Detecting Small Seabed Targets Using A High Frequency Multibeam Sonar: Geometric Models and Test Results

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Abstract

To date the detection of small seabed targets has predominantly been achieved using deep-towed sidescan sonar technology. Common targets include mines, wreck debris, and fishing hardware. The prime reason that traditional towed sidescan technology is used for this is the capability of maintaining the sonar close to the seabed thereby imaging using low (even limiting) grazing angles. The target cannot be relied on to have a distinctive backscatter strength (w.r.t. the surrounding seabed) but usually lies proud of the seabed, thus casting a shadow. Such techniques fail at higher grazing angles where shadows are no longer cast. Thus repetitive, overlapping survey geometries are required to fill the "nadir gap". An alternate technology which can detect topographic anomalies without relying on shadows is high frequency multibeam sonars (HFMS). If such systems can be combined with sidescan methods, target search times can be markedly reduced.

Traditionally HFMS sonars have been hull mounted (for use in hydrographic applications) and thus are not able to resolve small (<1.5m) targets in continental shelf water depths (30-200m). If such sonars were deployed on towbodies however, small target detection at high grazing angles may be feasible. Therefore we have investigated the capability of one of these sonars using altitudes between 10 and 30m (as might be achieved by mounting such a sonar on a terrain-following towfish). Our preliminary modeling suggest that the beam footprints (using 1.5 deg. beam) and beam sounding density potentially are sufficient to achieve the required objective.

We identify two principal limiting conditions: the method of bottom detection within a beam; and the sounding density. The first condition depends on the type of bottom detection algorithm used, the beams widths and sidelobe levels. The second depends on a number of factor including pulse repetition rate, sonar body speed and active motion compensation.

We compare the results of our modeling with actual data taken from a small survey launch in water depths between 10 and 30m using targets ranging in size from a few decimetres to 1.5m. The data is collected in a variety of roll, pitch and heaving conditions at speeds ranging from 3.5 to 10.5 knots.

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