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Parallel SVM for the analysis of hyperspectral data

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Remote sensing is the science of acquiring and interpreting information using sensors that are not in physical contact with the object being observed. In many cases, remote sensing takes advantage of satellite and airborne sensors to observe, measure, and record the radiation reflected or emitted by the Earth and its environment for subsequent analysis. The rapid advancement of remote sensing technology increases the availability of remotely sensed images with very high geometrical resolution (QuickBird 0.6m) and detailed spectral information (AVIRIS 224 spectral channels), which provide an important source of information for mapping and monitoring natural and manmade features. In this context, the amount of data is continuously growing with images more and more numerous, precise, frequent, but also complex. Remote sensing makes use of several analysis methods, such as image processing, automatic classification, multitemporal processing and data fusion, in order to handle different real applications. Specifically, addressing the problem of classification, which aims to categorize all pixels in a digital image into one of several land cover classes, the classifiers have to treat both spectral and spatial information in order to obtain a satisfactory level of detection accuracy. Therefore, increasing the amount of spectral information leads to an accurate discrimination of different materials of interest. For example, considering spectral mixture analysis: the pixels collected by an imaging spectrometer are likely to be mixed in nature and the spectral signature collected in natural environment is a mixture of the signatures of various materials. The availability of hyperspectral images with a number of spectral bands that exceeds the number of spectral mixture components makes it possible to obtain a set of pure spectral signatures and thus detect different materials. The high spatial resolution allows for the exploitation of the spatial characteristics (i.e. borders, edges, discontinuities, surfaces, shapes) by performing a detailed physical analysis of the structures. Mathematical morphology provides very useful tools which allow enriching the image analysis when dealing with very high resolution (VHR) images. One of the most promising of the recent developments in the field of pattern recognition are Support Vector Machines (SVMs). These are supervised learning methods which are widely used for classification and regression. In such a context, our work aims to explore some issues regarding the SVMs. In particular, SVMs require a significant computational and storage capacity due to the large number of training vectors used for the analysis of very high spatial and spectral resolution remote sensing data. Specifically, we will adopt a parallel SVM based on the iterative MapReduce in order to analyze large scale classification problems by improving the computation speed and preserving the classification accuracies.