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Author: Mr. Koki Ho
The University of TOKYO, Graduate school, Japan

Prof. Shinichi Nakasuka
University of Tokyo, Japan

SOFTWARE DEVELOPMENT OF STAR TRACKERS FOR SMALL SATELLITES

Abstract

Recently, many universities have begun to develop small satellites as an educational program. Small satellites projects not only provide easier access to the space, but also have an important meaning in project management and engineering education. Such education program is expected to spread throughout more and more universities.

However, to make possible such small satellites that can be developed by even students, the technology for the instruments used in the satellites should be developed at a low cost in both experiments and development. A star tracker is one of these instruments.

In this paper, I introduce a star tracker system which can be developed at a lower cost than the conventional one. This system has several features, the most important two of which is as follows.

First, this system can adjust the parameters by machine learning. There are various parameters which need to be adjusted in software design of star trackers. The most critical one is the permissible error for the brightness in star identification, because that error on the ground is often different from that in the space. The system in this paper can automatically and efficiently adjust these parameters, which can reduce the cost for experiments and calibration.

Furthermore, the system I propose also has a new robust star identification algorithm using two star trackers. This new algorithm works well for small field-of-view star trackers, which do not need a large baffle and a high quality image sensor. The idea of this new algorithm is combining two algorithms, both of which have their own advantages and disadvantages. One of them uses the stars that are already out of the image for identification as well as those in the image, which works well when the gyro errors are small. The other algorithm identifies the star pairs across the two images from the two star trackers as well as those within one image, which works well when the misalignment errors are small. Combining these two algorithms, we can make up a robust algorithm that provides high identification success ratio for small field-of-view star trackers, which can reduce the cost to develop a large baffle or a high quality image sensor.

A new star tracker system in this paper will provide a good performance at a low cost of experiments and development. We believe that this system will bring a bright future of small satellites development even for students.