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CONVOLUTIONAL NEURAL NETWORK FOR AUTOMATED IMAGE PROCESSING OF EARTH OBSERVATION MICROSATELLITE IMAGES

Abstract

The research presented in this paper aims to aid the efficient use of download links from microsatellites by giving priority to good quality images. This is to address the fact that over the course of the lifetime of an earth observation microsatellite, an enormous number of images are captured. Some of these images are not suitable for use due to cloud cover or low light conditions. Download of these unusable data increases downlink data size and time, without adding valuable scientific data. The high downlink data size and time translates to a need for more ground stations and longer manhours for classification of the images, translating to increase in total operation costs. It is therefore important to filter out the unusable data onboard without human intervention. To do this, we propose an automated classification of images onboard the microsatellite using Convolutional Neural Networks (CNNs) with image segmentation.

To optimize and calibrate the CNN, we use actual operation data and images from microsatellites Diwata-1 and Diwata-2, both 50-kg satellites of the Philippines. Diwata-1, which was launched in 2016, and Diwata-2 which was launched in 2018, have collected around 50,000 images in total. More than 30% of these images have significant cloud cover that make them unusable for science data extraction. Instead of training a CNN from scratch, a pre-trained ResNet50 is used as the base CNN. Succeeding neural network layers are then appended for image segmentation.

The automated onboard processing is triggered when an image capture operation is initiated onboard the microsatellite. The images captured are automatically input to the CNN, which in turn outputs the corresponding segmented image classified into cloud cover, land, and bodies of water. From the segmented image, the percentage of composition is calculated. These results are fed to another layer of the neural network to decide if the images are useable or not. The performance of the CNN is verified by comparing the results of the automated filtering to the baseline tagging done by a manual operator.