Applying Supervised Clustering to Landsat MSS Images into GIS-Application

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ABSTRACT

In this paper, the authors describe and implement an algorithm to perform a supervised classification into Landsat MSS satellite images. The Maximum Likelihood Classification method is used to generate raster digital thematic maps by means of a supervised clustering. The clustering method has been proved in Landsat MSS images of different regions of Mexico to detect several training data related to the geographic environment. The algorithm has been integrated into Spatial Analyzer Module to improve the decision making model and the spatial analysis into GIS-applications.

Keywords: Clustering Method, Geographic Information Systems (GIS), Maximum Likelihood Classification, Satellite Images, Supervised

1. INTRODUCTION

The integration of remote sensing and geographic information systems (GIS) in environmental applications has become increasingly common in recent years. Remotely sensed images are an important data source for environmental GIS-applications, and conversely GIS capabilities are being used to improve image analysis procedures. In this case, when image processing and GIS facilities are combined in an integrated system vector data, they can be used to assist in image classification and raster image statistics, within vectors can be used as criteria for vector query and analysis (Hinton, 1996).

Nowadays, the geographic information plays an important role in the decision making process, the spatial databases are very useful and
powerful tools to handle, display and process spatial data. Frequently the need arises to analyze mixed spatial data. The data sets can consist of satellite spectral, topographic and other point form data, all registered geometrically, as might be found in a GIS (Ehlers, 1998).

In this paper, we propose a supervised clustering algorithm applied to Landsat MSS images. The classification method is used to detect training data according to the characteristics of particular Landsat MSS images. This method has been integrated into GIS-Application. Our approach can be considered as a part of spatial analysis, because the method is focused on processing raster spatial data to find out new properties, which can define the behavior of a certain geographic environment.

The rest of the paper is organized as follows. In section 2 we present the architecture of the GIS-application. The supervised clustering method and algorithm applied to Landsat MSS satellite images are described in section 3. Section 4 presents some results obtained by the GIS-application. Our conclusions are described in section 5.

2. ARCHITECTURE OF GIS-APPLICATION

The GIS-application has been developed using client-server architecture. This tool contains the following components:

- **Spatial Database (SDB):** This module stores the spatial data (vector and raster) into a hierarchical structure. SDB contains a spatial dynamic index mechanism to organize physically the geographical objects according to the basic primitive of representation (Rigaux, Scholl, & Voisard, 2002);

- **ArcMap GUI:** This mechanism is a common gateway, which is used to process the requests of the users. The results obtained by the spatial analysis are rendered in this component;

- **Administration Module (AM):** AM is used to control all the processes of the GIS-application. This module receives all the requests that the users have generated to perform any spatial analysis;

- **Spatial Analyzer Module (SAM):** This module has been designed to make spatial analysis procedures. It includes the supervised clustering method to identify the characteristics of the raster data. SAM is composed by several methods to make spatial and visual analysis with the geo-information.

The functional mechanism of the GIS-application is the following: ArcMap users need to make a request. This request is sent by DCOM technology to the AM to interpret, control, and interact with the Enterprise GIS. AM processes the request and sends the parameters to SAM. In the Enterprise GIS, it is necessary to verify the definition to obtain the spatial data from SDB. The geographical objects are stored in the spatial database, in which they will be analyzed by SAM. SAM is focused on detecting the characteristics of vector and raster data.

3. SUPERVISED CLUSTERING METHOD

3.1. Supervised Clustering

The supervised clustering is the procedure used for quantitative analysis of remote sensing image data. It rests upon using suitable algorithms to label the pixels in an image as representing particular ground cover types, or classes (Atkinson & Tate, 1999). In this work, implement the Maximum Likelihood Classification. For supervised clustering, training regions are defined and pixels are assigned to one of these a priori defined classes. There are five basic steps that we followed for supervised clustering: (I) Determine the number and type of classes to use for this analysis, (II) Choose training regions for the classes to identify the spectral characteristics typical for each specific class, (III) Use these training regions to determine the parameters of the supervised clustering, (IV)
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