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MINIMIZING DOWNLINK TIME OF HYPERSPECTRAL IMAGES ON A CUBESAT BY PERFORMING CLASSIFICATION BASED ON CONVOLUTIONAL NEURAL NETWORKS

Abstract

Cube Satellites (CubeSat) are known for their small form factor, making them more affordable than larger satellites. However, as size has a direct effect on a satellite's power capacity, CubeSats are usually equipped with less powerful antennas. This results in reduced downlink speeds, essentially making them less effective at transmitting large amounts of data down to Earth.

This paper will use the 6U CubeSat HYPSO-1 (HYPerspectral Small Satellite for Ocean Observation) for its study. HYPSO-1 is equipped with a hyperspectral imaging payload, capable of capturing ocean color phenomena. Hyperspectral data is however known for its large data size, making it time-consuming to downlink. One of the HYPSO-1 mission goals is to achieve near-real-time data acquisition, making it important to improve on how much data is downlinked.

This paper will be discussing how Convolutional Neural Networks (CNN), such as the UNet architecture, can be utilized for onboard classification, and selectively removing redundant information from captured data. This is useful as the reduced size of the hyperspectral data directly affects downlink time. CNNs are known for their good accuracy in performing semantic segmentation of images and are also proven to be highly effective on hyperspectral data. The UNet architecture is known for its reduced resource utilization, as it utilizes a lower number of layer parameters. The main task of the paper will be to explore the potential of onboard classification, and to look into the possible improvements in downlink speeds through removing redundant data.