Shallow water surveying with swath bathymetry 3D sidescan

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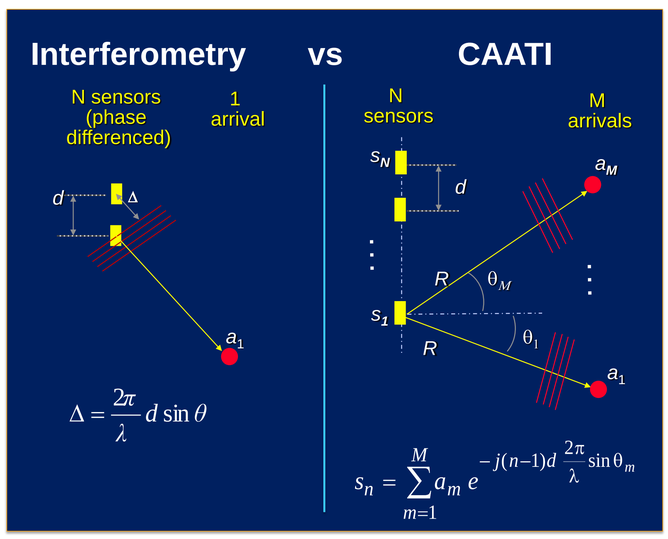
Introduction

This poster summarizes testing of a new ***Swath Bathymetry 3D Sidescan*** sonar. The ***3DSS-DX-450*** (Ping DSP Inc.) employs *Computed Angle-of-Arrival Transient Imaging* (***CAATI***) to overcome the inherent limitations of phase based swath bathymetry sonars. As a result, the ***3DSS-DX-450*** offers:

- IHO Exclusive order bathymetry over swath widths 6-14 times altitude depending on backscattering conditions and geometry
- Simultaneous, full water-column 3D point cloud imagery of small–scale seabed features , hazards, structures, vegetation and texture
- Extended range, enhanced 2D sidescan imagery

Principle of Operation vs Interferometry



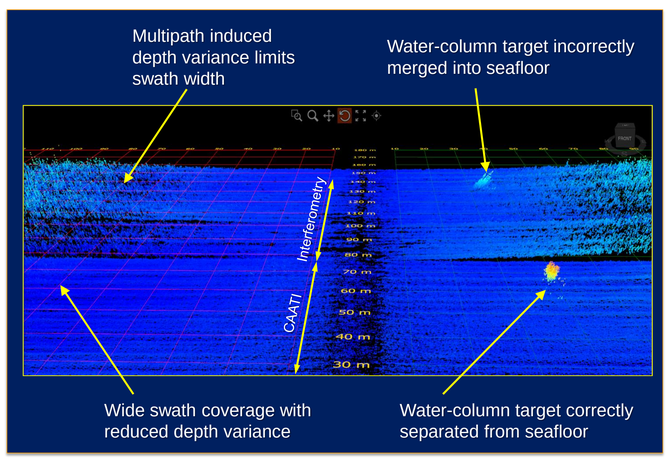
CAATI extends conventional phase based interferometry to multiple simultaneous angles of arrival.

CAATI separates arrivals in both angle and amplitude from the seabed, sea surface, water-column and multipaths.

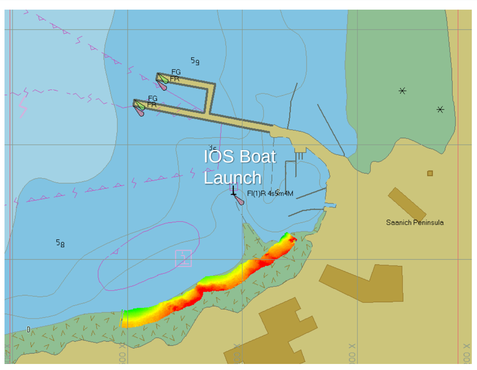
3D display of individual CAATI backscatter samples provides high resolution bathymetry and imagery concurrently (i.e. 3D Sidescan).

Seabed bathymetry data in the presence of backscatter from a water-column target processed using CAATI (foreground) and Interferometry (background).

CAATI processing separates the water-column target from the seabed and reduces variance at greater range. Interferometry blends targets with the seabed.

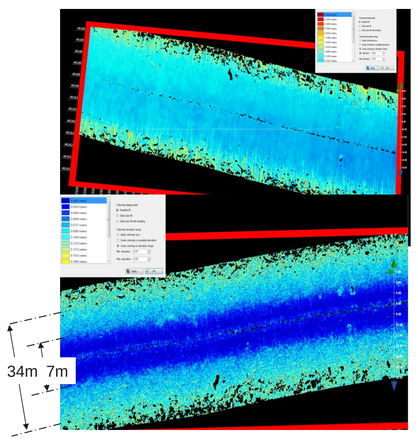


Test Method – Shallow Water Bathymetry



To test bathymetric performance for both flat and complex seabed geometries, a near shore survey was conducted. Binned bathymetry and variance results were compiled along with individual sounding examples at different swath distances.

