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3D Imaging to Identify Scour and Beach Morphology

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1. Introduction

Coda Octopus is the patent holder for the real time 3D sonar, the Echoscope®. Resulting bathymetric data can be used for numerical modeling of wave climate; sediment transport; tidal currents; and hydraulic currents.

The Echoscope® is a volumetric sonar that produces high resolution real-time 3D imaging. Complete 3D imagery is composed of over 16,000 data points, from each acoustic transmission in real time up to 12 times per second. With data densities far in excess of those generated by other sonars, the top-end visualization software takes advantage of patented statistical rendering techniques to enhance image clarity and detail, presenting an intuitive and easy-to-interpret image. When monitoring underwater activity, even when the target and the Echoscope® are moving independently of each other, the 3D imagery uniquely remains clear and accurate, giving the viewer an instant three-dimensional understanding of the underwater environment during operations. In dynamic survey and mapping tasks such as seafloor cable or pipeline inspections or scour monitoring, the ping geometry allows a target to be visualized many times in a single pass, with each view taken from a different angle. As a result more details and fewer shadows are seen, enabling mapping of complex subsea structures with a higher level of confidence and far more detail than can be achieved using alternative methods. A real-time view allows the operator to immediately make decisions to get a better view or to slow and take a "closer look" when he sees something of interest. With a navigation and attitude and positioning input, roll and pitch conditions are compensated for and an accurate geo-referenced measurable 3D data set is provided. This technology adds significant value to subsea inspections, marine structure inspections, archaeological surveys, and salvage operations.

Understanding the effects of scour around subsea structures such as seawalls, outfall piping and seafloor cables is critical for planning placement of protection and periodic maintenance (see Fig. 1). It is important for the survey to identify the current condition and provide data to understand variations over time due to seasonal events or tidal changes that can be critical to planning. Echoscope® provides a detailed, easy to understand assessment of scour conditions. Currently, it is being used in Brazil for underwater subsea sonar imaging and mapping to monitor erosion in the terrain surrounding pier piles and the morphology of the seabed attributable to the presence of vessels using the facility. These data are used determine scour changes over time and seasons so that computer models can be updated with actual data assessments. The data produced by the Echoscope® can be output in a XYZI RGB format and can be input into a GIS for further evaluation.

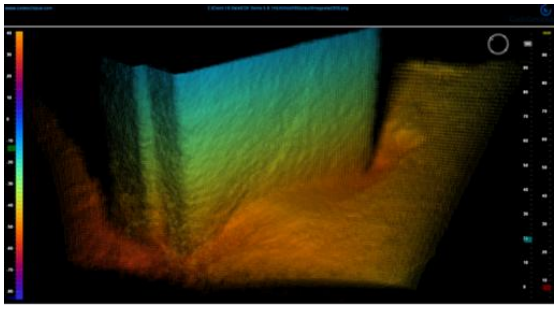

Figure 11. Main St. Bridge Jacksonville Florida depicting shoaling and scour

The Echoscope® has been shown to be capable of comfortably achieving bathymetric survey data that meet the various orders of IHO S-44 standards under typical survey conditions. Through the use of the post-processing steps in its Underwater Survey Explorer software package the data can further meet the highest of these orders (Special Order).

2. Conclusions

The Echoscope® can provide a detailed, easy to understand 3D image and bathymetric survey showing scour and morphology near and around subsea objects, near beach zones and seawalls. The IHO quality bathymetric data can be output to geodatabases for further evaluation and understanding of these conditions. Using its unique real-time visualization mode allows complete time-lapse monitoring of scour flow for detailed analysis. High resolution surveying could be used to quantify channel shoaling rates and as bathymetric data to develop improved numerical modeling grids.

Existing data processing strategies work to minimize the effect of rough water on data accuracy, but the effect on the collection crew must be considered especially in shallow water.