

ICA BASED VISUAL WORDS FOR DESCRIBING UNDER METER HIGH RESOLUTION SATELLITE IMAGES

Payam Birjandi

PhD student, Institute of Technology,
Telecom Paris, Paris, France

payam.birjandi@telecom-paristech.fr

Mihai Datcu

Prof. Dr. , Institute of Technology,
Telecom Paris, Paris, France

mihai.datcu@telecom-paristech.fr

ABSTRACT

Nowadays a lot of satellite images are being received every day from several satellite sensors and with different resolutions. These images, especially Very High Resolution (VHR) satellite imagery (such as Ikonos and Quickbird) provide valuable information to researchers for different applications. Because amount of remotely sensed data is enormous, for a human expert, manually extracting this valuable information is not possible. One possible solution to extract this information is using automated techniques. A wide variety of methods are used by researchers for satellite image indexing and classification.

Among different techniques, independent component analysis (ICA) is known as a recently used method for satellite images indexing and classification [2]. In an ICA procedure, each small patch from satellite images could be described using a new basis, called ICA basis functions which are obtained from an ICA learning process, and some coefficients called ICA sources. The objective in an ICA learning process is to estimate ICA basis functions such that ICA sources of image patches would be as independent as possible. This independency in ICA sources makes ICA basis functions to present useful information of satellite images. Bell and Senjowski [1] used ICA for natural images and found out that the independent components of images are short lines and edges. According to this property of ICA components, they could be more useful for modeling VHR satellite images containing geometric objects, especially urban area, rather than other non-geometrical satellite images.

On the other hand, some text retrieval approaches which are based on the idea of “bag of words” are recently used for satellite images processing [3]. In the “bag of words” model a document is viewed as an un-ordered set of words and is statistically modeled as a frequency of occurrence histogram along the dictionary. For using “bag of words” idea to describe images, the basic question is to define an analogy between texts and images, that is, defining visual words, documents and vocabulary.

In this paper our purpose is to model VHR satellite image as a “bag of words” model using ICA components. We aim to introduce an analogy between texts and images based on ICA. We explain how we can use ICA basis components for defining visual words of a visual document. Next for defining dictionary we apply different ideas based on ICA. Another important issue in our model is to explain how to label visual words inside a visual document using the dictionary. We propose to use correlation as a criterion to find the most similar visual

dictionary word for each visual document word. The proposed method for defining analogy between texts and images is applied to describe 0.6m resolution satellite images. Also for examining the capabilities of our method, we design a classification using a simple Bayesian method and computing a posterior probability. According to the results of this classification we can conclude that proposed method has important capabilities to describe very high resolution satellite images especially for geometrical satellite images such as urban area. Also we compare different types of dictionaries which are defined based on ICA and select the best one according to the results of classification.

REFERENCES:

- [1] A. J. Bell and T. J. Sejnowski. "The independent components of natural scenes are edge filters". *Vision Res*, Vol. 37, No. 23. (December 1997), pp. 3327-3338.
- [2] J.X. Zhang, Y.W. Chen, Z. Naka and T. Tateyama, "*Independent component analysis for classification of remotely sensed images*", *Int. J. Innov. Comput. Inf. Cont.* 2 ,2006
- [3] Lior Weizman and Jacob Goldberger, "Detection of urban zones in satellite images using visual words". *SPIE Int. Geoscience and Remote Sensing Symposium (IGARSS), 2008*