

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation & Control (3) (9)

Author: Ms. Chisato Sekigawa
Japan, sekigawa.chisato@jaxa.jp

Mr. Yuta Nakajima
Japan Aerospace Exploration Agency (JAXA), Japan, nakajima.yuta@jaxa.jp

FLIGHT RESULT OF THE ATTITUDE DETERMINATION USING SMALL SATELLITE ON-BOARD
CMOS CAMERA IMAGE

Abstract

This paper describes the satellite attitude determination process by using optical CCD/CMOS camera images. The proposed process is experimented to images taken by on-orbit CMOS camera of JAXA's Small Demonstration Satellite (SDS-4). The attitude determination process consists of four steps; image acquisition, image distortion correction, Earth center position estimation and Attitude estimation. At first, image distortion is corrected by the calibration process described in Heikkia and Silven (2000). The calibration parameter is derived through ground experiments using an engineering model of camera. After correction of the image distortion, the Earth edge is extracted by image processing. Then, coordinate of Earth center is calculated by solving a circle equation with any three points on the extracted edge. Finally, satellite attitude angles are calculated by equation derived from the geometric relations of Earth and the camera.

The attitude estimation experiments have conducted by using SDS-4. We took images in some different angle pattern, but for simplify, rotation is conducted around only one satellite body axis. The results show that the calculated attitude around satellite body X axis is slipped to the satellite body +Z direction approximately 8 degrees compared with on-board the star sensor and the gyro based EKF estimated angles. Similarly, calculated attitude around satellite body Z axis is also slipped to +Z axis about 12 degrees. These offset may represent the attachment gap of the CMOS camera detector and the satellite body axis. Furthermore, calculated attitude around the satellite body Z axis is also slipped to + X direction, and cause of this slip is now under investigation. Following topic is future works; 1) clarify the cause of +X offset, 2) finding optimized camera calibration parameter, and 3) establishment of auto attitude estimation process.