency	Iterations	Wall time
100,264	50,701	749,316	2 kHz	17	747.60 s

Study method and numerical setup

Objective: Evaluate an inclined plane wave scattered by a 30 m reference-guided ship wetted hull beneath a pressure-release water surface, resolving both hull pressure and the vertical underwater field.

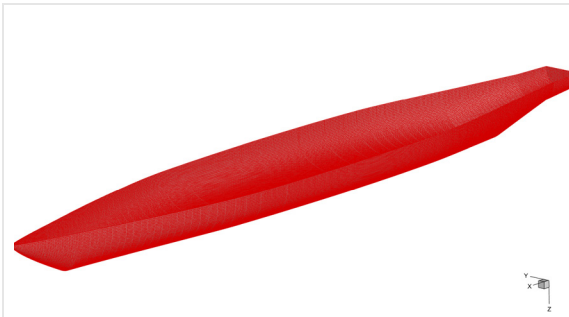
Key steps:

1. Reconstruct a smooth parametric wetted hull from the original CAD model's principal dimensions and section character while removing small appendages and pipes.
2. Generate a nearly uniform 100,264-element triangular boundary mesh with inward orientation. The minimum angle is 16.98 degrees and maximum aspect ratio is 4.41.
3. Place the hull in the positive-Z water domain with its upper edge 0.001 m below the soft $z=0$ half-space plane; no artificial closing cap is included.
4. Apply a unit-amplitude inclined plane wave in the direction $(-1, 1, -1)$. The incident-plus-image field satisfies zero pressure on the soft plane.
5. Sample scattered pressure on a vertical $y=0$ field surface: 300 x 100 m, 0.2 m Q4 cells, with a 36 x 3 m notch around the hull.
6. At 2 kHz the water wavelength is 0.75 m; the median boundary edge is 0.0557 m, about 13.5 elements per wavelength.

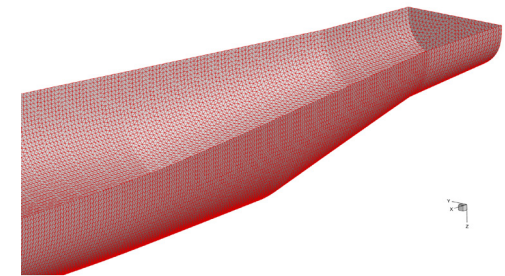
FastBEM setup:

Medium $c = 1500$ m/s and density $= 1000$ kg/m³
FMM parameters $p = 16$; 200 elements per leaf; $1.0E-3$ convergence tolerance; 10 CPU threads.

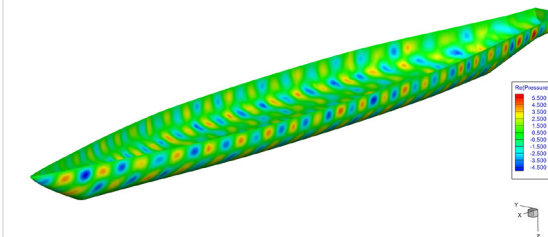
Model and computed response



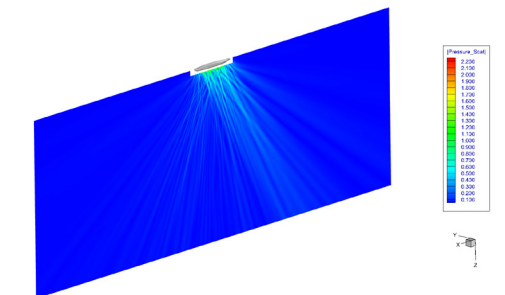
Full 100,264-element triangular boundary mesh



Local boundary-mesh detail



Computed boundary total acoustic pressure



Scattered pressure on vertical field surface

Result. The FMM solution converged normally in 129 iterations to a residual of $9.860E-4$. The complete run used 729.64 s wall-clock time, including direct evaluation at 749,316 field points. The computed contours resolve the oscillatory hull pressure and the downward scattered-wave pattern beneath the pressure-release surface, with the inclined plane wave in the direction $(-1, 1, -1)$.