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CONVOLUTIONAL NEURAL NETWORK BASED STAR TRACKER FOR HIGH-PRECISION SPACECRAFT NAVIGATION

Abstract

There are several sensors to detect the attitude determination of the spacecraft. One of the most accurate is the star tracker which is optical equipment that measures the positions of stars. However, traditional star identification algorithms are limited by their processing speed and may fail under tough conditions which can be critical for the spacecraft. Furthermore, large and complex databases of star trackers can cause inefficiencies throughout the processing. To address the aforementioned issues an improved star tracker algorithm is being proposed. This algorithm will be able to handle these challenging situations and give the most accurate estimation of the spacecraft orientation using state-of-the-art detection.

This paper proposes an improved star detection algorithm for spacecraft attitude detection using convolutional neural networks (CNN), which is a type of deep learning algorithm that has shown many promising results in various image processing applications. CNN-based star detection algorithm will be able to identify the stars based on the constellations and show the orientation of the spacecraft using a less complex database. This will positively affect the accuracy and efficiency of the processing, as well as increase robustness against challenging conditions. The use of CNN-based algorithms creates an opportunity for continuous improvement of spacecraft attitude control systems.

To overcome the issue of inaccessible star and constellation images from satellites, free open-source databases are being used to train the algorithm. Publicly available data from planetariums such as Stellarium and space simulator platforms such as Celestia are being used for training, evaluation, and performance analysis of the proposed algorithm. Moreover, various optimization techniques are implemented for the performance improvement of the spacecraft attitude determination algorithm. It is believed that this approach will surpass the performance of the traditional algorithm and will lead to a promising direction for the development of advanced star tracker systems. Further research can focus on applying this approach to other areas of spacecraft control, such as orbit determination and maneuver planning.