Urban land-use textural analysis for very high resolution optical imagery

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ABSTRACT

With the successfully launch of WorldView 1 operating by DigitalGlobe Inc., the analysis of panchromatic very high spatial resolution optical imagery has become relevant for investigating the urban environment with details of 50 cm ground resolution. Under these conditions, buildings appear as complex structures with many architectural details surrounded by temporary objects, such as cars, buses or daily markets. Therefore, the single panchromatic information is not always enough for classifying land-use of such a complex scene.

In this paper, we analyze the effects of 8 textural features (derived from the Grey Level Co-occurrence Matrix) extracted from panchromatic WorldView 1 and QuickBird images for land-use classification of urban areas. The data set used takes into account various architectures consisting of cities characterized by different urban structures, such as Las Vegas (USA) and Rome (Italy). The first scene denotes regular criss-crossing roads and different examples of buildings characterized by similar heights but different dimensions, while the Rome’s scene shows a more elaborate urban structure with less regular roads and buildings with variety in heights and dimensions. Therefore, several different surfaces of interest have been recognized, such as residential roads, parking lots and highways, buildings, blocks and towers, and more traditional classes, such as trees, vegetation, soil and water.

The information extracted from the panchromatic and textural features is fused and processed by a Multi-Layer Perceptron (MPL) neural network to produce land-use maps. The network topology has been carefully designed,
paying special attention to the number of connections in the hidden layers. A set of training areas has been selected within the scenes, generating the data set used to train the supervised neural algorithm. Once trained, the net’s performance has been validated over a statistically significant ensemble of patterns independent from the training set.

A neural network extended pruning technique is used in order to give evidence of the relevant inputs, providing information on the correlation between 8 textural features computed over 5 different windows sizes (3x3, 7x7, 15x15, 31x31 and 51x51), 2 shifts (15x15 and 30x30) and 3 directions (0°, 45° and 90°) for a total of 241 distinct inputs.

At the end of this analysis process, the extended pruning indicates the most suitable textural features for very high spatial resolution land-use classification of optical imagery.