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ON-ORBIT FLIGHT TESTING OF THE ROLL-OUT SOLAR ARRAY

Abstract

The Roll-Out Solar Array (ROSA) is an innovative, lightweight solar array with a flexible substrate that packages efficiently, and makes use of the stored strain energy in its composite structural members to provide deployment without the use of motors. The ROSA flight experiment was launched to the International Space Station (ISS) on June 3rd, 2017 as a part of the eleventh SpaceX commercial resupply mission. After two weeks of storage, ROSA was extracted from the Dragon spacecraft, deployed, and put through a week of tests to verify its structural characteristics and the performance of experimental photovoltaics. The structural dynamics experiments included active excitation of out-of-plane bending modes, and a study of the thermal-structural interaction of the structure during day-night transitions. Data was gathered from a small number of accelerometers located at key points on the solar array and from cameras observing numerous photogrammetry targets spread out over the structure and the photovoltaic blanket. The goal in this effort was to better understand the performance of ROSA and to improve modeling efforts for future designs of similar solar arrays. Of particular interest are the first few system modes and mode shapes of the array, the amount of structural damping present, and degree of structural-thermal interaction seen during eclipse exit. Discussions include; discrepancies between the behavior predicted by the models and that observed on orbit, the performance of the photovoltaics while on-orbit, and the methods of analyzing flight accelerometer data and comparisons with pre-flight finite element predictions.