Paper ID: 26637
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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Poster Session (P)

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TRIANGLE-SECTION COILABLE MAST DEVELOPMENT FOR BUAA-SAT

Abstract

BUAA-SAT is a 35kg gravity gradient stabilized micro-satellite. According to the mission design, after the satellite is separated from the launch vehicle, an extensible beam is expected to deploy as a gravity gradient boom, which is one of the key techniques to test on BUAA-SAT. Folded boom and spring-loaded telescoping boom have been used as deployment mechanism in some realized micro-satellite missions with good reliability. However, their extension ratio and operability could not satisfy BUAA-SAT because of its low power supply and limited dimension. Coilable mast has been used as extensible mechanism in large satellite programs, such as the New Millennium Space Technology 8 (ST8)which showed high extension ratio and low linear density. However, its drive system needs high power consumption and large installation volume, which would be impossible in BUAA-SAT. Moreover, the mast joint in published work was so complicated which is difficult to realize. In the present work, a Triangle Section Coilable Mast (TSCM) was developed through conceptual design, dynamical analysis and qualification tests. Two main problems were solved according to the BUAA-SAT requirements. Firstly, TSCM was designed to be rate-limited by an axially-located dyneema rope. A rotating damper combining with the rope would ensure the passive smooth deployment of TSCM within the limit power consumption and dimension. Meanwhile, The TSCM joint was simplified by removing two rotational degrees of freedom. The simplification would combine the longitudinal girder and transverse beams with a rigid body, which would increase the TSCM global stiffness while decreasing the joint complexity. To verify the mast design and deployment performance, zero-gravity test and dynamical analysis were implemented. By comparing the results of tests and numerical simulation, the parameters of simulation model were adjusted to optimize the deploying performance, which would ensure a smooth and low-impact deployment. Finally, zero-gravity deployment test was performed again to verify the feasibility of the optimized design.