ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (2) (2)

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SPACECRAFT ATTITUDE CONTROL SYSTEM BASED ON TOTAL ENERGY CONTROL APPROACH.

Abstract

Energy based controllers have proven to have excellent performance and to be robust since they consider intrinsic properties to nonlinear dynamic systems physics. In the total energy control method (TECS), the main purpose is to drive, using a proportional-integral scheme, the total energy rate of the system plant to a target total energy rate. It turns out that the total energy rate is proportional to the time derivative of the satellite Hamiltonian function. The attitude control objectives, either regulation or tracking, define the target total energy rate. As an advantage, the TECS controller provides drift compensation due to its integral part, which is ideal for secular disturbances rejection. The error space coordinates are represented on the nonlinear attitude configuration space $SO(3)$, and this allows the controller to avoid the classical singularities found on Euler angles and the ambiguity problem on quaternions. The control is applied to a Cubesat satellite model on a computer based simulation, for the case of full three-axis attitude control. In addition, real-time experiments are carried out on a satellite simulator for one-axis attitude control. On the simulator, an underwater vehicle emulates the satellite, while water emulates the conditions prevailing in outer space. Two reaction wheels controlled in current mode are the actuators for the underwater vehicle. The Attitude Control System (ACS) developed forms part of a project sponsored by mexican national space agency (AEM) and national science and technology council.