Attitude determination and control of a nanosatellite using geomagnetic field data and sun sensors

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Abstract: This paper describes an application of a control law to reorient the spin axis and control the spin rate of a spin-stabilized satellite in an intermediately inclined orbit using two magnetic torque rods. A simple control law that changes polarity of the rod to generate the desired torque is applied, using the angular momentum vector as the basis for the error function. Attitude determination will be done with a three-axis magnetometer, using an extended Kalman filter and sun sensors. Attitude information will be found by integration of angular velocities determined from the magnetometer and a Kalman filter. Initial values of the attitude information for integration will be found with the TRIAD algorithm using geomagnetic field vectors and sun vectors, and will be frequently updated to remove accumulated attitude error. Because the attitude sensor is a magnetometer, sensing is not possible while operating the magnetic torque rods, and attitude correction due to the control moment from the magnetic torque rods will be derived with only prediction of angular velocities. This research shows an optimal control sequence between measurements and control impulses. Application of this method to Penn State University's nanosatellite LionSat is presented.

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