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A neuromorphic approach to satellite image understanding

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Remote sensing satellite imagery provides high altitude, top viewing aspects of large geographic regions and as such the depicted features are not always easily recognizable. Nevertheless, geoscientists familiar to remote sensing data, gradually gain experience and enhance their satellite image interpretation skills.

The aim of this study is to devise a novel computational neuro-centered classification approach for feature extraction and image understanding. Object recognition through image processing practices is related to a series of known image/feature based attributes including size, shape, association, texture, etc. The objective of the study is to weight these attribute values towards the enhancement of feature recognition. The key cognitive experimentation concern is to define the point when a user recognizes a feature as it varies in terms of the above mentioned attributes and relate it with their corresponding values.

Towards this end, we have set up an experimentation methodology that utilizes cognitive data from brain signals (EEG) and eye gaze data (eye tracking) of subjects watching satellite images of varying attributes; this allows the collection of rich real-time data that will be used for designing the image classifier. Since the data are already labeled by users (using an input device) a first step is to compare the performance of various machine-learning algorithms on the collected data. On the long-run, the aim of this work would be to investigate the automatic classification of unlabeled images (unsupervised learning) based purely on image attributes.

The outcome of this innovative process is twofold: First, in an abundance of remote sensing image datasets we may define the essential image specifications in order to collect the appropriate data for each application and improve processing and resource efficiency. E.g. for a fault extraction application in a given scale a medium resolution 4-band image, may be more effective than costly, multispectral, very high resolution imagery. Second, we attempt to relate the experienced against the non-experienced user understanding in order to indirectly assess the possible limits of purely computational systems. In other words, obtain the conceptual limits of computation vs human cognition concerning feature recognition from satellite imagery.

Preliminary results of this pilot study show relations between collected data and differentiation of the image attributes which indicates that our methodology can lead to important results.