Wavefront Queue 3-D

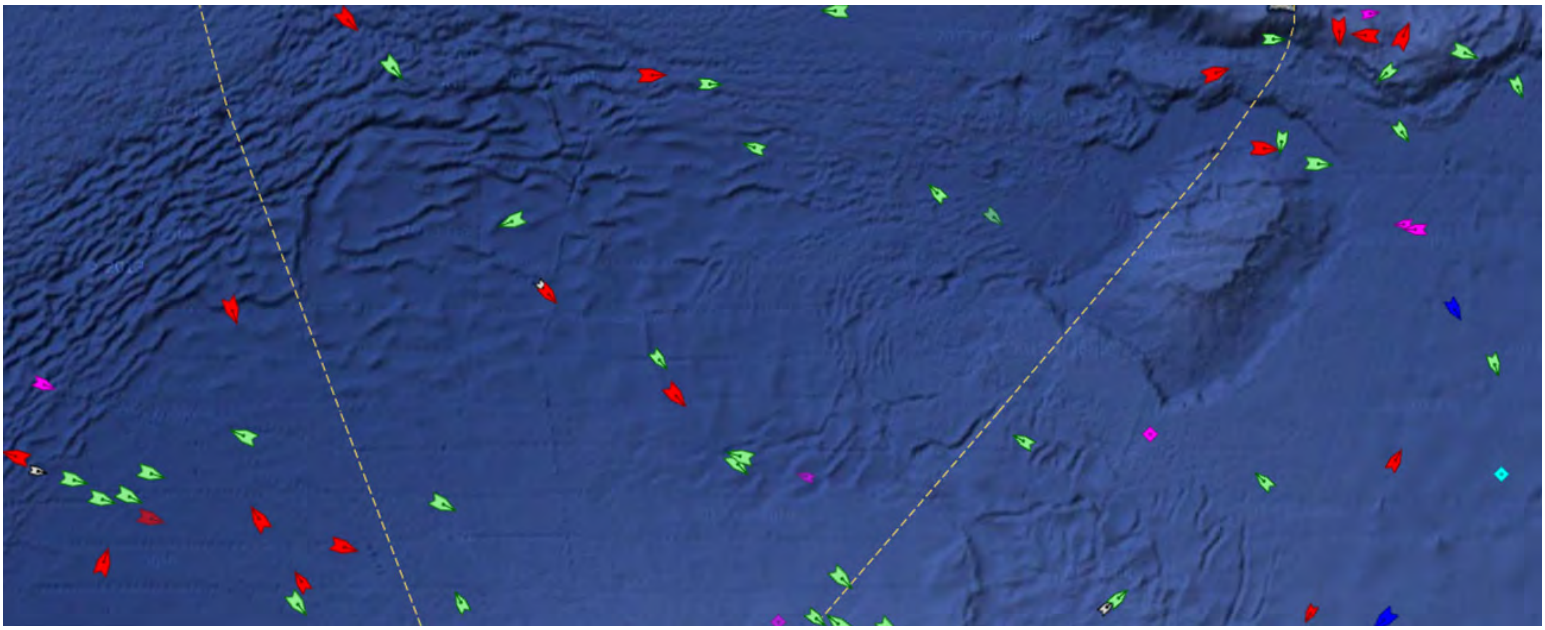
EXHIBIT FACT SHEET

Wavefront Queue 3-D

Developing sonar proficiency in littoral environments requires operators to distinguish threat submarines from large numbers of false targets and clutter in a dynamically evolving scenario, like the one illustrated in Figure 1. As threat submarines become quieter, sonar operations are increasingly relying on active sonar. Training systems now have new requirements for accurate simulation at frequencies above those traditionally used for passive sonar (below 100 Hz). Unfortunately, many existing efforts at improving active sonar simulation speed have either weakened the requirement for realistic solutions, such as the Automated Signal Excess Prediction System (ASEPS) Transmission Loss Model (ASTRAL) approach, or relied on massively parallel hardware with high acquisition costs, like the Surface Anti-Submarine Warfare Synthetic Training (SAST) approach.

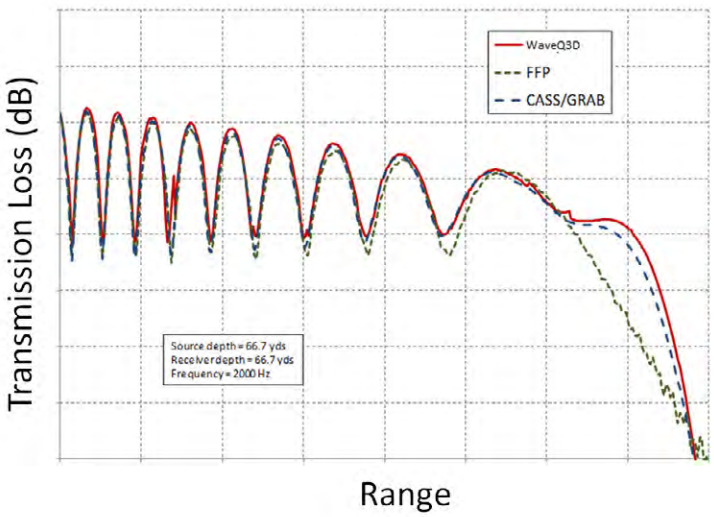
The Wavefront Queue 3-D (WaveQ3D) model is a research effort to create fast and accurate acoustic transmission loss (TL) and reverberation in littoral environments for active sonar simulation/stimulation systems. Because Parabolic Equation and Normal Mode models run prohibitively slow at active sonar frequencies (above 1000 Hz), WaveQ3D uses a

