MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

Author: Mr. Kyung-Won Kim
Korea Aerospace Research Institute (KARI), Korea, Republic of, kwkim74@kari.re.kr

Mr. Sun-Won Kim
Korea Aerospace Research Institute (KARI), Korea, Republic of, sunwkim@kari.re.kr
Dr. Jae Hyuk Lim
Korea Aerospace Research Institute (KARI), Korea, Republic of, ljh77@kari.re.kr
Dr. Juhun Rhee
Korea Aerospace Research Institute (KARI), Korea, Republic of, jrhee@kari.re.kr
Dr. Jin-Hee Kim
Korea Aerospace Research Institute (KARI), Korea, Republic of, kimjh@kari.re.kr
Dr. Do-Soon Hwang
Korea Aerospace Research Institute (KARI), Korea, Republic of, dshwang@kari.re.kr

SOLAR ARRAY DEPLOYMENT MECHANISM DEVELOPMENT FOR LEO EO SATELLITE

Abstract

In this paper, the conceptual design, structural design and analysis, and qualification test are described to develop Solar Array Deployment Mechanism (SADM) for LEO EO satellite. After satellite is separated from the launch vehicle, first of all, satellite deploys the solar array. Solar array deployment is one of the key factors deciding the success of the satellite mission. In the previous satellite program, we deployed solar array using several tape hinges. Although tape hinges have high reliability for deployment, they cannot provide high solar array deployed stiffness. For developing satellite program, high solar array deployed stiffness is required for high agility of satellite. The solar array of satellite consists of 3 deployable solar panels, and each solar panel is installed into bottom side of satellite. From the several trade-off studies, we decided SADM configuration, composed of one strut and two main hinges. Main hinge performs a function of deploying the solar array from the stowed configuration, and strut provides a function of latching the solar array. Main hinge consists of two brackets and two torsional springs. One side of two brackets is installed satellite part, and the other side is installed solar array part. In order to prevent over constraint after solar array is deployed, the latching device is not considered in the hinge. Strut is composed of two tubes, one central hinge using tape hinge, and two end hinges having similar design with main hinge. The material of most parts is aluminum, except tube manufactured from CFRP. In the solar array stowed configuration, strength and stiffness analysis are performed to check the safety of SADM under launch environment. In the solar array deployed configuration, stiffness analysis is accomplished to check deployed stiffness. In addition, solar array deployment analysis is performed to check deployment motion and to verify whether latching force is acceptable considering solar cell safety. After manufacturing, on the component level, torque margin test is performed on each hinge and strut under extreme low temperature. Solar array simulator, and solar deployment zig were made in order to perform qualification test under more realistic condition. After installing all related components into the solar deployment zig, on the assembly level, sine vibration test, random vibration test, and shock test are performed to qualify SADM under launch environment in the stowed solar array configuration. Torque margin tests are performed under ambient condition before and after vibration tests to check degradation of SADM. Especially, after vibration test, torque margin test also performed under extreme low temperature to qualify SADM under on-orbit environment. According to the described development process, we successfully developed SADM

providing high solar array deployed stiffness.