

Plane-Based Calibration for Multibeam Sonar Mounting Angles

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Abstract: Multibeam sonar systems are much more efficient than the convectional single-beam echo sounders for seafloor-mapping in hydrographic surveying. On the other hand, the operation of multibeam sonar systems needs to integrate more auxiliary sensor units. Because the world coordinates of each footprint is calculated based on the geometry of the sonar head relative to the GPS of the ship. Therefore, the resulting survey quality highly depends on the accuracy of the estimated mounting configuration of the sonar head, and other sensor units. Basically, the configuration parameters include the three Euler's angles, three linear translations and the asynchronous latency of signals between the transducer and other sensors. These parameters can not be measured directly. They can only be estimated from the post-process of the bathymetry data called patch test. Generally, the patch test requires the survey ship to follow several designated paths which are parallel, reciprocal or perpendicular to each other. Furthermore, the choice of seabed slope is also an important factor for the quality of

the result. The contour plots of the seabed for the different paths are used to estimate the mounting configuration of the sonar head.

In this work, we propose best-fitting a small flat patch to represent the seabed right beneath a segment of the path. A pair of patches from the two adjacent segments of reciprocal or perpendicular paths are selected for comparison. The difference between the two patches gives us an idea how the mounting parameters, i.e. the rolling, pitching and yawing angles, might be. If the parameters are accurately estimated, the two patches should be co-plane. We design several semi-positive definite functions and feed back control algorithms to steer the mounting angles to search for the solutions. One more advantage of this approach is that the variation of each mounting angles as the survey undergoes can be monitored. Our preliminary study shows that our results are only 1% different from other commercial software. Further comparisons will be reported in the final paper.