A simple sun-pointing magnetic controller for satellites in equatorial orbits

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Abstract: This paper describes a simple satellite attitude controller designed to run on a fairly low capability processor. The controller is intended to be used in a contingency mode when the spacecraft flight computer and full sensor and actuator suite are not available, making use of only analog-output sensors (three-axis magnetometer and sun sensors) and analog-input actuators (magnetic torque rods or coils). The controller is designed to keep an axis near the principal axis of maximum inertia pointed at the sun. Because control torques may only be applied in a plane perpendicular to the local geomagnetic field the control scheme uses a very low control bandwidth in conjunction with gyroscopic spin stabilization. While originally designed for a satellite in a high-inclination orbit, the spacecraft was adapted for a new mission in a nearly equatorial orbit, where purely magnetic attitude control is not typically used because the direction of the local geomagnetic field is nearly constant during an orbit. This paper reviews the design of the original controller as well as the modifications which were made to improve performance in the nearly equatorial orbit. Statistical performance results based on Monte Carlo simulations are included.

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