RESEARCH OVERVIEW:

The University at Buffalo Nanosatellite program is a student based organization which aims to solve critical issues in space situational awareness that has arisen due to the growing occupancy of space. As the number of objects in orbit increase, which include rocket bodies, satellites and space debris, the probability in collisions between satellites and manned space vehicles increase. The nation’s most recent space surveillance satellite cost approximately one hundred million dollars to design, manufacture and to launch. Our goal is to limit the cost by demonstrating the feasibility of using a network of Nanosatellites to monitor space. The orientation, and material composition will be estimated. An important subsystem of our Nanosatellite is the Attitude Determination and Control (ADC). ADC is responsible to control the orientation of the satellite with respect to the Earth and other satellites. Reaction wheels allow the satellite to stabilize the satellite and direct the cameras towards the objects of interest. In late 2015, The reaction wheels will be put to the ultimate test in a guaranteed NASA launch.

What do Reaction Wheels do?

- Help stabilize the satellite once it’s launched into space.
- Counter the rotation from solar pressure, drag, and moving parts inside the satellite.
- Produce torque in one or multiple directions to counter the rotation from tumbling.
- Allows for small and precise movement.
- Consists of three perpendicularly mounted wheels.
- Can build up stored momentum, should be accompanied with magnetorquers to transfer angular momentum.

UB Nanosatellite Reaction Wheels

- Dimensions 3” x 3” x 2.75” (24.75 in³).
- 3-axes of rotation, which provide no redundancy.
- 0.002 N*m of Momentum Storage.
- Operating temperature of -40C to +80C.
- Provides a maximum torque of 0.635 mN*m.
- Weighs 640 gm (1.41lb).
- Requires 12-28 V at 200mA of DC.
- Suitable for 20h Nanosatellites.

Testing

- Used 3-D printer to construct a housing unit in order to hold all loose components.
- Created wireless communications to a command center using Bluetooth.
- Defined constant properties (pressure, weight, dimensions/inertia).
- Used the Physics Department’s compressed spin tables to measure the velocity and angle of the reaction wheel output.
- Recorded multiple tests at 1,-1,3 and -3mNm.

Acknowledgments

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Results

- Used Microsoft Excel to compute the average velocity and acceleration.
- Created graphs of degrees versus seconds.
- Formed functions from the graphs, which could be derived to find the torque output.
- Found a total error of 6 percent.

Over the next few weeks, we will continue to do multiple tests with a digital torque gauge with a reaction sensor from Com-Ten Industries. The resolution of the sensor is 0.004 mN*m, has an accuracy of 0.2 mN*m, and has sample measurement rates up to 1000Hz. Once these tests are preformed, we will use Microsoft Excel to compare the spin table tests with the sensor tests. We can then conclude that our reaction wheel produces accurate torque, and that the UB Nanosatellite will be one step closer to being in space.

References