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SATELLITE ATTITUDE DETERMINATION ALGORITHMS BASED ONLY ON STAR TRACKER MEASUREMENTS USING TRIAD AND Q-METHOD

Abstract

The satellite is subjected to external disturbances forces which can affect its attitude (orientation), for this reason, the attitude determination of a satellite is an important task for a good stabilization and a suitable pointing accuracy in order to ensure satellite mission services. The attitude determination uses some measurements from the attitude sensors installed in the satellite, the selection of the sensors used in the satellite depends essentially on the satellite's mission and the characteristics of the sensor such as its precision, cost, weight and power consumption. ... The star sensor is the most precise attitude sensor (high resolution) which provides a direct impact on the attitude estimation performance, for this reason, the use of this sensor is indispensable in some satellite missions such as high-resolution imaging satellite missions. The attitude determination algorithms offer a suitable solution for estimating the attitude of the satellite which amounts to determining or estimating the rotation matrix describing the orientation of the satellite fixed reference frame, with respect to a known reference frame, say an inertial reference frame. The Triad algorithm (Triaxial Determination) is a simple and reliable method for attitude determination, it presents the fastest method for attitude determination. Otherwise, the quaternion method (q-method) offers a solution of the attitude problem (Wahba problem) which minimizes the loss function, it is based on the direct calculation of the optimal quaternion through the eigenvector which corresponds to the maximum eigenvalue, which makes this method the most accurate method. In this work, an investigation of the two methods was carried out using only the measurements from the star sensor, subsequently, a comparison between the two methods was made based on two important factors: the estimation precision and the processing speed. The results of simulations have been carried out under the Matlab/Simulink environment and can clearly confirm the feasibility, the effectiveness and the performances of the applied methods.