

Chapter 12

Image Segmentation Methods for Object-based Analysis and Classification

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12.1 Introduction

The continuously improving spatial resolution of remote sensing (RS) sensors sets new demand for applications utilising this information. The need for the more efficient extraction of information from high resolution RS imagery and the seamless integration of this information into Geographic Information System (GIS) databases is driving geo-information theory and methodology into new territory. As the dimension of the ground instantaneous field of view (GIFOV), or pixel (picture element) size, decreases many more fine landscape features can be readily delineated, at least visually. The challenge has been to produce proven man-machine methods that externalize and improve on human interpretation skills. Some of the most promising results in this research programme have come from the adoption of image segmentation algorithms and the development of so-called object-based classification methodologies. In this chapter we describe different approaches to image segmentation and explore how segmentation and object-based methods improve on traditional pixel-based image analysis/classification methods.

According to Schowengerdt (1997) the traditional image processing/image classification methodology is referred to as an *image-centred approach*. Here, the primary goal is to produce a map describing the spatial relationships between phenomena of interest. A second type, the *data-centred approach*, is pursued when the user is primarily interested in estimating parameters for individual phenomena based on the data values. Due to recent developments in image processing the two approaches appear to be converging: from image and data centred views to an *information-centred approach*. For instance, for change detection and environmental monitoring tasks we must not only extract information from the spectral and temporal data dimensions. We must also integrate these estimates into a spatial framework and make *a priori* and *a posteriori* utilization of GIS databases. A decision support system must encapsulate manager knowledge, context/ecological knowledge and planning knowledge. Technically, this necessitates a closer integration of remote sensing and GIS methods. Ontologically, it demands a new methodology that can provide a flexible, demand-driven generation of information and, consequently, hierarchically structured semantic rules describing the relationships between the different levels of spatial entities.

Several of the aspects of geo-information involved cannot be obtained by pixel information as such but can only be achieved with an exploitation of neighbourhood information and context of the objects of interest. The relationship between ground objects and *image objects*