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HIGH DYNAMIC STAR TRACKER FOR REMOTE SENSING SATELLITE

Abstract

Commercial remote sensing satellite technology is developing rapidly in recent years. On these satellites, star tracker plays a key role, which is one of the most promising attitude measurement devices for its high accuracy, free drift and absolute attitude output. Nowadays, small satellites, especially those used for Earth observation and video capture, propose tremendous challenges for the star tracker, since the space is limited, the imaging mode is flexible, and the accuracy and dynamic requirements are extremely high.

A high dynamic star tracker technology is proposed in this work. It can provide essential attitude information or even angular velocity information, and assist the small satellite and small satellite cluster to conduct Earth observation, celestial navigation, deep space exploration, and other complex space missions.

This paper mainly focuses on four aspects: (1) High dynamic star image processing technology. It involves background analysis, image filtering, connected component analysis and centroid calculation in hardware. Meanwhile, rolling shutter exposure is adopted to increase the update rate to the level of 100Hz. (2) Fast star tracking technology. Star spot-based optical flow approach is utilized to detect the fast moving star spot, which has advantages in conditions of large angular velocity and large angular acceleration. (3) Stray light suppression method. A design method of the star tracker baffle based on orbit motion analysis is proposed. And a background estimation and noise suppression approach is proposed. Thus, the exclusive angles of the sun and the earth can be optimized, and the on-orbit working range can be extended. (4) Star tracker measurement technology. Working performances of the star tracker under conditions of large angular velocity, large angular acceleration, close to dawn, and stray light interference are tested. On-orbit performances are additionally summarized and analyzed.

Small satellite technology is developing towards higher performance and multiple task mode in addition to advantages in size, weight, development cycle and launching costs. Vigorous development and fierce commercial competition have appeared in the field of Earth observation. As the 'eye' of a satellite, miniature star tracker with low-cost and high performance will definitely be an important information source. Appropriate utilization can provide more possibilities for small satellite tasks, and bring unimaginable opportunities in the future.