Geophysical Research Abstracts
Vol. 12, EGU2010-3045-1, 2010
EGU General Assembly 2010

Unsupervised Binary Change Detection in VHR Images using a Kernelized Clustering Algorithm

Michele Volpi and Mikhail Kanevski
Institute of Geomatics and Analysis of Risk, University of Lausanne, Switzerland (michele.volpi@unil.ch)

When dealing with Change Detection (CD) it is often important to obtain a binary mask of changes occurred in two or more coregistered images. Methods involving unsupervised CD are known for their fast application and the minimal dependency on the user. The peculiarity of a multitude of such methods is the application of linear functions resulting in fast solutions, but on the other hand the final model is suboptimal, in the sense that nonlinearities are not taken into account.
Depending on the composition of the scene (classes of similar object and their spectral response), non-linear relationship can be a crucial topic to consider in change detection studies, especially when in the binary mask different semantic and radiometric classes are grouped into a single cluster. Classical clustering algorithms like k-means, hierarchical schemes, similarity based metrics or graphs, mixtures of gaussians can give suboptimal predictions due to the impossibility of recognizing the correct cluster in the input space. A partial solution to this problem can be found by applying some bagging on the clustering scheme and obtaining a solution by voting, but remaining suboptimal. An improved solution can be obtained by applying some explicitly nonlinear clustering scheme.
In the present research, we propose a clustering scheme based on a kernelized version of the well known k-means algorithm. The so-called Kernel k-Means (KKM) looks for clusters in an induced reproducing kernel Hilbert space, where data are mapped by a kernel function. The final clustering is thus a classical k-means applied in a higher dimensional space where clusters are assumed to be more recognizable.
In order to make the problem feasible, a bagging scheme is adopted, which helps to avoid explicit computing the kernel matrix of the entire image. Iteratively, the clusters are computed using different random subsets of the multitemporal image. By applying such approach on many random subsets, the whole variance of the pixels is considered. The final map is obtained by a voting scheme on the cluster assignments.
The efficiency and superior accuracy of the proposed method is studied using real data (QuickBird image of Zurich) and are compared with classical and bagged version of k-means algorithms.
This work is supported by the SNFS Project No. 200021-126505 “KernelCD”.