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HIL SIMULATION OF SPIN STABILIZED SPACECRAFT DYNAMICS BY TWO DEGREE OF FREEDOM GYROSCOPE SIMULATOR

Abstract

Spin stabilization is a passive control technique in which the entire spacecraft rotates so that its angular momentum vector approximately fixed in inertial space. Spin stabillized spacecraft (or spinners), employ the gyroscopic stability to passively resist disturbance torques about two axes.

The design, build, and development of a two degree of freedom gyroscope is presented in this paper. The simulator consists of gimbal platform with dimension 38 x 31 x 31 centimeter, IMU (Inertial Measurement Unit) package, tachometer (sensor for monitoring the rotational speed of the wheels), microcontroller system, and two axes reaction wheels actuators each of which may produce torque of approximately 0.03 Nm.

The simulator is intended to be used for investigating control method for a spin stabillized spacecraft. In this case spacecraft has 600 km circular orbit. The platform model represents the dynamics of a spinner spacecraft rotating in Z (major axis) of the simulator platform, equipped with two reaction wheels actuators providing torque around X and Y axes as disturbance torques input from space environment at 600 km altitude such as gravity moment, solar radiation moment, aerodynamic moment, etc (two types of disturbance torques that will be generated : cyclic torques and constant torques by pulse width modulation method).

The behavior of the platform then is compared to the response obtained from numerical simulation of a dynamic mathematical model of the platform. The results show some comparable response of the platform, although some adjustment and modification on the platform mechanism still need to be carried out. The simulator platform then will be further developed to analyze the stability of a spin stabilized spacecraft and also to study gyroscopic phenomenon for CMG (Control Moment Gyros) development.