MORPHOLOGICAL OPERATORS APPLIED TO X-BAND SAR FOR URBAN LAND USE CLASSIFICATION

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The availability of Synthetic Aperture Radar (SAR) images with spatial resolution on the order of meters has opened new opportunities for urban monitoring. TerraSAR-X, operating at X-band, is designed for multiple imaging modes such as StripMap, SpotLight and ScanSAR operating with single-, dual- or full polarization. Remote sensing data from this system has the potential for producing accurate classification maps of urban areas, but at the same time they present additional problems in terms of information extraction using automatic classification schemes. Advantages of synthetic aperture radar images are that they are independent of meteorological conditions and have the possibility of evaluating dielectric and geometric properties of surfaces. However, there are many limits to the use of SAR imagery for land classification, such as the SAR imaging geometrical features, which result in detrimental phenomena such as layover, foreshortening and shadowing, the complex scattering process and the presence of speckle. These aspects have to be taken into account when dealing with urban classification due to the presence of complex structures.

The data set used in this study consists of one TerraSAR-X image (dual-polarization) taken on July 1, 2007 over the sub-urban region of Indianapolis (U. S. A.) . This area is composed of roads and buildings with a variety of dimensions and contains a wide mixture of architectures, such as residential housing, commercial buildings, recreational areas, utilities and industrial buildings.

This study provides an assessment of the potential for using different polarizations and contextual information of SAR images in classifying urban land-use. Indeed, due to the lack of multi-spectral data, a contextual analysis is needed to extract geometrical information of objects/classes within the images. Morphological features have been extracted by applying the open and close operators on the original backscattering images. We use the open and close filters to isolate bright (opening) and dark (closing) structures in the image. For bright and dark, we mean brighter and darker with respect to other neighboring structures. They may be used in a multi-scale approach based on a range of different Structuring Element (SE) sizes, so as to investigate a range of different spatial domains and to use the best response of the structures in the image corresponding to specific objectives of the classification process. The morphological profiles calculated from original backscattering images are the input space of a classification step. The decision task has been performed on a pixel basis and the information extracted has been processed by a Multi-Layer Perceptron (MPL) neural network to produce urban land-use maps. The network topology has been carefully designed, paying

special attention to the number of neural network connections by means of pruning algorithms. If on one hand more information may be helpful for the classification process, on the other hand, the increasing number of input features may introduce additional complexity in class separability. In order to overcome this problem, a feature selection algorithm based on the pruning technique is used to provide a reduced set of features and at the same time optimizes the network topology.