FUSION OF MULTISOURCE DATA SETS FROM AGRICULTURAL AREAS FOR IMPROVED LAND COVER CLASSIFICATION

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ABSTRACT

Many land cover classifications are performed for areas dominated by agricultural land use. These areas are often characterized by great temporal variability and typical spatial patterns of high-frequent land cover changes between individual plots. Regarding the great differences in the phenology of planted crops, multitemporal approaches appear appropriate for such applications, whereas monotemporal applications can be limited. Synthetic Aperture Radar (SAR) data is particularly interesting in this context, because SAR sensors operate independently from weather conditions and solar illumination. Moreover, in several experiments the classification accuracies were increased by multisensor imagery, and the analysis of such data sets becomes more important. However, they should be analyzed by adequate classifier and an efficient data fusion technique.

Regarding the typical plot structures of agricultural fields, the concept of image segmentation and integration of spatial information appears useful in rural environments. Nevertheless, an accurate classification in this context is often limited to a few classifier concepts, and conventional pattern recognition methods are often inefficient for classifying such data sets.

Support vector machines (SVM) are a recent example of machine learning algorithms, which is a promising alternative to traditional classifiers. SVM have been successfully in several remote sensing studies. They often perform more accurate than other classifiers or perform at least equally well. In a linearly not separable case the input data are mapped into a high dimensional feature space, which enables the fitting of a linear separating hyperplane. This transformation requires the definition of a so-called kernel-function. As shown in previous experiments, the definition of an adequate kernel function for the whole heterogeneous data set can be difficult and it might be more appropriate to define the kernel function for each data source separately and afterwards fuse the derived outputs.

In contrast to other classifiers, which directly provide class labels (e.g., decision trees) and membership probabilities (e.g., maximum likelihood classifier) respectively, the output of a SVM consist of the distances between each pixel and the hyperplane. This information is used to determine the final class membership, using for instance a simple voting strategy. However, some recently introduced concepts transfer the distance values to probability values for the individual land cover classes. In doing so the class memberships can be derived from probability values (similar to the concept of maximum likelihood classification) instead of using the derived class labels and distance measures itself.

In this paper the classification of multisensor data sets from an agricultural area is addressed. The data sets consist of multitemporal SAR data and a time series of multispectral imagery. Spatial information are derived by image segmentation and included into the classification process. As in previous studies each data source, i.e. the multispectral imagery and the SAR data set, is treated separately and classified by a single support vector machine. Instead of using the original outputs of the SVM classifier, the distance measurements are transferred to probability measures for each class. Afterwards the probability values of the two data sets are combined to generate a final classification result.

The results are compared to well-known parametric and nonparametric classifier methods, e.g., decision trees and maximum likelihood classifier. The proposed approach with the separate training and further subsequent fusion of the probability measures outperformed the other parametric and non-parametric classifiers in terms of accuracy. In general, it is shown that the use of multisensor applications as well as spatial information is worthwhile and the overall accuracy is significantly increased by such data sets.