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DESIGN OF LOW GROUND SAMPLING DISTANCE (GSD) IMAGING SYSTEM PAYLOAD FOR 1U-SIZED CUBESAT APPLICATION

Abstract

The imaging system can be less complex to be designed for a small 1U-sized CubeSat with the availability of the commercial off-the-shelf (COTS) imaging sensor. The constraints of 1U CubeSat in terms of size, mass, power supply and interface protocols have limited the selection of components for an imaging mission system design. This leads to the development of imaging mission system with low resolution imagery as the ground resolution is not vitally considered. To solve the issue, an imaging system with high ground resolution was designed to be practical for the application of 1U CubeSat. High ground resolution is associated with low ground sampling distance (GSD). To strategize the design and development of the imaging system, a low value of GSD was the vital element to be contemplated with respect to the limited capabilities of the small 1U CubeSat. Thus, the focal length of the implemented passive optical lens was varied optimally until the suitable length for 1U CubeSat and clear imagery were obtained. Focal length of a lens was a crucial parameter in this research to obtain a small GSD. For the space application at 400 km altitude, it was designed that the imaging mission system for 1U CubeSat could provide a 16 m GSD by a 35 mm focal length lens that was mounted on to the 5 MP CMOS imaging sensor. With the small GSD, the swath area was also shrunk as to allow the imaging sensor to focus on the small element of the target area. To ensure the develop imaging system was qualified for space application, functionality test that proved the performance of system and vibration test that was crucial for application of longer lens were conducted. The RGB test and SNR computation on the obtained imageries proved the quality of the captured image when 35 mm focal length lens was implemented. The distribution of red colour decreased, and the SNR value increased when the IR Cut Filter that removed the propagation of IR ray into the imaging sensor was applied. The design and development of the low GSD imaging system for 1U CubeSat were entrenched from the BIRDS CubeSats Project that was involved by Universiti Teknologi MARA (UiTM) in 2016. This research contributed to the multination collaborative ASEANSAT project which was the continuation of 1U CubeSat development in Malaysia.