Fig. 1 – Merchant Traffic 11/25/2013 from http://www.marinetraffic.com



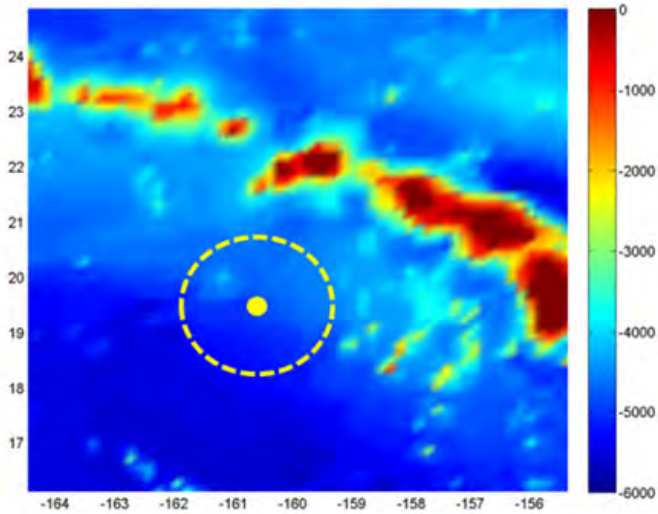
Gaussian ray theory like those employed by the Gaussian Ray Bundling (GRAB) and FeyRay models. However, WaveQ3D is unique because it conducts its Gaussian ray calculations in the latitude, longitude, and altitude coordinates of the underlying environmental databases. This approach allows WaveQ3D to calculate propagation a single time, in a 3-D environment, instead of decomposing the scenario into a series of Nx2-D radials. Although propagation to individual targets is slower in this coordinate system, WaveQ3D quickly gains efficiency when a large number of dynamic targets are required. This approach also has the benefit of supporting out-of-plane, 3-D effects.

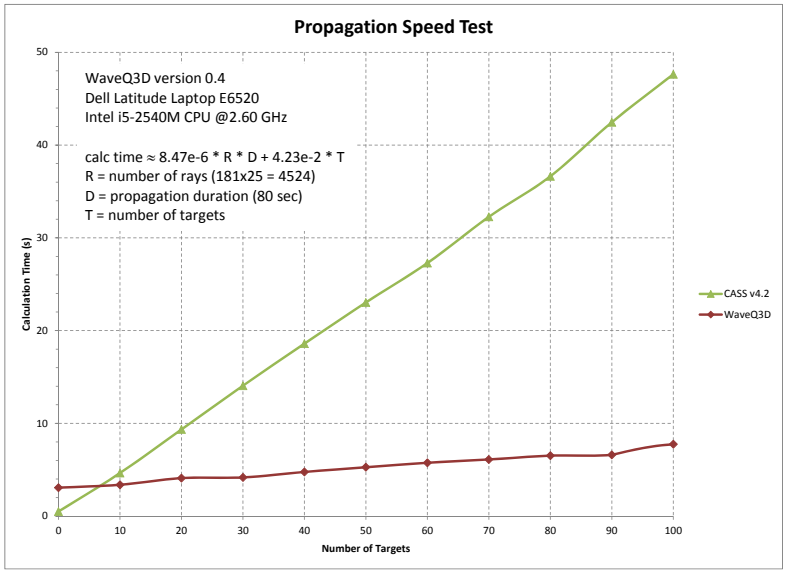
Fig. 2 – Comparison of WaveQ3D and CASS to analytic solution at shadow zone edge



For the last two years, the development, testing, and evaluation of the WaveQ3D model has been funded by the High Frequency Active Sonar Training (HiFAST) project at the Office of Naval Research (ONR). The results of this research to date indicate that WaveQ3D accuracy is comparable to GRAB (see example in Figure 2) for several key benchmarks, and significantly faster than GRAB for large numbers of targets (see Figure 3). This year, the Naval Air Warfare Center Training Systems Division (NAWCTSD) is working with ONR to integrate WaveQ3D into the Live Virtual Constructive Modeling and Simulation (LVCMS) product line that includes P-3C Aircrew Tactical Team Trainer (PACT3), Bravo Acoustic Tactical Team Trainer (BATTT), and Effective Active Acoustic Simulation (EFAAS). WaveQ3D offers NAWCTSD the potential to improve the complexity of scenarios supported by the Live, Virtual, Constructive Modeling & Simulation (LVCMS) training suite, without increasing their hardware costs or footprint. This will enhance NAWCTSD's ability to produce small foot-print, low-cost sonar training capabilities with an accuracy that meets or exceeds that of the large footprint systems.

Figure 3 – Comparison of WaveQ3D and CASS execution speed for 3-D environment





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