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DESIGN AND DEVELOPMENT OF A METAMORPHIC SPACE TELESCOPE BASED ON A 6U CUBESAT FOR ASTRONOMICAL OBSERVATIONS

Abstract

Observational astronomy plays a crucial part in humans satisfying their curiosity and in turn, growing their understanding of the universe. Earth-based mega telescopes account for most of the optical(visible) astronomy. These telescopes encounter the obstacle of atmospheric distortion since the light travelling through the earth's atmosphere has to withstand the change in air density as well pass through a significant amount of turbulence. Furthermore, the celestial bodies' emissions are not just restricted to visible light, however, the life-friendly atmosphere of our planet plays a vital role in restricting all other wavelengths from entering the atmosphere to safeguard all life forms from fatal radiations. Henceforth, to expand our knowledge of the universe, telescopes are sent into space to interact with all the wavelengths possible and bring back the valuable data that the earth's atmosphere would have rather engulfed.

However, manufacturing space telescopes is quite expensive, and the launch cost surrounding them is also exorbitant because of their massive size and mass. These telescopes typically involve substantial and complex optical subsystems, nonetheless, endeavors have been adapted to miniaturize and incorporate all that bulky setup into small satellites.

In this paper, we propose a metamorphosing design of a 6U CubeSat-based optical/infrared space telescope capable of transforming into a hexagonal toroid with one side of the CubeSat serving as the primary mirror along and an unfolding secondary mirror to focus the image onto a set of fast steering mirrors for further analysis. The design demands an off-axis mirror system derived from the unobscured Ritchey-Chrétien objective type of telescope. This paper includes the mechanical design of the proposed telescope, optical design and analysis of the modified off-axis system well optimized for astronomical observations along with this, the paper sheds light on infrared and visible image capturing and processing and analyses an attitude control architecture for the final structure (unfolded).