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Natural Hazard Detection and Monitoring: Artificially Inteligence Enhanced Multispectral Observations

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ABSTRACT

Although along time many researchers used Earth observations to detect and monitor natural disaters, this challenge still faces issues due to the complex structures of images. The visualization of a multispectral EO product is usually performed by mapping the three bands of the visual part of the spectrum to natural color representation. Yet, these products often ehibits clouds, fog, or smoke, phenomenas that hinder the ability of humans or machines to interpret and properly used these data. The wavelength of the bands in the visual spectrum is small, so they fail to penetrate the haziness to get to the sensor and the information about terrestrial aspect is lost. Relevant information could be transferd betwen bands in an attempt to visually reconstitute those parts of the image affected by atmospheric phenomena. This poster highlights two approaches: a stacked autoencoder that successfully encompasses the information from all spectral bands into a latent representation used for visualization and a self-supervised paradigm in learning image representations by training a deep convolutional model to differentiate in a series of geometric transformations. Preliminary experiments performed on two Sentinel-2 datasets including burned areas within predisposed zones to fire events, Australia and Bolivia. Future work aims to test the developed methodology on Sentinel-2 time series data to monitor pre and post extreme phenomennos and natural disaster's impact over the land .

The authors of [1] propose five different neural network based methods to improve visualization of multispectral remote sensing images. All methods share the same general neural network: a stacked autoencoder which compresses the input into a hidden representation, subsequently used for the result visualization. The difference between these approaches is represented by objective to be met and distinctive combination of involved actors: input and error function.

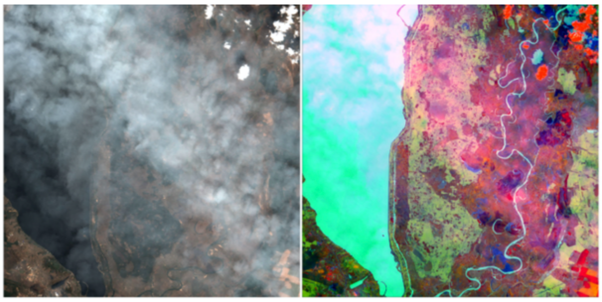

Fig.2 Highlight of the better visualization result obtained. Although the left side of the figure shows a scene covered by clouds, the right one succeeds to disclose the Earth surface.

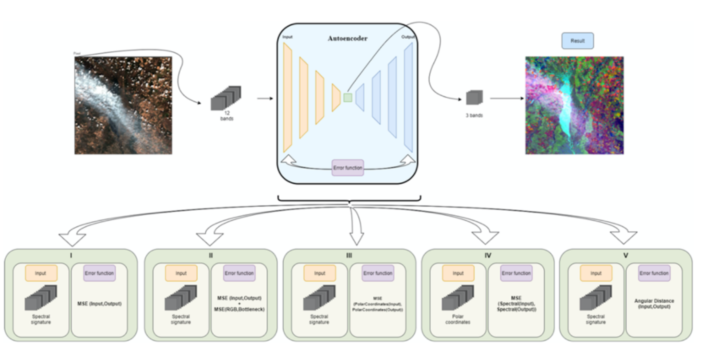

Fig. 1 General architecture of the proposed methods for visualization of multispectral images [1].

The main objectives consist of ambiguities and contamination reduction. Spectral and polar features are the possible options for the input and the error function encounters variations in terms of augmentation (method II) transformation applied (methods III, IV, and V).

The anomaly classifier [2] is composed of a data preprocessing module, a self supervised classifier for transformations applied on data, and a ranking estimation module. The data processing module takes the raw image as input and generates normalized and augmented non-overlapping patches. The self supervised classifier is trained to differentiate between k transformations, defined and employed in transformation component. The ranking estimation module takes as input a product between a softmax response vector of a test sample and a Dirichlet precision calculated for each transformation, and outputs an anomaly score. Onward a binary decision is made based on the anomaly score of each test sample.

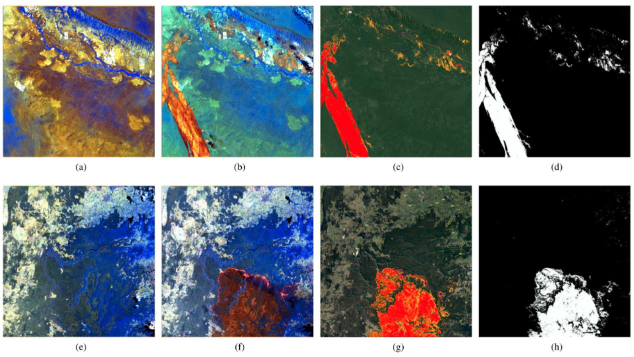

Fig. 3 In a) and b), respectively e) and f) are displayed pre-event and post-event scenes (FCI; R: Band 12; G: Band 11; B: Band 8A). In c) and g) are shown the maps with fire affected zones in red-yellow colors. In d) and h) are presented the reference binary maps used as ground truth.

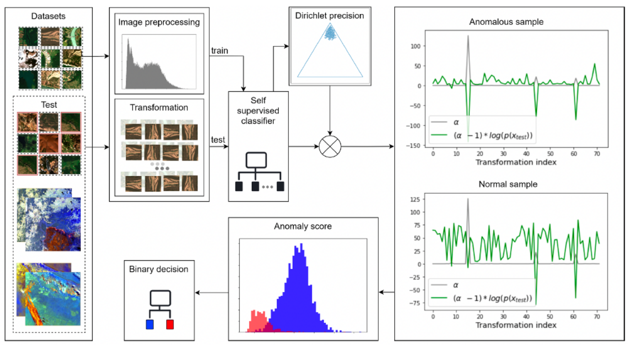

Fig. 4 General architecture of the anomaly detection method based on ranking [2].

References

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[2] M. Coca, I. Coca Neagoe and M. Datcu, "Hybrid DNN-Dirichlet Anomaly Detection and Ranking: Case of Burned Areas Discovery," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-16, 2022, Art no. 4414116, doi: 10.1109/TGRS.2022.3207311.

DRAGON 5 Cooperation project ID.58190's objective is to develop hybrid explainable AI, deep learning and big data analytics techniques and tools for large-scale dense SITS analysis.
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