ATTITUDE CONTROL SYSTEM FOR LOW-SPEED CUBESAT CENTRIFUGE TO SIMULATE ASTEROID SURFACE CONDITIONS. S. Shah¹, A. Cannady¹, I. Alizadeh¹, J. Thangavelautham², E. Asphaug².
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Summary: AOSat is a 3U CubeSat based centrifuge that will be launched into low Earth orbit in the 2015-2016 timeframe. The satellite will be used to answer fundamental questions of how dust accretes into larger objects under microgravity conditions and to simulate asteroid surface conditions by spinning at upto 1 rev/min to produce 0.0001g. An Attitude Determination and Control System (ADCS) capable of producing and keeping this low spin rate is challenging. Typically a conventional satellite spins at high angular velocities and is spin stabilized using the gyroscopic effects.

In contrast, AOSat will be spinning at much lower rates that prevents us from exploiting this phenomenon. AOSat poses additional challenges, due to its limited volume that prevents use of 3-axis reaction wheels. AOSat with its small the moment of inertia compared to large satellites is subject to faster dynamic response and consequently higher sensitivity to perturbation torques which make attitude control stability more difficult. The only viable option for AOSat is to use magneto-torquers in combination with a reaction wheel. Magneto-torquers alone cannot provide AOSat with total control authority, hence a novel method of utilizing 3 magneto-torquers and 1 reaction wheel to achieve full control of AOSat is proposed. This allows AOSat to periodically dump all excess momentum.

The proposed method has been successfully implemented using a state feedback control method to achieve stabilization of AOSat and required 1 rev/min. Simulation results show that settling time for AOSat from a stationary state to one rev per minute takes 500 seconds. These results account for all significant disturbance torques the satellite will be experiencing in low earth orbit. The state feedback control algorithm shows that it is a robust system that can overcome these disturbances. Work is proceeding on testing the approach using an attitude control test-bed in preparation for flight hardware integration and testing.