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Attitude Dynamics (2) (9)

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ATTITUDE DETERMINATION OF ABOUT ONE DEGREE ACCURACY USING ONLY MAGNETOMETER DATA IN MEGHA-TROPIQUES

Abstract

Megha-Tropiques is an Indo-French mission, for studying the convective systems that influence the tropical climate. To study the tropical region, it is located at an inclination 20 degrees and thus a highly regressing orbit. Due to this regression , the sun crosses the orbital plane. In such scenario , the spacecraft has to be rotated by 180 degrees about yaw axis in order to keep star sensor FOV (Field Of View) free from sun intrusions. After the flip maneuvers , the gyros are updated using star sensor data . Primarily Star sensors are used for updating gyro in order to maintain the spacecraft attitude. In case of unavailability of star sensors, the only sensor available throughout the orbit is Magnetometer. The 3-axis magnetometer measures the earth's magnetic field. These measurements are affected by the magnetic field generated within the spacecraft, more prominently by the torquers which are used for dumping of the excess momentum built on spacecraft due to various disturbances. These intrinsically varying magnetic fields due to torque currents appear as time varying magnetic bias affecting the actual magnetometer measurement. This paper deals with the Kalman filter approach for attitude estimation using magnetometer data and gyro measured rates. Apart from the ECI (Earth Centered Inertial Frame) attitude quaternions, the magnetometer biases and the gyro drifts are also taken as the states of the filter. The estimated attitude quaternions are used to update the gyros. The IGRF 2005 (International Geomagnetic Reference field) model is used to determine the reference magnetic field. The filter is implemented to work in real-time. It is interfaced with the telemetry data of the spacecraft and the determined attitude is converted to commands to be uplinked to spacecraft for updation of gyro measured attitude. The attitude accuracy achieved is about 1 deg when there is no change in the torquer current. Whereas, when the torquer current is varying frequently the accuracy is around 1.6 deg during the same state of torquer action. Even during maneuver operations of the spacecraft the accuracy is within 1 deg.