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END-TO-END COLLAPSIBLE OPTICAL PAYLOAD FOR 6U-CUBESAT AND SATELLITE IMAGE ENHANCEMENT SOFTWARE FOR EARTH OBSERVATION

Abstract

High-resolution satellite imagery accessibility for commercial applications and research purposes has been difficult with price information and specifications difficult to obtain. New trends in small satellite platforms such as CubeSat constellations combined with image enhancing operations after image acquisition are allowing for easier access to high-resolution imagery. Higher spatial resolution allows for better detection of features on the image. This allows for better analysis results in remote sensing applications including but not limited to crop monitoring, disaster management, deforestation, climate change monitoring, and urban planning. The design of high-resolution optical payloads in CubeSat platforms is a challenging prospect from an engineering perspective. To overcome this obstacle, in-orbit deployable and collapsible payload designs have been proposed. Especially, collapsible optical payloads are beneficial when dealing with a system that has significant mass and volume constraints. For this purpose, a conceptual analysis of a collapsible payload design on a 6U-CubeSat platform is demonstrated. The Collapsible Electro-Optical Payload (CEOP) will have an image resolution of 1.2 m ground sampling distance (GSD) which corresponds to the National Image Interpretability Rating Scale (NIIRS) of level 5. Image processing applications with deep learning algorithms are a constantly developing field with applications in satellite imagery. Enhancing satellite imagery is done through Super-Resolution (SR), denoising, and colorization of panchromatic images. SR which is used for improving spatial resolution can be categorized as Single Image Super-Resolution (SISR) and Multi Image Super-Resolution (MISR). These enhancement techniques are implemented in a software called Image Processing Software (IPS). In the IPS, Conditional Denoising Diffusion Probabilistic Model (CDDPM) will be used for the SR and colorization approaches. CDDPM with SISR and MISR is applied to satellite imagery with varying terrain and cloud features. The denoising is done by modelling the atmospheric and satellite specific noise components. This research proposes an easily accessible end-to-end image acquisition and processing for users of Earth Observation data. The CubeSat payload CEOP and advanced image processing software IPS will allow for affordable and easier access to high-resolution imagery.