COMBINING SAR AND OPTICAL FEATURES IN A SVM CLASSIFIER FOR MAN-MADE STRUCTURES DETECTION.

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1. INTRODUCTION

The increasing quality of satellite images has generated interests in extracting man-made structures in urban areas, such as buildings and roads. A classification adapted to urban areas can help to identify these structures. For now, classification accuracy of panchromatic metric resolution data is not fully satisfactory. Spectral characteristics, geometrical information and multi spectral bands are usually used in classification. In high or very high resolution images, spectral characteristics of urban areas such as parking, grass field or building roof, are so similar that they are not sufficient to separate the different classes. It becomes useful to introduce additional information into the classifier. Some methods introduced multiband images, morphological pyramids or digital model of elevation [1] [2] [3]. In this paper, we propose an object-based method: first a segmentation of the optical image of urban areas is performed; second, textural and geometrical characteristics are extracted from each segment; then, statistical information of SAR images are incorporated to the classifier; finally a supervised classification is performed. The model is evaluated using Support Vector Machines in a cross-validation process.

2. CLASSIFICATION PROCESS

2.1. Segmentation

The proposed framework relies on a preliminary segmentation of the data to extract shape characteristics of the segment. Due to the specific appearence of buildings in SAR imagery, the segmentation is performed on the optical image. The segmentation tool we used is presented in [4]. It is based on the Fast Level Set Transform [5] for the decomposition and then regularized considering the noise present in optical images. This segmentation is then projected in the SAR data using the method proposed in [6].

2.2. Feature Extraction

Feature extraction can be seen as finding a set of vectors that represents a good observation of each target objects and helps to discriminate their classes. For this purpose, textural and geometrical characteristics are used. The Gabor wavelets [7] are used to extract textural characteristics, with 4 orientations and 3 dimensions. For each object, the variance of the Gabor filter is computed; this will constitute the 4*3=12 textural features. Other characteristics are extracted, like mean and variance of the original image.

Textural characteristics are not sufficient to discriminate the different classes in high resolution panchromatic data. Thus, some geometrical features of each object have been extracted according to their shape. For this purpose, the perimeter, surface and a term of scale of each objects have been computed.

In this paper we have investigated how the introduction of SAR data can improve the classification process. Some specific features like bright scatterers are visible on buildings, whereas roads appear dark; thus these images are particularly relevant in order to discriminate the classes of urban areas. In [8] it is shown that the 3 first log-cumulants are very usefull to capture discriminative information. Log-cumulants on the SAR image over the segmented objects provide the last feature set.

	buildings	roads	high vegetation	ground	shadow
optical only (text. + geom.)	66%	0%	75%	76%	85%
radar only	76%	61%	64%	24%	0%
both features	90%	85%	94%	81%	90%

Table 1. Mean classification recognition rates obtained on the urban area of Toulouse, considering five classes and features extracted from optical image only, radar image only and from both data.

3. EXPERIMENTAL RESUTS

The proposed classification method has been tested on a couple of Quickbird and Ramses images with size 2048x2048. First of all, these images have been roughly registrated using the method proposed in [6]. The classifier returns five classes corresponding to urban areas: buildings, high vegetation, ground, roads and shadows. The classification method is based on Support Vector Machines.

Table 1 shows the mean classification recognition rates obtained with features extracted from each and both data. It can be seen on the one hand that the optical image provides good information to identify the shadows, ground and high vegetation. But the textural and geometrical features are not sufficient to recognize roads. On the other hand, the SAR image helps to identify buildings and roads, even if the images are not exactly registrated. Using the information contained in both data improves the classification performance.

4. REFERENCES

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