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STAR IDENTIFICATION OF A MINIATURIZED MULTI-APERTURE STAR TRACKER FOR CUBESATS

Abstract

In the past decade, CubeSat has experienced tremendous progress due to the advancement of enabling technologies, such as miniaturized sensors/actuators, and the revolution of design philosophy. CubeSat is not only a platform for education and simple demonstration, but also a promising solution for demanding missions.

Most demanding CubeSat missions planned for the next few years have tough requirements on attitude determination and control accuracy, which is a bottleneck of current CubeSats since they typically use sun sensors and magnetometers to achieve an attitude knowledge at the level of up to 0.1 deg. Therefore, a miniaturized star tracker would be essential for those demanding CubeSat missions.

This paper addresses the star identification (ID) strategy of a miniaturized multi-aperture star tracker which is under development in ISIS B.V. for CubeSats with an ESA contract. This innovative star tracker can provide both large field of view and high accuracy. It also has compact structure, which makes itself light and small. However, compared with single-aperture star trackers, it is much more difficult to perform star ID for multi-aperture star tracker since it requires larger star database and faster search algorithms for mapping. Therefore, how to efficiently generate a star database and how to efficiently perform searching are very important for star ID.

This paper is organized into four parts. At the beginning of the paper, star ID algorithms, most of them are for single aperture star trackers, are reviewed. Then, the approach of generating a star data base for this multi-aperture star tracker is addressed. This star database generation method is developed for a two-aperture case but also can be used for star trackers with more than two apertures. In the third part of the paper, high efficient search and mapping methods for star ID with multiple apertures are presented. Combined with star database generation, these methods are robust to deal with failure of one aperture. In the end, simulation results with ISIS's two-aperture star tracker are shown to validate the design including the star ID strategy.