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ANOMALY DETECTION IN SPACE DATA USING A CONVOLUTIONAL NEURAL NETWORK

Abstract

The bandwidth of transmitting remote sensing data, captured by satellites to Earth is limited in speed (mb/s) and data sizes captured are growing due to the increased capability of sensors (in terms of resolution and/or capture rate or bands collected). Using machine learning techniques to remove images that contain errors, and/or to identify images containing the phenomena that is desired, the total amount of data that is required to be downlinked to earth can be reduced. This speeds up the time in which data can be analysed and removes a pre-processing step once the data is collated in the required ground station. This paper will present a Convolutional Neural network (CNN) based on AlexNet (Alex Krizhevsky et. al, 2012) which was used with simulated space data that shows cosmic ray tracks on Ultraviolet (UV) spectrometer images. The CNN was able to identify the cosmic ray tacks with a 99The paper will also discuss research results aimed at anomaly identification in space data to remove anomalous frames in data sets. This is to reduce wasted bandwidth and to perform identification of anomalous phenomena so that only frames of data containing useful information are required to be downlinked to a ground station on Earth. The proposed method is to use a CNN for object identification in images, specifically the identification of anomalous cosmic ray tracks in x-ray spectrometry performed using an X-Ray Imaging Spectrometer. The CNN is trained on simulated space data and taught to identify events based on the shape of events occurring in pixels such as those seen in (H. Yamaguchi, 2006). This will allow for identification of 'Charge Trails' which are split into different grades and cause issues in X-Ray spectrometry. This research shows a method for more efficient on-board processing of big data sets on satellites that will allow for faster knowledge gain and more autonomous operation. Anomaly analysis is especially helpful in remote missions such as those visiting Jupiter's moons due to the lack of communication availability. Application to FPGA is presented to demonstrate the model working on space analogous hardware.