Magnetic Control Using Magnetometer and Partial Gyro Measurement

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The magnetometer measuring the near-earth space environmental magnetic field, and the gyro measuring the angular rate with respect to the inertial space are the well-known sensors for the attitude control of spacecrafts. Particularly, the magnetometer which detects the direction and magnitude of the geomagnetic field induced inside the spacecrafts is used for the attitude determination and the momentum unloading of the reaction wheels. Although the magnetometer has lower accuracy than other attitude sensors such as the sun sensor, the earth sensor, and the star tracker, it has low power consumption, low mass budget, and high reliability. The magnetic torquers are used in spacecrafts for the attitude control instead of the reaction wheels and the thrusters, the momentum dumping of reaction wheels, and the residual magnetic field compensation inside the spacecraft. Although the magnetic torquer produces smaller torque level than the reaction wheel and the thruster, it is usually mounted on the most spacecrafts as a fundamental actuator owing to its simple structure and high reliability. Most spacecrafts have their own operation modes which use a minimum set of the reliable and low-power consuming sensors/actuators in contingent case for spacecraft survivability. This contingent operation usually engages the sun sensor, the magnetometer, the gyro, and the magnetic torquer. Some spacecrafts also engage the gyroless contingent operation mode. In this paper, we presents a magnetic control method of spacecraft using the magnetometer and the partial gyro measurements. The proposed method does not use any sun sensor but uses the geomagnetic field model and orbit ephemeris model. The proposed method can be applied usefully to the sun pointing operation without sun sensor for contingent case.