MULTISCALE REPRESENTATION OF BROWNFIELD SITES WITH IKONOS IMAGERY

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Currently, remotely sensed data for the study of regional and global scale environmental change are available from a multitude of sensors. Each has its own intrinsic characteristics and so the choice becomes more challenging since these characteristics determine the suitability of the dataset for any particular task.

Once a dataset has been identified, the method of extracting the information on land cover and its transformations must be considered, because the accuracy of the final data processed may depend on the method used.

In remote sensing techniques the informational classes of a thematic mapping are not directly registered, but must be derived indirectly by using evidence contained in the spectral data of an image. Many approaches are available. Commonly, techniques that include a range of statistical, structural and neural approaches are used. Integrated strategies of classification are particularly useful, especially when information on land cover transformation is necessary in order to evaluate the effects of these processes and to provide one of the information layers needed for designing national environmental strategies.

When standard procedures of per-pixel multispectral classification are applied to VHR data, the increase of spatial resolution leads to augmentation in ambiguity in the statistical definition of land cover classes and a decrease in accuracy in automatic identification. These imagery sources are likely to generate other problems. Even if the radiometric resolution is enhanced (11 bits for IKONOS or QuickBird imagery), spectral capabilities are generally limited compared to those of the previous generation sensors (seven bands for Landsat TM). Moreover, together with an increase in spatial resolution there is, usually, an increase in variability within land parcels ('noise' in the image), generating a decrease in accuracy of land use classification on a per-pixel basis.

In order to solve such problems, some post-classification procedures were investigated on the basis of intrinsic contextual data information. Although a reduction of noise in the classified image was obtained, substantial improvements in overall accuracy was not seen. Moreover, a loss of meaningful information in classified data was noticed because of geometric and dimensional non-correspondence of real elements with moving window implementation matrix (for example with *majority* logical filter). Such methods need extensive editing operations on classified images in order to be stored in GIS databases.

An alternative technique to per-pixel classification is the per-field classification (so called because fields, as opposed to pixels, are classified as independent units), which takes into account spectral and spatial properties of the imagery, size and shape of the fields and the land cover classes chosen. In fact, this approach requires a priori information on the boundaries of objects in the image. 'Field" or 'parcel' refers to homogenous patches of land (agricultural fields, gardens, urban structures or roads) which already exist and are superimposed on the image. Some studies indicate that this methodology is contributing positively to the classification of remote sensing imagery of high to medium geometric resolution. Problems arise in cases where no boundaries are readily available or when those boundaries should be updated.

One solution is image segmentation. In many cases, image analysis leads to meaningful objects only when the image is segmented in 'homogenous' areas. Because an 'ideal' object scale does not exist, objects from different levels of segmentation (spatially) and with different meanings have to be combined for many applications. The human eye recognises large and small objects simultaneously but does not cross totally different dimensions. From a balloon for instance, the impression of a landscape is dominated by land use patterns such as the composition of fields, roads, ponds/ lakes and built-up areas. Closer to the ground, one starts to recognise small patterns such as single plants while simultaneously small scale patterns loose importance or cannot be perceived anymore. In remote sensing, a single sensor highly correlates with a specific range of scales.

The recognition of an object can be treated according to the sensor's resolution and the scale of image objects to be detected must be significantly bigger than the scale of image noise relative to texture. This ensures that subsequent object oriented image processing is based on meaningful image objects. Therefore, homogeneity of the objects is one of the most important characteristics of a segmentation procedure. The resulting segmentation should be reproducible and universal, thus allowing application to a large variety of data.

In this paper an object-oriented classification methodology on IKONOS multispectral data will be implemented on the test area of Manfredonia in the Apulia region (Italy), in which the regeneration process of industrial polluted areas is being carried out. The analysis will be conducted with a classification strategy that allows to classify complex objects, such as brownfield sites, combined with high quality data and that is able to distinguish land use functions on the basis of differences in spatial distribution and pattern of land cover forms. It consists of two phases: segmentation of the image into meaningful multipixel objects of various sizes, based on both spectral and spatial characteristics of groups of pixels; then, assignment of the segments (objects) to the classes using fuzzy logic and a hierarchical decision key.