**Research on methods of reading satellite image**

Goal of assignment: After NO2 TROPOMI data has been visualised, we need to interpret the data.

Link articles image processing

[**https://www.researchgate.net/publication/220413797\_An\_Unsupervised\_Artificial\_Neural\_Network\_Method\_for\_Satellite\_Image\_Segmentation**](https://www.researchgate.net/publication/220413797_An_Unsupervised_Artificial_Neural_Network_Method_for_Satellite_Image_Segmentation)

**Summary**: Image segmentation is an essential step in image processing. The goal of segmentation is to simplify to change the representation of an image into a form easier to analyze.

Self organizing map (SOM) is used to organize pixels according to grey levels of multiple bands into groups then a threshold technique is used to cluster the image into disjoint regions, this new method is called TSOM.

SOM - Converts patterns of arbitrary dimensionality into the responses of two dimensional arrays of neurons. It consists of two layers: an input layer and an output layer. The number of input neurons is equal to the dimensions of the input data. The output neurons are, however, arranged in a two-dimensional array. Each input is fully connected to all units. The initial weights are random and small, and their contribution for the final state decreases with the decrease of the number of samples . The network is composed of an orthogonal grid of cluster units (neurons), each is associated with three internal weights for the three layers of the satellite image. At each step in the training phase, the cluster unit with weights that best match the input pattern is elected as the winner usually by using minimum euclidean distance. After the SOM neural network converges to a balance state, the original image is mapped from a high color space to a smaller color space. The number of colors in this space is equal to the number of neurons of the SOM network. The final weights vectors in the map as the new sample space. This new data set is used for clustering, and allows determining a set of cluster centers.

T- cluster - to eliminate small clusters which has fewer pixels T cluster eliminates over segmentation problem. After obtaining cluster centers by SOM, cluster processing starts by calculating the distance , where the clusters are combined if their distance between centres is less than predefined threshold T. If this is true then the clusters are combined with the large one. The value of the final cluster is the cluster with the higher number of pixels.

TSOM - Now the combination of SOM and T-cluster works sequentially to complete the segmentation process. SOM uses satellite image features to organize pixels in groups. The highest peaks of the histogram are used as cluster centers and are provided to T-Cluster to deliver the final solution in the image segmentation process.

TSOM is the best unsupervised neural network as it gives better results according to the experiment conducted in the paper and its two times faster when compared to ISODATA.

**Article 2: Satellite Image Interpretation using Spatial Reasoning** [**http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.39.6506&rep=rep1&type=pdf**](http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.39.6506&rep=rep1&type=pdf)

**Summary:**Currently, interpretation of satellite data is done mainly manually by comparing previous geographic maps with updated ones. Here, based on experience of data analysts and background information and contextual information about the problem, a conclusion is made about the data. This is feasible for small sets of data, but becomes a tedious task for bigger sets of data.

Proposed solutions in article:

* Extract features by classification such as crop fields, bare soils, grassy areas and houses;
* A knowledge-based system to detect shapes in the data;
* Qualitative representation of positional information. Spatial relations are divided in 2 classes: topological relations and orientation relations. Topological relations: How boundaries of 2 objects relate to each other, while orientation relation describes where objects are placed. For orientation relations, the object is divided into 8 parts. Then, based on changes in orientation, we can reason about it.

Summary: 8 different types of algorithms suitable: Parallelepiped, Minimum distance, Maximum Likelihood, Decision tree method, Support Vector Machine, K Nearest Neighbor Classifier, Artificial Neural network ,Genetic Algorithmic approach.

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.735.6733&rep=rep1&type=pdf>