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Entitled

Analysis, Design, and Validation of the Structural System of AlAinSat-1 CubeSat

by

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Abstract

This thesis presents the process of conducting structural analysis on AlAinSat-1 CubeSat through numerical solutions using Siemens NX. AlAinSat-1 is a 3U remote-sensing CubeSat equipped with two Earth observation payloads and is scheduled for launch using SpaceX's Falcon 9 rocket. To ensure the mission's success and its ability to endure the launch environment, several scenarios must be analyzed. For the AlAinSat-1 model, the Finite Element Analysis (FEA) method is employed, covering four types of structural analyses: modal, quasi-static, buckling, and random vibration analyses. The workflow cycle includes idealization, meshing, assembly, applying connections and boundary conditions, and finally, running simulations using the Siemens Nastran solver. The results of each analysis are reviewed, highlighting issues encountered during the analysis and proposing solutions. The simulation results for all types of analysis indicate that the model can safely withstand the loads experienced during launch. Additionally, the numerical results of the Command and Data Handling Subsystem (CDHS) module of AlAinSat-1 are experimentally validated through a vibration test conducted with an LV8 shaker. The module successfully met the test criteria provided by the launcher. The numerical simulations, coupled with the experimentally obtained results, are consistent and enhance the understanding of the design simulation and testing process.

Keywords: 3U CubeSat, Structural Analysis, Finite Element Method, Modal Analysis, Quasi-Static, Random Vibration, Buckling, Shaker, CDHS HW, Vibration Testing.