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MISSION AND SYSTEM DESIGN FOR 80KG-CLASS X-BAND ACTIVE SAR SATELLITE OF S-STEP

Abstract

With the beginning of the New Space Paradigm, interest in small satellite development is increasing. This development philosophy makes it possible to realize a smaller, better, faster and cost-effective small satellite constellation with the advantage of being able to perform missions quickly through a short revisit time. Small SAR Technology Experimental Project (S-STEP) is to develop 80kg-class ultra-light weight X-band active Synthetic Aperture Radar (SAR) satellite constellation system with an additional function of S-band Inter Satellite Link (ISL). The mission applications are focused on observation of inland/coastal region, geological mapping, environment and disaster monitoring, marine surveillance for ship and pollution detection. The S-STEP system with unique mechanical configuration of flat plate-type satellite provides a high resolution of 1m stripmap mode, ScanSAR mode with 4m resolution and VideoSAR mode with 1m resolution for identification of moving target. As a SAR payload, aperture-coupled cavity-backed microstrip patch array antenna with high-gain was considered in the system design. The S-STEP has innovatively reduced the total mass of satellite by adopting design strategy of multi-functional integrated structure. For example, Transmit/Receive (TR) module for active SAR mission is also used as structural stiffener and heat dissipation radiator to guarantee a long-term image acquisition of 120 sec regardless of left and right looking mission due to a novel passive thermal design of TR module. The main feature of the system is to adopt a strategy of whole spacecraft vibration isolation to decrease the total mass of satellite by reducing the launch design load. This also contributes to reduce a development cost and schedule of the project by optimizing the conventional verification process which takes a large portion of the time and cost in entire satellite development programs. In addition, the new design concept of satellite with bus and payload integrated structure makes it possible to achieve a high-dimensional stability of the structure with SAR antenna under severe on-orbit thermal environment. In this paper, S-STEP mission, system design, development philosophy and innovative thermo-mechanical design will be introduced to demonstrate the feasibility of the design approaches.