Improved Geocoder Integration For HIPS and SIPS Software

A Pending Update to HIPS and SIPS Resolves a Number of Issues, Creating Mosaics More Similar to Those From Standalone Geocoder

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Geocoder is a software toolset that processes acoustic backscatter data for mosaic creation and seafloor characterization. It was developed by the University of New Hampshire and released under license in 2006 to a consortium of specialized software companies that work closely with the university's Center for Coastal and Ocean Mapping (CCOM). The software has been the focus of much discussion within the ocean mapping industry as the desire to take advantage of its capabilities has become more pronounced.

CARIS has worked with the CCOM to integrate the Geocoder toolset into its products. The toolset was integrated with CARIS HIPS and SIPS software to ensure that Geocoder's new features worked in conjunction with pre-existing and well understood workflows. A tight integration makes the tools simple for new users to learn and facilitates future extensions. Geocoder was made available for the first time in HIPS and SIPS version 7.0 in August 2009. CARIS also chose to support a variety of sonar formats to maximize flexibility for the end user.

CARIS has been working to address issues with its Geocoder integration, as well as to address some problems in the standalone Geocoder toolset on which the integrated system is built. The issues relate primarily to differences in the appearance the mosaics produced using HIPS and SIPS and the mosaics produced by the standalone Geocoder. To resolve these issues, CARIS collaborated with the University of New Hampshire on further research and development. These improvements will be released this October in HIPS and SIPS 7.1 Service Pack 1 (7.1.1).

Investigation and Findings

In order to conduct a thorough and fair investigation, CARIS used a baseline data set of backscatter data from a Kongsberg (Kongsberg, Norway) EM 3002 dual-head multibeam sonar. It is important to note that though some of the problems were found to be specific to the processing of data from certain sensors, other problems were independent of the data format or sensor type. RESON (Slangerup, Denmark) multibeam and sonar data logged in Hypack Inc.'s (Middletown, Connecticut) HYPACK software were also tested, but to a lesser degree. Using the EM 3002 data set as a test bed, the evaluation uncovered issues with both the standalone Geocoder and its integration into HIPS and SIPS.

Simrad Data Issues. Two issues with the standalone Geocoder related to the Simrad data. Firstly, the standalone Geocoder understood each head of the EM 3002 as having 256 beams rather than the 254 beams that is stated by the manufacturer and used in HIPS and SIPS. This issue could have accounted for some small discrepancies in the HIPS and SIPS software, as different angular offsets can be applied in processing when using a dual-head configuration. For example, the offsets applied would change when crossing over from the last beam on head one (254) to the first beam on head two (255). This was fixed in the standalone Geocoder but is unlikely to be a major contributing factor to the differences seen in the mosaics.

Secondly, unlike HIPS and SIPS, the standalone Geocoder does not use the multiple attitude observations that are stored with the Simrad data. Instead, it simply uses the first attitude observation for the positioning of the samples. The attitude component contributing most to the mosaic differences is heading data, as a small difference in gyro at nadir is exaggerated toward the outer limits of the swath. This could lead to the placement of different intensity values when comparing the outer edges of mosaics from the two systems.

Handling of Data. Issues were also found with the HIPS and SIPS-integrated Geocoder's handling of data from some specific sensors. Geocoder uses opposite sign conventions for pitch and roll than what HIPS and SIPS was expecting, so this required the data to be inverted, which was missed during the initial implementation and has now been fixed HIPS and SIPS 7.1.1. A problem involving the application of physical offsets relating to the specific EM 3002 dual-head configuration was also discovered and has been fixed.

Encoding of Intensity Values. The most important sensor-independent issue found in the Geocoder integration was the

absence of a necessary equation to scale encoded backscatter intensity values back to decibels. This was a key problem that led to different intensity values being reported when comparing results in the two applications. It should be noted that although the numbers could be quite different, the distribution of values about their means would be the same so the appearance of the mosaic would not necessarily be dramatically different. This was fixed in the 7.1.1 version of HIPS and SIPS.

Gridded Data Structures. A main thrust of the investigation focused on the way the standalone Geocoder and the HIPS and SIPS-integrated Geocoder store gridded data. In both versions, the mosaic process uses a similar method to associate intensity values to the respective gridded data structures. The association process uses the grid column and row number, as well as the intensity value, priority and line number as its required parameters. Unfortunately each version uses quite different methods to determine the final pixel intensity value used in the mosaic.

In HIPS and SIPS, the pixel values are computed for the grid nodes, whereas in the standalone Geocoder, pixel values are computed for grid cell areas. The difference in the way samples are assigned to the grid can result in different intensities being associated to corresponding spatial locations. It is also important to note that more than one sample can be associated with a grid cell in the association process. This often occurs, for example, when there are a number of overlapping data sets in the same area of a mosaic. A blending process is required to compute the final intensity value for the pixel in question. The standalone Geocoder uses a "first in, first out" policy, in which the last intensity value associated to a grid cell is chosen over the first, regardless of whether the first was more accurate. HIPS and SIPS uses a "greatest intensity wins" policy, which was implemented to retain targets that would usually have a higher intensity.

The differences between the computations for grid nodes and grid areas and the differences in blending methods were found to account for significant differences in appearance between the mosaics generated by the two applications.

Conclusions

After applying the above corrections to both the standalone Geocoder and the HIPS and SIPS integration, the mosaics produced by both versions are now much closer in appearance. The updates will be released in HIPS and SIPS 7.1.1, which is scheduled for release in October.

More research and development is still required to ensure that the HIPS and SIPS integration of Geocoder is as good as it can be. CARIS is now focused its efforts on the robust handling of the other supported data formats, as well as determining more sophisticated ways to blend associated intensities in the final mosaic. Moreover, CARIS has taken measures to propagate corrections to the standalone Geocoder back to CCOM in such a way that other implementors of Geocoder, and the industry as a whole, can benefit from this partnership.

Other collaborative work with CCOM includes creating a standard code repository to ease future investigative efforts and the creation of unit test data sets for future developments.

CARIS is committed to the improvement of Geocoder and refining its integration with HIPS and SIPS. These ongoing efforts will provide scalability, flexibility, intuitive workflow and, most importantly, robust results for backscatter processing, mosaic creation and seafloor characterization.

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Fig 1

The comparative graphed distribution of intensity values for an area within the baseline data set from HIPS and SIPS 7.0, HIPS and SIPS 7.1.1, and the standalone Geocoder respectively.

Fig 2

Comparative mosaics of the baseline data set from HIPS and SIPS 7.0, HIPS and SIPS 7.1.1, and the standalone Geocoder.