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ROBUSTNESS STUDY OF NON-DIMENSIONAL STAR PATTERN RECOGNITION FOR A TYPICAL STAR TRACKER

Abstract

In the past few decades, it has been proved that one of the most accurate attitude determination tools in space navigation is the star tracker. Up to day, several star pattern recognition algorithms have been developed which use different types of recognition features. The Non-Dimensional star pattern recognition algorithm is one of these algorithms which is claimed to be independent of image Focal Length and Optical axis offset because it benefits the planar angles of a triangle with vertices on the stars. But this independency doesn't mean that the algorithm conserves it's robustness in presence of any type of errors. These errors arise from poor hardware calibration and software inaccuracy which causes the algorithm's input to be different from the true amount stored in the database. This research's intention is to determine a robustness margin for the non-dimensional algorithm. Many error sources can affect the algorithm's performance. But in order to avoid the complexities of modeling error sources individually, it was decided to study their final effect which is the bright point position variations. These variations cause the planar angles to be different from their true combination in the database. Assuming Normal error distribution on the vertices of a typical planar triangle, the monte-carlo simulation method is used to evaluate the maximum angular error. The mentioned error is implied on the calculated planar angles. MCS method is used for 10000 random boresights. The effect of different amounts of error on bright point positions is studied as mentioned above. For example for 0.02 pixel size error 99.5% true recognition is made while for 0.2 pixel size error only 42.8% true recognition is made. Although the percentage for 0.02 pixel size error is fairly good but it requires high accuracy of centroiding algorithm and excellent calibration of electrical and optical hardwares. The results demonstrate that 0.1 Pixel size error is admissible to conserve the trade-off between valid update frequency, hardware accuracy and algorithm's robustness.