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GUIDE STAR CATALOG FOR SATELLITE ATTITUDE ESTIMATION

Abstract

Nowadays star sensors provide the most precise satellite attitude determination. They are being used for a variety of satellites from cubesats to big satellites for long-life missions. Solving the lost-in-space problem is the most challenging task for the star tracker's software. The key point of the lost-in-space problem is a star identification algorithm seeking for the correspondence between stars observed in the field of view (FOV) and the data in the guide star catalog. The efficiency of the stars identification algorithms noticeably depends on the quality of a guide star catalog, which influence the following characteristics of the star tracker such the probability of finding true orientation, its estimation accuracy, the time for the autonomous attitude determination, an amount of necessary RAM. The properties a of guide star catalog for each star tracker depend in its turn on such star tracker's characteristics as the form and the size of the FOV, the optical system of the star tracker, the spectral response of the sensor, its sensitivity and signal-to-noise ratio. A guide star catalog for a star tracker is: 1. the number of the stars in the FOV for each position of the FOV on the celestial sphere is to be more than two; 2. the minimal distance between the stars of the catalog is to be greater than a certain value; 3. stellar magnitudes are to be evaluated taking into consideration the spectral response of the device; 4. the distribution of the stars on the celestial sphere should be maximum possible uniformly. The report is devoted to different aspects of creating star catalogs: 1. instrument stellar magnitude estimation for a star tracker taking into account its spectral response. The estimation is based on using standard photometric bands B, V, R, I, J of photometric star catalogs Tycho, Cousins, 2MASS, HIPPARCOS; 2. clusterization of nearby stars and removing the stars hindering the identification; 3. an optimal selection of guide stars and catalog decimation - removing redundant stars which are not important for the identification. Thise decimation reduces the size of the star catalog and makes the star distribution on the celestial sphere more uniformly; 4. an effective correction of stellar aberration. A concise survey of star identification algorithms will be performed in the report. Some of the methods suggested in the report are successfully being used on the four operated russian data rely satellites of "Louch" series.