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SUGARCANE CONTOUR EXTRACTION USING QUADTREE STRUCTURE AND ANISOTROPIC DIFFUSION ON LANDSAT - TM

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INTRODUCTION

Contour extraction methods are of fundamental importance in the context of mapping and updating for GIS (Geographic Information Systems) applications. The ISPRS (International Society for Photogrammetry and Remote Sensing) Commission VII/4 included Image classification techniques and new algorithms for the image extraction as a reference term.

Methods based on remote sensing image have been proposed to evaluate several aspects related to the sugarcane cultivation. For example, Rudorff et al. (2010) have proposed a study to establish the expansion of sugarcane for ethanol production in São Paulo State (Brazil) using Landsat data. Mello et al. (2010) focused on the automatic classification of sugarcane harvest based on spectral Linear Mixing.

The motivation of this research are that the area test used in this paper is situated in the Upper Paraguay Basin, Mato Grosso State, Brazil, this basin encompasses the floodplain region known as Pantanal, the largest inundated area on Earth. In the scope of our research, contour extraction of sugarcane culture, due to scene complexity, requires the development of specific methods in the Remote Sensing image that permit to obtain the interest object.

METHODS

The proposed method for sugarcane culture contour extraction uses the following steps briefly discussed below. Initially is produced a Landsat TM false-color image 5R4G3B. After this, is applied an enhancement technique. This enhancement operation use an adaptive average of the pixel value, based on a specifically function which adjusts the intensity of each pixel based on its relative magnitude with respect to the neighboring pixels.

The recursive splitting technique (Jain et al., 1995) using the quad tree structure consists of splitting the image into four homogeneous subregions of identical size. Each subregion is checked for homogeneity using a predefined threshold based on prior knowledge of objects presented in the scene. The splitting process proceeds recursively until no regions can be subdivided. In the end, the result is the input image organized according to the quad tree structure, where all homogeneous regions are explicitly represented. In order to meet the goal, the resulting regions are firstly structured by using the neighborhood structure. Next, the resulting regions are classified using similarity criteria, in this case regions presenting high probability of similarity are merged.

The algorithm for contour filling is applied to the regions that is, in essence, the same procedure described by Ballard and Brown (1982). This procedure uses three steps: 1) scan the binary grid until a region point is encountered; 3) if the point is a region point, turn left and step; otherwise, turn right and step; and 3) terminate upon returning to the starting pixel. The algorithm stops when all original segments generated by the recursive splitting algorithm have been properly analyzed and grouped. At the end of the segmentation process, all regions that match our concept of culture are categorized accordingly, and the fundamental result is a binary grid where sugarcane culture grid points are assigned a zero value and other objects grid points are assigned a value of one.

The sugarcane contours are segmented using techniques such as, anisotropic diffusion detector that is used to previously focus the edge structure due to its notable characteristic in selectively smoothing the image, leaving the homogeneous regions strongly smoothed and mainly preserving the physical edges, i.e., those that are really related to objects presented on the image. The mathematical model proposed by Barcelos et al. (2002) is based on the non-linear anisotropic diffusion equation. This model follows the idea formulated by Perona and Malik (1990).

Finally, we generate polyline representations for the ordered lists of contour points obtained using the three-step contour following algorithm.

RESULTS

Landsat-TM images from 2008, bands 3, 4 and 5 over upper Paraguay Basin (Mato Grosso State, Brazil) is used to evaluate the proposed approach. Below, we present and analyze the results obtained. Figure 1

shows the result obtained for sugarcane culture contour extraction. The corresponding polylines are visualized in Figure 1 and edges of figure 1(e) overlaid on the original image.

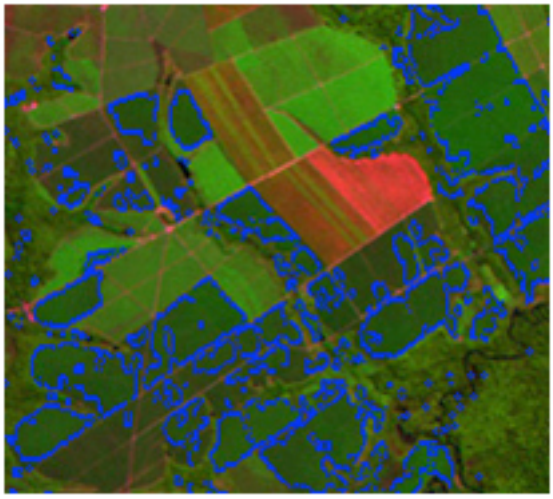

Figure 1. Landsat-TM images; sugarcane contours overlaid on the original image.

CONCLUSIONS AND FUTURE PLANS

The preliminary results showed that the proposed methodology is promising for application involving extraction of cultures, because it has made possible the extraction of regions usually related to sugarcane culture.

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