Paper ID: 47489
oral

25th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Spacecraft for Deep-Space Exploration (8)

Author: Dr. William Wilkie
National Aeronautics and Space Administration (NASA), Langley Research Center, United States

Dr. Jeannette Heiligers
Delft University of Technology (TU Delft), The Netherlands
Mr. Darin Foreman
National Aeronautics and Space Administration (NASA), United States
Dr. Juan Fernandez
National Aeronautics and Space Administration (NASA), Langley Research Center, United States
Dr. Olive Stohlman
National Aeronautics and Space Administration (NASA), Langley Research Center, United States
Dr. Geoffrey Rose
National Aeronautics and Space Administration (NASA), Langley Research Center, United States
Mr. Nigel Schneider
National Aeronautics and Space Administration (NASA), United States
Dr. Jin Ho Kang
National Institute of Aerospace (NIA), United States

A COMPOSITES-BASED SOLAR SAIL SYSTEM FOR DEEP SPACE SMALL SPACECRAFT

Abstract

The National Aeronautics and Space Administration (NASA) has recently begun investing in deployable structures and materials technologies for small satellite scaled applications. This effort is motivated, in part, to facilitate the use of CubeSat-class small satellites in future low-cost deep space missions. Recently, challenges associated with miniaturizing electric propulsion systems for long-duration (2.5 years or more) CubeSat-class deep space missions have generated renewed interest in solar sail propulsion systems. Solar sail performance considerations – namely, the desire for high characteristic acceleration - have incentivized development of several new NASA lightweight, high packaging efficiency deployable composite booms specifically intended for CubeSat-class missions. In this paper, we will describe ongoing development efforts for a new high-performance, small satellite solar sail propulsion system intended for 12U to 27U CubeSat-class deep space missions. An overview of the underlying high-strain composite boom technology, and related radiation-resistant polymer membrane technology development activities, will be presented. Development and testing of a composites-based ground demonstration solar sail system sized for a 6U form factor CubeSat will also be described. A proposed technology development roadmap to extend the 6U-sized solar sail system to future 12U and 27U CubeSat-class spacecraft will also be provided, including descriptions of several representative near-term small spacecraft solar sail mission concepts. These mission concepts include a 6U low Earth orbit solar sail risk reduction technology demonstration mission, targeted for launch in the 2020 timeframe, a 12U-27U concept for small body reconnaissance missions (e.g., Asteroid 2016 HO3), with launch in the 2023 launch timeframe, and a multiple-CubeSat small spacecraft Sun-Earth sub-L1 space solar weather monitoring mission, with launch in the 2023 or later timeframe. Extensibility of the composites-based small spacecraft solar sail technology to non-CubeSat form factor small satellite architectures will also be discussed.