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THREE DOF TESTBED FOR CUBESAT ADCS VERIFICATION AND TEST

Abstract

Verification of attitude determination and control algorithms before launching the satellite can minimize the possibility of any errors. This can be done with SIL and HIL. Simplification is usually done in software simulations; however, the use of hardware in performing tests allows all available parameters to be considered. In this paper, the test of ADCS subsystem of a 6U cubesat on two testbeds is presented. In one of them, the test was performed on a hemispherical air bearing, and in another one, due to the low weight of the ADCS components of cubesats, the suspension was done through a thread attached to the ceiling. The degree of freedom of the hemispherical air bearing is +/-45 Deg in Pitch/Roll directions and 360 degrees in Yaw direction. All ADCS elements (including 3xReaction Wheels, 3xMagnetorquers, 1xMagnetometer, 1xSun Sensor, 1xGyro) are mounted on the air bearing. An automatic CoM mass balancing system is also provided to achieve well balanced setup. In the case of suspension using thread, all the above elements are mounted on a frame and this frame is connected to the thread through a special joint. This joint is of special importance for achieving the maximum degrees of freedom in all three directions. This method is similar to using a spherical joint, except in this case, the friction is very low. The degrees of freedom in all directions are approximately 360 degrees. Obviously, this platform is very suitable for testing the ADCS subsystem in detumbling mode, because the satellite in this mode has angular motion in all directions. This testbed also uses an automatic mass balancing system. Both systems are housed separately inside a Helmholtz cage, expose to a sun simulator. All ADCS algorithms (including EKF/UKF filters and control algorithms such as: detumbling, nadir pointing, sun pointing, slew maneuver, momentum dumping) were tested, evaluated and validated in both platforms. Both testbeds were shown to be suitable for testing the ADCS of cubesats. The thread suspension setup, in comparison with the air bearing is low cost and testing the detumbling mode is also possible. However, with increasing mass, the air bearing testbed is a stable and reliable setup. Of course, the detumbling mode test on the air bearing is done in a tricky way, using a Skewed configuration to project the yaw (360 Deg) axis rotation of the bearing on all cubesat body axes.