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Evaluation of a New 3-D Sidescan Sonar for Naval Mine Countermeasures Applications

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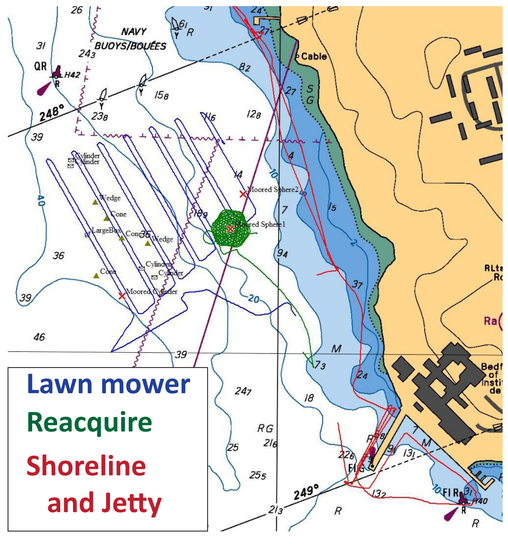
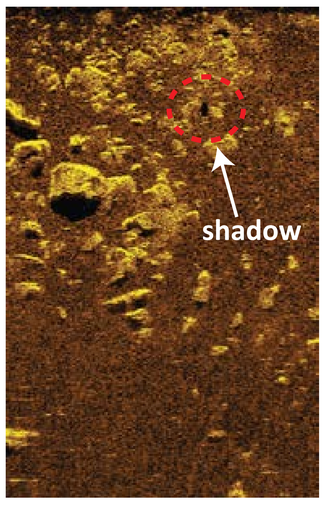
Abstract: DRDC recently tested a new 3-D sidescan sonar, the Ping DSP 3DSS-DX-450, for Naval Mine Countermeasures (NMCM) applications. It was acquired through the Build in Canada Innovation Program (BCIP) and was evaluated during a 2-week trial in Feb 2016. The ability of this sonar to resolve angle of arrival of return echoes should improve detection over conventional sidescan sonar in geometries such as mid-water moored targets, next to sea-wall structures or in very shallow water. The sonar was integrated with DRDC's Sea Robotics Unmanned Surface Vehicle (USV) catamaran and trials were performed in Bedford Basin, operating out of the Bedford Institute of Oceanography (BIO), mostly over an established NMCM practice area containing mine-like targets. The DRDC testing was concentrated specifically on evaluation as an MCM sensor.

Objectives: Evaluation of the sonar specifically for use in NMCM survey, with particular focus on 3-D imaging capabilities:

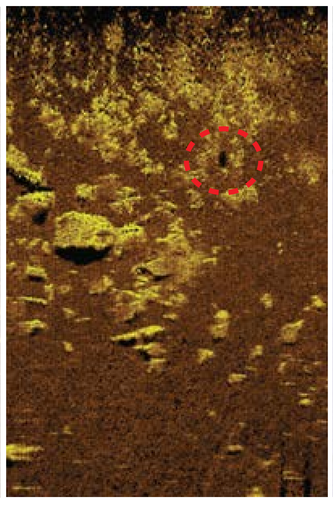
- detection of mid-water moored targets,
- close to jetty or sea-wall structures where conventional sidescan sonar systems suffer multipath interference,
- very shallow water (VSW),
- fit on DRDC's USV, a platform which allows forward deployment in NMCM applications for environmental assessment and seabed survey.



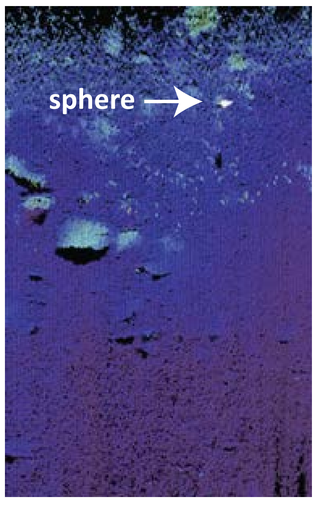
Survey lines: Routine MCM surveys are specified by coverage, with staggered line spacing to cover the sidescan nadir gap on the subsequent pass ("lawn mower"). Also shown is a "reacquire" mission, designed to provide multiple passes at varying range and look-angle over a particular object on the seabed. Surveys were also run along the shoreline in very shallow water and along the jetty, where CCGS ships were berthed.



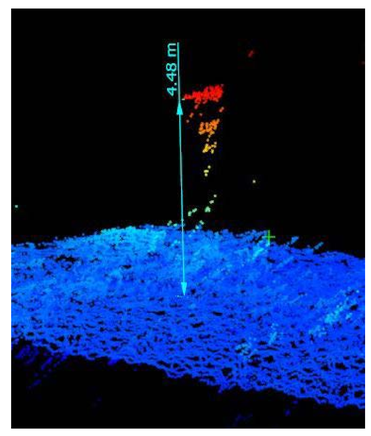
2-D sidescan



3-D sidescan Intensity



3-D sidescan Depth



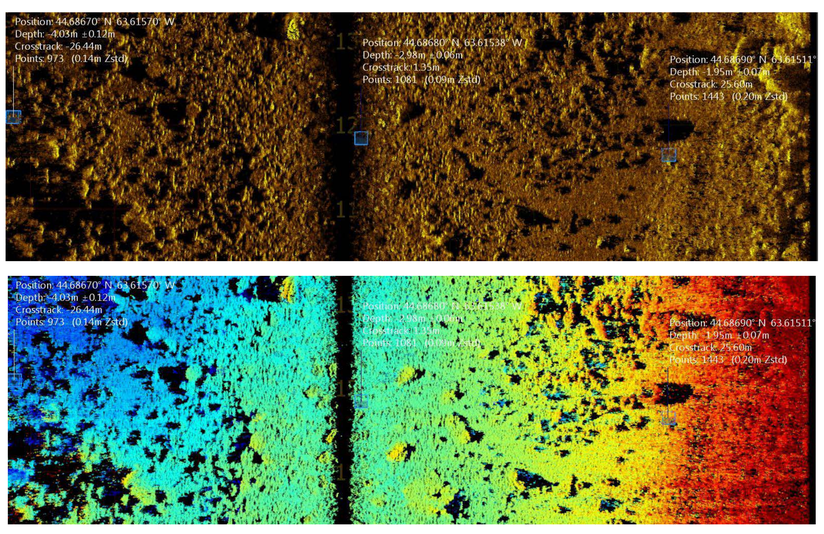
3-D point cloud

Mid-water moored sphere: the target shadow shows in 2-D and 3-D sidescan, but the body of the target is only visible in the depth, not intensity. (1 m diameter sphere on 3 m tether)

Sea Robotics USV-2600 4-m catamaran unmanned surface vehicle, with sonar installed at bottom of keel

Ping DSP 3DSS-DX-450

USV just off BIO Jetty



Very Shallow Water: in 5 m water depth, running parallel to shore, the sonar sees into water depths of about 2 m at outer range (stbd side to right). Results in water as shallow as 3 m were comparable. Typical range up-slope of 6-8 times water depth.

Conclusions:

- 3DSS is very effective in locating mid-water moored targets,
- impressive performance in VSW and alongside jetty,
- NMCM is different from hydrography, but requires some of the same performance features in a sonar. Absolute water depth is not a priority for NMCM (usually), but good highlight-background-shadow signal contrast ratio and ground resolution are required for object detection. Moored targets are a problem for conventional towed sidescan systems.

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