Department of
Geodesy and Geomatics Engineering

Graduate Seminar

Thursday, November 19, 2015

11:30 am

Head Hall, Room E-4

Precision-Based Optimization of Across-Track Radiometric Beam Pattern Extraction Method for Multi-Sector Multi-Swath Multibeam Sonar

Anand Hiroji
PhD Candidate

An across-track radiometric beam pattern extraction method is being developed in the Ocean Mapping Group at the University of New Brunswick. The majority of the work has been completed and across-track radiometric beam patterns can be successfully extracted and applied. The extracted radiometric beam patterns are used to correct backscatter intensities, and to produce corrected backscatter images and more reliable angular response curves required for seafloor classification. The aim of this study is to compute precision of extracted across-track radiometric beam pattern. The assessment will help to understand what factors of the extraction method have maximum impact on the precision of extracted radiometric beam pattern. The total uncertainty of the radiometric beam pattern comes from the precision of the computation method and random noise in the seafloor backscatter intensities. The random noise from the backscatter intensitiy data used for radiometric beam pattern extraction is ignored in this assessment.

The radiometric beam pattern extraction method was broadly divided in to three steps; computing and stacking the sub-functions, averaging the sub-functions to get a function for each sector, and then adjusting those functions for entire swath to get a final master radiometric beam pattern function. The starting point of precision computation was the stacking of the sub-functions, where multiple stacking offsets from common sonar relative angles were used to compute a single offset. The related precision of each stacked sub-function has then propagated through the remaining steps to get a final precision of the extracted radiometric beam pattern in decibel units.
Once the statistical scheme was developed, the analysis was performed to establish guidelines for the selection of stacking references that will result in more precise radiometric beam pattern. The statistical scheme was also used to justify that splitting the central sector in to two independent halves actually increases the final precision. It was possible to optimize the radiometric beam pattern method using the developed statistical scheme resulting in increase of the final precision of extracted radiometric beam pattern up to 0.8 decibel units.

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A Look Into Aided Inertial Navigation

Eduardo Infante
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Aided inertial navigation filters play a very important role in real-time positioning and attitude determination applications. At the very minimum, aided inertial navigation filters make use of GNSS observations for absolute positioning and inertial measurement units (IMUs) for attitude determination. However, it is entirely possible for an aided inertial navigation filter to use more than these two sensors. In fact, sensor fusion of multiple technologies is the backbone of automated vehicles which are playing a bigger prominence in military and civilian applications.

This report goes through a summary of aided inertial navigation filters, starting with an overview of the sensors inside inertial measurement units as well as the different methods used to align the filter. The following section goes through an explanation of the mechanization equations which integrate raw accelerometer and gyroscope data and rotate it into the working mechanization frame. These data is fed into the GNSS/INS Kalman Filter which uses knowledge of the current states to weigh incoming measurements. The GNSS/INS Kalman Filter requires proper modeling of the process in order to remove the drifting inherent in accelerometer and gyroscope measurements.

The long-term goal of this report is the development of a loosely coupled aided inertial navigation filter using positioning and attitude determination from sensors inside every-day smartphones.