Applying Artificial Intelligence Techniques to Earth Observation Data Quality Control Activities

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Abstract

Telespazio VEGA UK are employing an innovative application of Deep Learning (DL) techniques to support anomaly detection in optical Earth Observation (EO) data products, utilising supervised (One-class Convolutional Neural Networks) approaches to provide a soft classifier (probability estimation) for anomalies.

A dedicated software tool has been developed that supports the quality analysis of the data, the data preparation activities for DL and enables visualisation of the output of the DL algorithms. The Quality Control Optical Learning Tool (Q-COLT) combines a large backend database containing information and image data relating to the optical products under investigation, with a customised GUI permitting the QC inspection of the data and assignment of anomaly information to each of the product entries. Simultaneously facilitating both the activities of the QC engineers, as well as enabling the AI experts to assemble the datasets required in order to train the AI models, the SW also allows the results from the AI models to be displayed and their results verified against inspection. Using Landsat data, the Telespazio VEGA UK team have developed and tested an AI model that successfully identifies the occurrence of a specific anomaly within the Landsat data based on the 'supervised' learning model. The developed model relies on numerous image processing techniques, with the analysis performed upon browse or 'quick look' products rather than the full data products, significantly reducing the required processing time and resources. Specific metadata information may also be incorporated into the analysis depending upon the anomaly under investigation.

This model enables an increase in check coverage for the anomaly in question from 5% human inspection to 100% AI inspection and permits the systematic detection of anomalies that, using conventional techniques, is only generally detectable using human operators. It is also compliant with the constraints of the architecture of a typical EO Ground Segment, with the majority of the required time and effort invested up front in the training and validation phase, and rapid execution of the model within the operational phase. The overall objective of the work is to (a) reduce the time taken for QC inspection, (b) achieve wider inspection coverage (from ~5% to 100%) and (c) achieve more comprehensive inspection, when compared to human inspection. This outcome can be applied in operational EO production services as well as for bulk archive reprocessing.

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