Verification of Pointing Calibration Methods for Kompsat-6

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Abstract

The Kompsat-6 (K6) satellite with Synthetic Aperture Radar (SAR) with sub-meter resolution will be launched in November 2021. Beam pointing calibration will be performed during the K6 Launch and Early Orbit Phase (LEOP) to improve the quality of K6 images. For this purpose, Doppler centroid (DC) and notch pattern will be used to correct the satellite attitude bias.

In this study, we describe methods of calculating DCs using K6 geometry and image, and estimating the satellite attitude bias using the difference between the two DCs (Delta DC). In order to calculate DC using satellite geometry information, we consider satellite position, attitude, antenna misalignment, beam steering, etc., and use precision sensor modeling for accurate position determination of ground targets. To calculate the DC from SAR images, we use the Average Cross Correlation Coefficient (ACCC) method that calculates the phase difference in the Azimuth direction of the images. To verify the reliability of the proposed methods, we used SAR simulation data provided by K6 Image Chain and Simulator (ICAS) system and Kompsat-5 Amazon data. In addition, the satellite attitude (Yaw and Pitch) is estimated using the Least Square Optimization method using Delta DCs acquired over a wide beam elevation range.

As a result, when using simulation data, the DCs could be estimated with 0.01 Hz (RMSE) accuracy for geometric-based method and 2.0 Hz (RMSE) for image based method. When using K5 data, it was possible to estimate with 5.11 Hz (RMSE) accuracy with the geometric-based method and 10.6 Hz (RMSE) accuracy with image based method. By comparing the Delta DC values, it was confirmed that the accuracy of the newly calculated satellite attitude bias error with the suggested K6 attitude estimation algorithm from K5 image data is improved by about 15% compared to the value calculated during the K5 LEOP period. In conclusion, the proposed pointing calibration algorithms could be proven to be highly effective and precise.

Keywords - Calibration of future missions