Complexity Based Analysis of Earth Observation Images

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Complexity based methods showed their large efficiency in data analysis for the purpose of interpretation, classification etc. These methodologies using Kolmogorov theory have been successfully applied for the mining of data like for instance DNA sequences, text, or in image analysis. Thus algorithms exploiting the Minimum Description Length principle, based on the Kolmogorov complexity reach results equivalent or better than Bayesian or maximum-likelihood based methods, in several domains like segmentation, classification or inference clustering. However, such applications require strong a priori knowledge on the data, which is possible on well described kinds of objects, but may restrict the efficiency of these methodologies on Earth Observation images databases. Indeed, the large volumes of data provided by satellites, and the large variety, diversity and irregularity of the observed scenes do not allow one to establish enough general statistical description models for the data. Nevertheless, recent approaches, based on compression tools establishing typical dictionaries, directly learned from the data, independantly from any statistical model, enable one to discard such limitations. These new aspects will thus let such concepts find their applications in the field of Earth Observation images.

After a survey of the theoretical notions necessary for such a complexity based analysis of images, the first practical application will be related to Pattern Recognition and classification in the field of satellite imagery. Using a complexity based similarity measure derived from dictionnaries extraction, a hierarchical clustering will be performed achieving good indexing and classification of Earth Observation data. The second application will be related to artifact detection in the optical remotely sensed images. We will show how the concepts of complexity enable one to highlight blemishes introduced during the image formation process.