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DESIGN AND EVALUATION OF A ROTATING APPARATUS FOR TESTING EARTH OBSERVATION OPTICAL PAYLOAD

Abstract

In earth observation missions, remote sensing images acquired by an optical payload are widely utilized because of their wide coverage and rich spectral bands. Despite being deployed in airborne platforms, a significant phase of the payload's development happens on the ground by utilizing terrestrial technologies and testing equipment. While the payload prototype is expected to be close to its final form before testing on a flight platform, the prototype often needs to be tethered to computers and other instruments during earlier stages. To emulate a platform moving at a constant speed, a line-scanning camera under development can be attached to a scanning rail. However, rails are relatively large setups, and the scanning distance will be limited by the available laboratory space and wirings.

To overcome these limitations, a proposed scanning approach will be presented in this study by using a rotating apparatus for a line-scanning camera, which will translate real-world images while keeping the camera and optics fixed. This rotating apparatus is an improvement of a previous design developed for the same purpose of optical payload testing and evaluation. The new design has a target minimum rotational speed (ω) of 0.4 °/s compared to the previous design with $\omega = 0.48$ °/s. These improvements are achieved by changing the types of gear, bearing, and output shaft. The proposed design also incorporates a single-stage worm drive which enables a speed ratio of 1:72. Although the modified design has a smaller gear reduction, it is expected to have better performance as a result of a more manageable backlash due to parts reduction. To efficiently support axial loads and increase capacity of the rotating apparatus, angular contact bearings and a crossed roller bearing will be used. To facilitate low-cost development, a custom software and commercial-off-the-shelf (COTS) components will be implemented to ensure reliable operation under extreme environmental conditions and provide necessary control signals to the motor which controls the rotating mechanism of the proposed design.

In this study, the scanning device's performance will also be demonstrated in terms of versatility, portability, and panoramic shots. The expected outcome is an improved scanning (or rotating) device that advances infrastructure development in terms of earth observation optical payload for remote sensing applications. Leveraging on this proposed scanning approach and understanding its disruptive potential with respect to testing and evaluation of ground-based payloads could be essential to future payload developments for spaceborne remote sensing applications.