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A Deployable Membrane Telescope Payload for CubeSats

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Abstract

This article reports on the design and development of a deployable membrane telescope suitable for incorporation on 3U CubeSats. When hosting imaging payloads, the size of the primary optic has effectively been limited to the cross section size of the satellite bus. For 1U to 3U CubeSats, this is a diameter of less than 10 cm. To overcome this limitation, cadets and faculty at the US Air Force Academy (USAFA) are currently developing a deployable membrane telescope called Peregrine. Peregrine fits into a 1.5U volume and has a mass of less than 1.4 kg. The telescope includes a 20 cm photon sieve membrane primary optic that is deployed from the end of a CubeSat using a spring-loaded pantograph-based deployment system. A photon sieve (PS) is a diffractive optic that uses a pattern of billions of circular pads with relative size and positioning such that transmitted light though the photon sieve is diffracted to a focal plane array within the CubeSat. The deployable membrane telescope promises the ability to enable missions with a primary optical element that is larger than that of traditional optics, allowing for missions with greater optical resolution.

1. Introduction

The development of technology for the CubeSat industry over the past several years has been impressive. CubeSat capabilities have enabled a wide range of space experiments and missions, ranging from orbital decay studies (Fuller, 2010) to environmental monitoring (Bleier, 2004) to biological missions (Minelli, et al., 2008; Niesel, 2010) to imagers (Simms, 2012). Cadets and faculty at the US Air Force Academy (USAFA) are

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