Paper ID: 15072
student

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control (3) (3)

Author: Mr. Takayuki HOSONUMA
University of Tokyo, Japan, hosonuma@space.t.u-tokyo.ac.jp

Dr. Takuji Ebinuma
University of Tokyo, Japan, ebinuma@nsat.t.u-tokyo.ac.jp
Prof. Shinichi Nakasuka
University of Tokyo, Japan, nakasuka@space.t.u-tokyo.ac.jp

THE STUDY ON SATELLITE ATTITUDE DETERMINATION METHOD USING GPS SIGANL STRENGTH

Abstract

Recent years, many studies have been reported on the attitude determination systems based on the Global Positioning System (GPS) signal strength measurements. The fundamental principle of this method is based on the assumption that the GPS signal strength varies as a function of the line-of-sight direction to the GPS satellites being tracked by the receiver. The satellite attitude can be estimated by comparing the observed signal strength to the predicted signal strength obtained from the known antenna gain pattern. In early studies, the predicted GPS signal strength was modeled as a function of off-bore-sight angle of the antenna. In many cases, however, the actual signal strength varies in the azimuth direction as well since it is affected by the signals reflected off the antenna mounting surface. The resulting signal strength variation in the azimuth direction decreases the accuracy of the attitude determination. Furthermore, in conventional methods, it is difficult to estimate the attitude angle of around the antenna bore-sight vector since the modeled signal strength varies only in the off-bore-sight direction. In this study, we proposed a new method for improving the attitude determination accuracy by using a 2-D signal strength map. The vertical and horizontal axes of the map correspond to the elevation and azimuth direction of the antenna gain pattern, respectively. By utilizing an image matching algorithm, it is possible to estimate the 3-axis attitude of the satellite including the angle around the bore-sight vector. The demonstration results with simulation and actual flight data showed the estimation accuracy of about 10 degree around the antenna bore-sight axis and about 5 degree around the other axes were achievable. The flight data was obtained from APE (Advanced Positioning Experimental) antennas and receivers installed on SERVIS-2 (Space Environment Reliability Verification Integrated System 2).