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MAN-PORTABLE SAS: THE FUTURE OF SHALLOW WATER SURVEYING

Mapping of the nearshore and surf zone environments is vital for marine safety, security, and environmental/archeological protection. The conventional method of surveying in shallow water with manned survey vessels is challenging and often hazardous because the risk of running aground is high.

Utilizing unmanned vehicles such as Autonomous Underwater Vehicles (AUVs) significantly reduces the risks while increasing operational efficiency. Man-portable AUVs are quickly becoming recognized as ideal shallow water survey platforms due to their ease of handling and rapid deployment. Operators can deploy several unmanned AUVs at once, which decreases both the deployment and survey time. For shallow water operations, the ideal imaging sonar must fit on a small AUV while providing the sophisticated technology needed to operate in the shallow water environment.

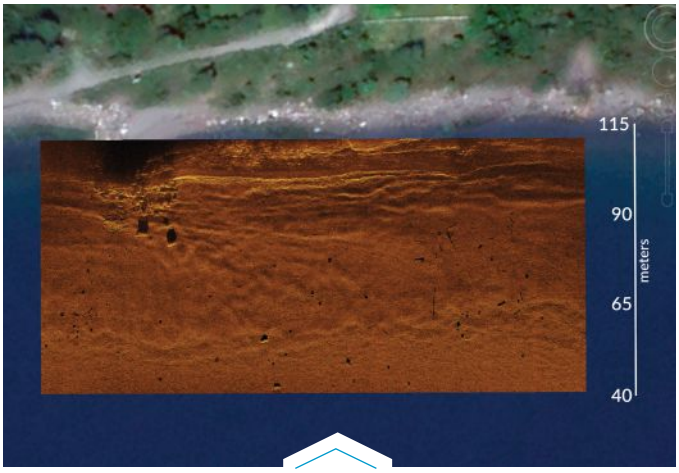
Shallow water poses significant challenges for both imaging and bathymetric sonars. The nearshore environment is typically characterized by sloping seabeds, multipath reverberation (interference in the received signal due to sound bouncing between the seabed and surface), complicated and rapidly changing sound velocity profiles, and strong water column returns from fish or other marine life. All these factors diminish the received Signal-to-Noise Ratio (SNR), which reduces image contrast and impairs target detection. Shallow water also typically features strong currents and turbulent conditions, which cause significant nonlinear platform motion that can lead to image distortion, poorly registered imagery, and artifacts in the measured bathymetry.

Synthetic Aperture Sonar (SAS) exploits the forward motion of the vehicle to combine successive pings from a small sonar array, achieving the resolution gains of a much larger array while dramatically increasing the area coverage rate relative to conventional sidescan sonar. Until recently, most SAS systems required large AUVs as host platforms to accommodate large, low frequency sonar arrays and to avoid the nonlinear trajectories of smaller vehicles. Now, miniaturized high frequency SAS systems can suppress multipath using narrow vertical beams and correct for nonlinear trajectories using sophisticated motion estimation algorithms. Miniaturized high frequency SAS is particularly advantageous in shallow water conditions where ping-to-ping integration enhances the seabed signal in strong multipath conditions.

» *SAS payload module with embedded real-time processor designed for 7.5"-9" diameter man-portable AUVs. Photo courtesy of Kraken.*

The enhanced range and resolution achieved by SAS allows for the collection of imagery and bathymetry all the way into the nearshore environment up to the air/water interface (Figure 1). Outfitting man-portable AUVs with SAS requires a new generation of light-weight miniaturized components with low power consumption. The payload needs to be designed so that it can be easily installed, removed, and swapped between vehicles in the field (Figure 2). To expedite post-mission analysis for military applications, it is essential to have onboard GPU-accelerated real-time SAS processing and automatic target recognition algorithms to enable in-stride target detection, classification, and localization.

Surveying in shallow water with man-portable AUVs reduces the safety risk to operators while increasing survey efficiency. With SAS, the survey area coverage rate, resolution, and data quality are improved over standard sidescan sonar payloads. By equipping man-portable AUVs with miniaturized SAS payloads and onboard real-time processing, operators can provide the capability of larger vehicles without the additional weight and handling requirements.



» *Example SAS image from Kraken's miniature synthetic aperture sonar overlaid on a Google Earth image showing data collected all the way to the shoreline. Image courtesy of Kraken.*

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Kraken will be presenting papers and exhibiting at OCEANS 2019 Seattle. Stop by booth 127 to learn more.