Paper ID: 41797
student

ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (2) (2)

Author: Mr. Dagvasumberel Amartuvshin
Kyushu Institute of Technology, Japan

Prof. Kenichi Asami
Kyushu Institue of Technology, Japan

VISION-BASED ATTITUDE DETERMINATION SYSTEM FOR SMALL SATELLITES USING UNSCENTED KALMAN FILTER

Abstract

Robust attitude determination system is an important component of many satellite missions. However, most of the small satellites operate without redundant attitude sensors and are therefore highly vulnerable to the failure of such sensors. It is common for small satellites to carry an imagery sensor as its primary payload. But, a majority of these sensors are only used for earth observation and scientific missions. In addition, Earth horizon and visual features in an imager's field of view provides an important prior feature for attitude estimation. It increases the capability to maintain robust estimation of the satellite's attitude. This paper presents an approach of vision-based attitude propagator concept for low-cost small satellite attitude determination and control system(ADCS). The proposed attitude determination system is a vision-based attitude propagator that is capable of propagating a satellite's attitude in three degrees of freedom by tracking the motion of the visual features in an imager's field of view. Algorithms to perform the inertial-aided visual feature tracking, 2D-to-3D correspondence, attitude propagation with Unscented Kalman Filter (UKF) and sensor self-calibration are presented in this paper. The system described in this paper, implemented using a low power on-board computer, inexpensive monocular CMOS camera and MEMS-based inertial sensors, to increase the accuracy and robustness of attitude estimation algorithm to minimize different drift sources affecting visual position, attitude, and scale drift. Comprehensive experimental and simulation results are presented, which demonstrate the performance of the algorithm on generated visual datasets of known attitude changes and analyze the system's ability to minimize the drift of an attitude propagator.