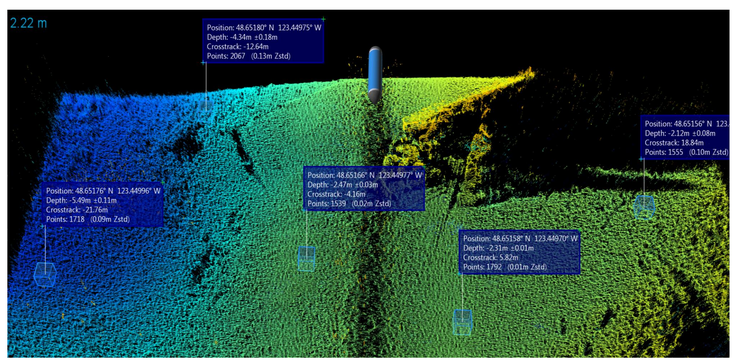
Results



Binned Bathymetry (2.2-2.5m)

20cm grid cells, 50m swath width

- <4cm to ~17m, 7.5x (dark blue)
- <10cm to ~34m, 15x (light blue)



Shallow Water Bathymetry Spot Soundings (2.2-2.5m)

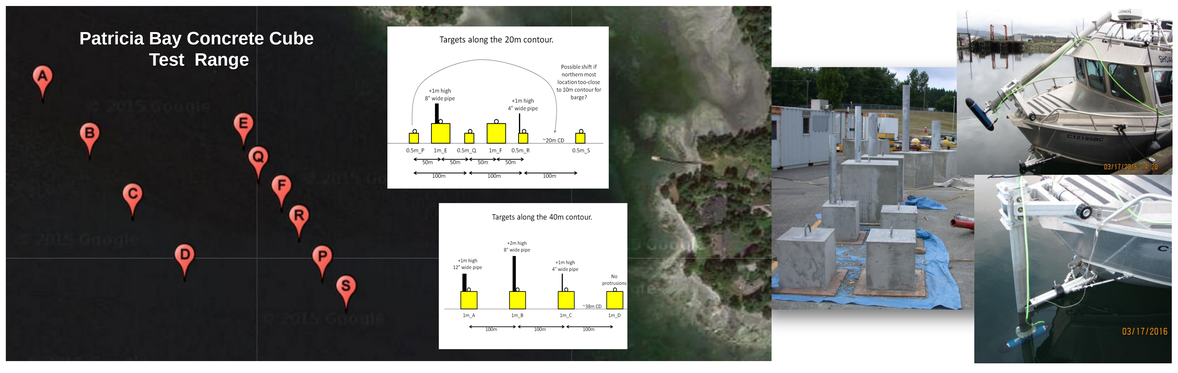
Real-time 3D point cloud with spot measurements, 50m swath width

- Incredible 40m (18x nadir depth) swath width
- 2 sigma (95% confidence level) uncertainty measurements 1cm to 11cm
- no data cleaning
- Boat ramp and adjacent wall clearly defined
- Nadir fully covered, though sounding density is reduced

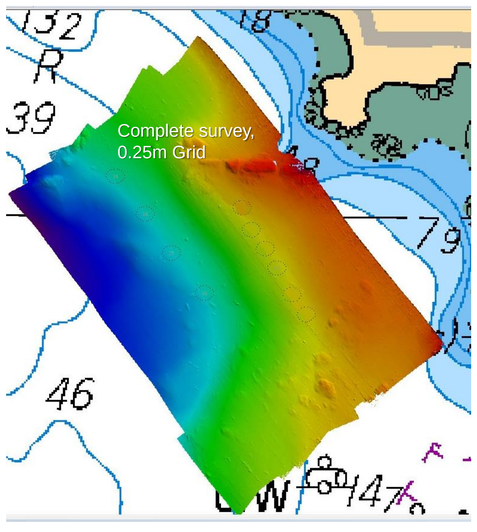
Bathymetric performance analysis over a flat seabed, 2.2-2.5m depths, exceeded IHO Exclusive Order specifications with a 2σ uncertainty of <4cm to 7.5x depth, and 10cm to 15x depth. Sounding results in complex geometries were also impressive.

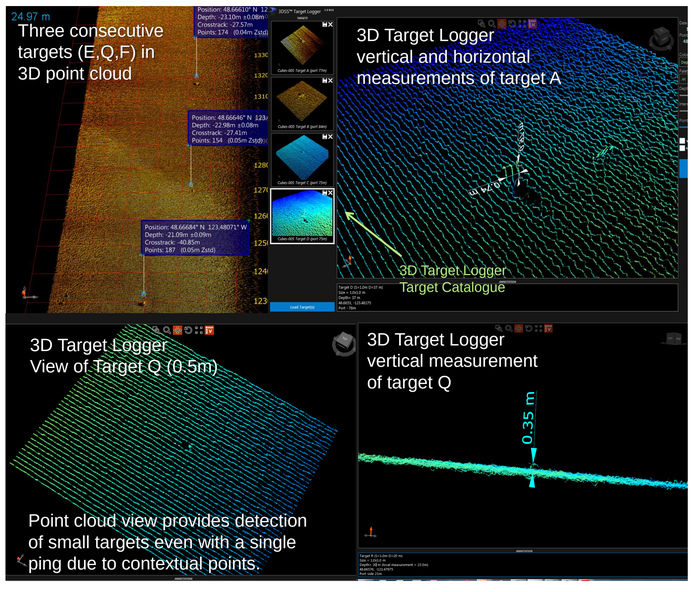
Data from the concrete cube survey was gridded, examined for features and compared with 3D point cloud data. 3D point cloud results resolved both the 1.0m and 0.5m cubes at varying offset distances (all cubes detected) and provided dimensional measurements. However, gridded processing obscured detection of the cubes, indicating a processing limitation (e.g. navigation offsets error).

Test Method - Detection of Small Seabed Features



To test detection of small-scale features, a survey was conducted of the Patricia Bay Concrete Cube Test Range using the CHS vessel *Shoal Seeker* with the ***3DSS-DX-450*** bow mounted. Binned bathymetry and 3D point cloud results were compiled .





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Conclusions

The 3DSS-DX-450 sonar exceeded IHO Exclusive Order specifications in shallow water bathymetry testing and resolved all 1m and 0.5m concrete cubes in 20m and 40m water depths at offsets exceeding 40m and 75m respectively.