NOTICE OF UNIVERSITY ORAL

GEODESY AND GEOMATICS ENGINEERING

Master of Science in Engineering

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July 20, 2007
@ 1:00 pm
Room E-11 - Head Hall

Board of Examiners: **Supervisor:** **Dr. John Hughes Clarke, GGE**

Examining Board: **Dr. Marcelo Santos, GGE**
Dr. Bob Courtney, NRCan

Chair: **Dr. Sue Nichols, GGE**

"MAXIMIZING THE COVERAGE AND UTILITY OF MULTIBEAM BACKSCATTER FOR SEAFLOOR CLASSIFICATION."

ABSTRACT

This thesis is focused on the backscatter strength data collected by the Brazilian Navy with the Simrad EM1000 multibeam echosounder installed onboard the Hydrographic ship Taurus. Data has been collected since 1999 as part of the national hydrographic mapping program. During this period, the echosounder was operating primarily in the equiangle beam spacing (EABS) +/-75^{o} angular sector, with survey lines spacing achieving 200% coverage.

Although bathymetric data has been already processed for chart production, valuable backscatter has not been analysed until this present study. Backscatter is a useful tool for the task of seafloor classification, as long as it is compensated for the radiometric and geometric artefacts.

With the aid of Ocean Mapping Group (OMG) software, data artefacts related to the angular response effect and beam-to-beam variations have been normalized. This research developed additional algorithms capable of reducing artefacts related to within-beam directivity pattern. This processing enhanced the quality of external amplitude traces logged beyond the -3dB limits of the outermost beams. Through this approach, the usable backscatter coverage has been expanded by 28%.

Taking advantage of the expanded coverage, outermost beams are now used to replace the noisy inner beams of adjacent lines during mosaicking construction. This alternative mosaicking method, using higher weights for outer beams, delivers backscatter mosaics with reduced along-track printed artefacts. As a complimentary addition to backscatter mosaics enhancements, a parallel study has been undertaken, which uses digital image analysis techniques to reduce the remaining along-track artefacts printed in the same direction of the survey lines. This technique uses two-dimensional Fourier transform to bring the mosaic to the frequency domain where structured directional noise can be filtered out.

Building on the increased coverage and removal of within-beam pattern artefacts, power spectral analysis algorithms were implemented to explore the lower grazing angle data. A dynamically-located classification box scheme identifies and uses the most valuable region of the swath for statistical and power spectral analysis. The resulting maps of these variables cover the entire survey area and add further degrees of freedom towards successful seafloor segmentation.

Finally, the same software that has been implemented for the EM1000 multibeam was also adopted to work specifically on the outermost beams of the newer EM710 multibeam. The EM710 data have been collected by the CCGS Matthew operating in the equidistance beam spacing (EDBS) +/-65^{o} mode (with only one swath per ping cycle at this time). But, this newer sonar is going to operate with multiple across-track swaths per ping cycle, which gets around the bathymetric requirement of narrowing the angular sector to achieve better along-track spacing. Therefore, improvements described here for the EM1000 wide angular sector (+/-75^{o}) can be also useful for the EM710 echosounder in the future surveys.

Faculty Members and Graduate Students are invited to attend this presentation.