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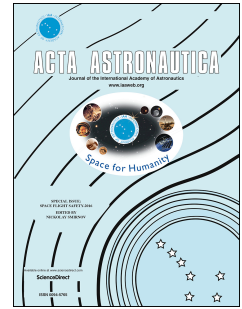
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# A Novel Voting Algorithm Utilizing Local and Global Distribution for Star Sensor

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## Abstract

A novel star identification algorithm based on voting scheme is presented in this paper. In the proposed algorithm, the global distribution and local distribution of sensor stars are fully utilized, and the stratified voting scheme is adopted to obtain the candidates for sensor stars. The database optimization is employed to reduce its memory requirement and improve the robustness of the proposed algorithm. The simulation shows that the proposed algorithm exhibits 99.81% identification rate with 2-pixel standard deviations of positional noises and 0.322-Mv magnitude noises. Compared with two similar algorithms, the proposed algorithm is more robust towards noise, and the average identification time and required memory is less. Furthermore, the real sky test shows that the proposed algorithm performs well on the real star images.

*Keywords:* star sensor, star identification, global distribution, local distribution, stratified voting, database optimization.

## 1. Introduction

Attitude determination plays a significant role in aerospace missions. The existing attitude measurement devices contain horizon sensor, sun sensor, star sensor, magnetometer, gyroscope and others. As a kind of high-precise apparatus among these devices, the star sensor is widely used in spacecraft.

Star identification is one of important techniques in space attitude measurement. It matches sensor stars with the corresponding catalog stars to determine the spacecraft attitude. The speed and accuracy of attitude determination are affected by the speed and robustness of the star identification algorithm, so the research on rapid and robust star identification algorithm is essential and attractive.

Existing autonomous star identification algorithms can be roughly classified into two categories [1]: subgraph isomorphism algorithms and pattern recognition algorithms. Subgraph isomorphism algorithms tend to consider the stars in the obtained sensor image as the vertexes in the subgraph and regard the angular distance between two sensor stars sharing the same field of view (FOV) as the edge in the subgraph. In this case, the star identification is completed when the subgraph in the sensor image is uniquely matched with a part of the star database. Generally, there are many similar candidate matches for the given subgraph, so the verification process is required to find the unique match for it. These algorithms mainly include: triangle algorithm [2], pyramid algorithm [3], match group algorithm [4], geometric voting algorithm [5], iterative algorithm [6] and K-L transforming-based algorithm [7]. This class of algorithms often uses the star triangles or star pairs to construct database, which results in the relatively large memory requirement.

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