Interferometric Synthetic Aperture Sonar as a tool for seafloor geological mapping on the Grand Banks offshore Atlantic Canada: preliminary results.

Caroline Gini\textsuperscript{1}, Katleen Robert\textsuperscript{2}, John Jamieson\textsuperscript{1}, and Jeremy Dillon\textsuperscript{3}

\textsuperscript{1}Earth Sciences, Memorial University of Newfoundland, Saint John's, Canada (cgini@mun.ca)
\textsuperscript{2}Marine Institute, Memorial University of Newfoundland, Saint John's, Canada
\textsuperscript{3}Kraken Robotic Systems Inc., Dartmouth, Canada

With less than 20% of the seafloor mapped at a sufficiently high resolution for geological and biological studies (<50m), there is a need for new technological approaches to map and characterize the seafloor environment at higher resolutions. Here, we present preliminary results of an investigation into the use of interferometric synthetic aperture sonar (InSAS) as a new approach to help fill this gap. InSAS can provide very high-resolution acoustic imagery (3cm/pixel) and bathymetry (25 cm/pixel) as well as large coverage area (up to 150m across track per side while flying at a 15m altitude, at 6 knots). Compared to traditional sidescan sonars, high-resolution imagery in both along and across track directions is achieved by the synthetic aperture of the sonar array, which uses a large number of receiver arrays and a cm-size spacing between individual elements. This technique has so far mostly been used for military and industrial purposes.

Onboard the Atlantic Kingfisher in October 2020, we used Kraken Robotic Systems' InSAS system on a Katfish towed vehicle to survey 85 km\textsuperscript{2} of the Tail of the Grand Banks, the southernmost extremity of the continental shelf offshore Newfoundland, Canada. During a survey, the sonar is set at a center frequency of 337 kHz and survey planning included data coverage overlap for 140% coverage of the seafloor. Kraken Robotic's processing algorithm and the towing optic cable allowed for real-time processing of the data and initial post processing using Caris Onboard.

We show one of the first applications of InSAS for geological studies. This system is excellent for identifying fine-scale geological features as well as variations of seabed texture and composition at a large scale on flat seafloor. We identified distinct seafloor sedimentary textures on the imagery, such as relatively homogeneously spaced alternations of high and low backscatter (BS) strength corresponding to well-defined ripple marks, as well as multiple 1-10m wide circular depressions of high BS strength surrounding individual rocks and a lower BS strength on the seafloor surrounding depressions. With high coverage, speed and resolution, InSAS represents an effective tool for environmental, biological and geohazard monitoring.