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ONBOARD CLASSIFICATION TO GUIDE CAPTURE DOWNLINK USING THE HYPSO-1 SATELLITE

Abstract

The HYPSO-1 6U CubeSat is the first Norwegian academic research satellite and was successfully launched on the 13th of January 2022. The satellite is equipped with a novel hyperspectral imager and has acquired and downlinked over 1800 hyperspectral images. The payload can acquire many images per day, but the satellite is downlink bottlenecked at about 5-6 captures per day. Since its launch, the academic team has operated HYPSO-1 and continued updating its functionality, including an on-board classification algorithm currently being applied to the acquired images. The on-board classification is based on Support Vector Machines (SVMs) in a binary decision tree structure labeling pixels into 10 different classes, including clouds, land, and water. Currently, these labels are exclusively analyzed after downlink to a ground station. In this work, we utilize on-board classification by on-board analysis of the generated labels. The knowledge gained can be used for prioritizing the downlink of captures with a small amount of clouds or indications of algae blooms. The main idea is to use the payload to acquire more images than the satellite can downlink, and use the on-board classification to filter out the acquisitions of poor quality. We explore the validity and feasibility of this idea. The method used consisted of making an executable program running on the payload that decodes and reads the labels and uses them to score the captures based on predetermined quality measures. These scores were downlinked and compared to the actual images on the ground to verify the validity of the measures. The architectural changes to the satellite operation scheduling and payload software needed to implement this downlink prioritization are discussed. We wish to increase the satellite's autonomy level, but one must also consider potential consequences. We did not raise the autonomy level as part of this work, but we discussed how the considerations and procedures that should be considered as part of allowing the payload to affect its operations.