IAF ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (1) (5)

Author: Mr. Arland Thompson
Raytheon, United States, arland.thompson@raytheon.com

MINIMUM JERK ATTITUDE SLEW MANEUVERS

Abstract

This paper presents a method for generating a smooth rest-to-rest satellite vehicle attitude slew maneuver profile. The method attempts to generate attitude slew maneuver profiles which have modest torque requirements with reasonable attitude slew maneuver times while meeting rate, acceleration, and jerk limits. The method readily lends itself to flight software implementation or ground generation and uplink. Derived expressions for rate, acceleration, and jerk limits are concise and easily implemented. This method is very well suited for small satellites that have lower torque and power capability, as well as low, modest on-board computational power requirements. This satellite attitude slew method is the rotational analogue of a translation expression which yields a smooth minimum jerk trajectory which resembles a reaching motion of a hand, foot, or other end effector. Slew maneuver basics are presented. Examples of smooth attitude slew maneuvers generated by this method are also presented. To evaluate performance, a comparison is made to a shape-based method which uses polynomials to represent a quaternion attitude trajectory as a function of time. Coefficients of the polynomials of this method are solved for to meet boundary conditions of zero rate and zero acceleration, and a smooth close-to-optimal trajectory is generated analytically.