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DISTURBANCE TORQUE ESTIMATION AND COMPENSATION SCHEME FOR THREE-AXIS ATTITUDE CONTROL OF SPACECRAFT USING MAGNETIC TORQUERS

Abstract

SRE-2 is the second satellite in the series of Satellite Recovery Experiments after the successful re-entry of SRE-1. On-orbit attitude control and maintenance is primarily done using three magnetic torquers and a micro-wheel. Control scheme presented in this paper is implemented as backup mode in case of micro wheel failure. 3 - Axis attitude control of spacecraft using magnetic torquers as actuators has high significance in the control system design of small satellites. Magnetic torquers based control involves the generation of appropriate magnetic moment by a set of current carrying coils, which interacts with the external Geo magnetic field causing a torque in the satellite to control the attitude. Design of control system using magnetic torquers has its own in built complications. Torquer based control forms an under-actuated system since torque cannot be supplied in required direction at a given instant. Since Geo Magnetic field varies with time in a given polar orbit, the entire system becomes time varying system. Magnitude of torque supplied by the torquer is very less resulting in a long settling time even under no disturbance conditions. Disturbance torques such as gravity gradient and residual magnetic torque are always present in the system leading to a high attitude error. A new disturbance torque estimation compensation method is presented in this paper which reduces the magnitude of the attitude error of the spacecraft when compared to conventional methods. Compensation for the non-linearities caused by torquer driver electronics is also incorporated in this paper. Detailed description of the work along with simulation results will be presented later.