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Author: Dr. Jae-wook Kwon
Korea Aerospace Research Institute (KARI), Korea, Republic of

ATTITUDE CONTROL MODE DESIGN AND ITS PERFORMANCE VERIFICATION FOR KOREA PATHFINDER LUNAR ORBITER

Abstract

The Korea Lunar Pathfinder Orbiter (KPLO) mission objectives are to place an orbiter via a cis-lunar transfer phase into polar lunar mission orbit, and to perform technology demonstration and science operations. The cis-lunar phase will contain Weak Stability Boundary Trajectory for a total duration of approximately three months, and the mission phase takes place in a 10030 km circular polar lunar orbit. The orbiter will be three-axis stabilized, and utilize star trackers, sun sensors, and gyros for attitude determination and reaction wheels and thrusters as attitude control actuators. Scientific instruments equipped in KPLO plan to measure lunar environmental states during all of mission period. In order to minimized the interrupted orbits caused by the wheel momentum unloading and minimize fuel consumption for the momentum unloading, KPLO has twin solar arrays driven in both side of the body. Lunar orbiter that is orbiting on the polar orbit at the moon has non-sun synchronous orbit, but Sun beta angle of the lunar orbiter is widely changed in a whole year. In order to obtain sun light for battery charging in the whole orbit, 45degree yaw tilted attitude is the normal attitude for nadir pointing. There are seven KPLO attitude control sub-modes, excluding ground test mode. Two sub-modes of them are dealt with in this paper. Target Pointing sub-mode uses the reaction wheels to maintain a nadir-pointing attitude intended to be used in lunar mission orbit. The other sub-mode that uses the reaction wheels is Sun Pointing sub-mode. Sun Pointing locks the solar arrays into their home positions and steers the spacecraft body using the reaction wheels to keep the solar arrays pointed toward the Sun and the high-gain antenna pointed toward the Earth. The remaining sub-modes are thruster-based Del-V, Wheel Off-Loading sub-mode that dumps wheel momentum and Thruster-based Safe Hold sub-mode for a safe hold emergency mode. Communicated in high rate with High gain antenna. However, the limited moving range of the antenna makes constraints to Sun pointing attitude. These constraints should be considered in Cis-lunar phase to make sure about the communication. This paper shows how to design attitude commands for the sun pointing and target pointing under the system constraints. Moreover, the analysis results are shown as the output profile generated and visualized from the KPLO own simulator, which is called LUNASIM (Luna Attitude SIMulator).