Proceedings of the Canadian Society for Mechanical Engineering International Congress 2021
CSME Congress 2021
June 27-30, 2021, Charlottetown, PE, Canada

RADSAT-SK Cube-Satellite Frame Design

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ABSTRACT

This abstract outlines the custom frame design for Saskatchewan's first Cubesat, the RADSAT-SK. The justification behind a custom frame design was the enhancement of student education and the ability to cater to the specific needs of RADSAT-SK's mission. Payload preservation and the mounting of the solar assembly are essential to the success of this cube-satellite mission. Therefore, the frame must incorporate many intricate aspects including structural stability, thermal survivability, and accessibility. The frame must securely anchor all components of the cubesat during launch while minimizing the effects of mission vibrations, remaining accessible for all pre-launch work, and facilitating radiation conduction when in orbit. The RADSAT-SK's custom frame design is the implementation of a repeating, modular L-shaped design that combines a shear panel and rail for each side of the cube-satellite into one contiguous bracket. This design takes advantage of strategically placed ribs to reduce the fastener count, such that each L-bracket is easily removed for access to the internal payload by the removal of four (4) fasteners. This permits inspection and testing of the payload without complete disassembly of the cubesat. The payload bus is secured to the frame by three (3) cross members and can be removed from the cubesat in one piece. This provides stability for the payload while simplifying disassembly during pre-launch procedures. The RADSAT-SK frame design simplifies secondary component integration, reduces the frame's mass and component count, and improves clearances. The frame meets the Nanoracks integration requirements, ensuring the frame is compatible with the designated deployment mechanism from the International Space Station (ISS). Aluminum (6061-T6) was chosen as the material for the frame's fabrication due to a history of being successfully employed in aerospace applications. Thermal and vibration simulation tests were conducted to confirm design viability using Siemens NX and ANSYS software packages, respectively. For thermal control, the simulations showed that the cubesat frame will not require any additional heat management mechanisms. Regarding vibrations, the frame adheres to GSFC-STD-7000 and ASAP5 qualifications. The frame will undergo a series of physical tests to validate the vibrational analyses performed through simulations, using a hydrostatic-bearing slip table. Likewise, the custom-built frame will be tested in a thermal vacuum chamber to ensure its ability to conduct radiation to maintain desired internal temperatures. The RADSAT-SK frame is uniquely designed and optimized for the team's mission to ensure its structural integrity.