



FINAL REPORT FOR AWARD # 0406756

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Installation, integration and testing of a precision heading and vertical reference and real-time navigation capability for the USCG Icebreaker Healy's Science Data System

Participant Individuals:

Technician, programmer(s) : Val E Schmidt; Richard Perry; Ethan Gold

Partner Organizations:

United States Coast Guard: In-kind Support; Facilities; Personnel Exchanges

The POS/MV was installed on the US Coast Guard Cutter (research icebreaker) Healy, WAGB-20. USCG personnel participated in many phases of this project including the planning, the physical installation, and integration with science data systems.

Other collaborators:

The vendor of the Healy's multibeam (L3/Elac/SeaBeam) was involved in updating the software in the SB2112 so that it would work properly with the attitude input from the POS/MV-320 which we installed. I also discussed SB2112/POSMV interface issues with Peter Lemmond and Barrie Walden of the Woods Hole Oceanographic Institution.

Activities and findings:

Research and Education Activities:

During the planning process for the installation of an Applanix POS/MV-320 GPS-aided inertial Attitude Heading Reference System (AHRS), we learned that we would have to develop the documentation for the US Coast Guard's Engineering Change Request (ECR) process. With excellent support from the ship, we generated the necessary documentation and received approval to proceed.

We purchased a POS/MV-320 from Applanix and installed it on the Healy during the July 3-8, 2004 port call in Yokosuka, Japan. Using a local contractor we fabricated a rigid cross-tree on the overhead of the Helicopter Control Office (HCO) above the flight deck, installed a new electronics cabinet under the table in HCO, provided a mount for the POS/ MV Inertial Measurement Unit (IMU) in HCO and added cable pass-throughs for a cable route from HCO down to the Computer Lab.

In close collaboration with ships force we installed two 24-pair fiber optic cable runs between HCO and the Computer Lab with patch panels on each end. Although we only need a few pairs for the actual POS/MV installation the effort to install two runs and the material costs are relatively low and the extra fibers provide a useful extension of the science network for future applications. The GPS antennas were installed on the cross tree and the IMU was installed on a special foundation in HCO. A temporary electronics rack was installed in the Computer Lab to hold the fiber patch panels and the logging, control and display computers. After the installation of the IMU and antennas, we made precision offset measurements to allow us to tie the newly installed equipment to the Healy's existing offset and alignment survey. A logging and prototype display was installed during the transit back to Nome and operated through the remainder of the 2004 season. Andreas Muenchow has used the logged position and heading data in his routine reprocessing of the ADCP data. The interface to provide attitude data to the SB2112 multibeam sonar was installed and a number of

unsuccessful attempts were made to configure the SB2112 to use this data in real-time during the 2004 season.

We revisited the attitude interface issue as part of the SeaBeam groom during the 2005 shakedown (April 2005) and after recompiling the entire SB2112 software package with correct configuration parameters, we were able to properly integrate that POS/MV attitude with the SB2112. During the '05 shakedown, we also implemented and tested an output of position and heading data from our logging system that provides improved resolution in position and heading to the SB2112 from the real-time POS/MV data stream.

Findings:

We have significantly improved the accuracy of the heading, attitude and position data being provided to the Healy's SeaBeam 2112 deep sea multibeam sonar. Heading resolution has been improved from one tenth of a degree to one thousandths of a degree. The heading accuracy is improved from approximately one sixth of a degree at mid-latitude to approximately five thousandths of a degree even at very high latitudes.

Position (latitude and longitude) resolution has been improved from one hundredth of a degree to one ten-thousandth of a degree. Position accuracy provided by the POS/MV has generally been on the order of a few meters and the source is now clear. The as-delivered navigation input was provided by the ship's Integrated Bridge System (IBS) and source is known to change more or less arbitrarily from one GPS receiver to another without adjustment for offsets.

The attitude data from the POS/MV is now provided in real-time to the SB2112 beamformer and is no longer susceptible to transients resulting from intermittent contact with sea-ice.

The high quality position, heading and attitude from the POS is also being provided in real-time to the ADCPs and is available for other systems.

Training and Development:

Working with the US Coast Guard has improved our social engineering skills and further developed our ability to provide detailed planning documents for their approval process. As a side benefit of the requirement for reformatting the POS/MV navigation and heading data to meet the format specifications and provide higher resolution to the SB2112 we have learned how to improve the performance of our data acquisition system.

Outreach Activities:

A significant education of members of the US Coast Guard, the science community and the reviewer community was required in order to convey the poor performance of conventional mechanical gyrocompasses at high latitudes and in the presence of rapid accelerations such as experienced when breaking ice.

Journal Publications:

Chayes, D. N. and D. Forcucci, "An Update on USCGC HEALY (WAGB-20) and its Capabilities.", *EOS Trans. AGU Fall Meet. Suppl.*, vol. 85, (2004), p. 0. Published

Book(s) of other one-time publications(s):

Other Specific Products:

Internet Dissemination:

<http://www.ldeo.columbia.edu/~dale/projects/healy/systems/posmv/>

This site contains the public documentation about this project. At present it contains technical planning documents. In the future it will contain as-installed and performance documentation.

Contributions:

Contributions within Discipline:

This project has led to an improved community awareness of the problems with using mechanical gyrocompasses at high latitude and on icebreakers.

Categories for which nothing is reported:

Products: Book or other one-time publication

Products: Other Specific Product

Contributions to Other Disciplines

Contributions to Education and Human Resources

Contributions to Resources for Science and Technology

Contributions Beyond Science and Engineering