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EXTRACTION OF CILIARY FOREST FROM LANDSAT-5 IMAGE USING QUADTREE STRUCTURE ON KNOWLEDGE BASED APPROACH

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The ciliary forests are fundamental importance to protect the most important natural resource, the water. In the context Remote Sensing and Geographic Information Systems (GIS) techniques are important tools contributing to improve planning and control procedures of its natural resources. In this paper, a method is proposed for classify and extract ciliary forest area from Landsat-5 image by image enhancement, recursive splitting technique using the quadtree structure, region merging technique by spatial analysis and anisotropic diffusion detector via Partial Differential Equation. The motivation of this work is threefold: Firstly, the area test is situated in the Upper Paraguay Basin, Mato Grosso state, Brazil, this basin encompasses the floodplain region known as the Pantanal, the largest inundated area on Earth. Secondly, Landsat-5 image allow rapid and efficient analyses of land cover, as well as it is possible to detect changes occurred during the period of image acquisition. Thirdly, and more important in the scope of our research, the task of extraction in ciliary forest, requires the development of specific methods that permit to obtain the interest area. In this context, the proposed method comprises preprocessing steps: Initially is applied an enhancement technique in the Landsat-5 image. This technique is based on domain knowledge. 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 enhancement technique was applied to facilitate image interpretation and subsequent classification. After this stage, segmentation of the image is performed using recursive splitting technique (Jain et al., 1995). The recursive splitting technique subdivides the image into homogeneous regions represented as a quad tree structure. Our criterion of homogeneity is based on an magnitude standard deviation previously fixed by a human operator. 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. Considering that we are interested in homogeneous regions that are ciliary forest areas, our algorithm initially searches for two segments for which the difference between their mean pixel value is greater than a threshold value. The lower segment is designated as the other region seed and is set to zero, whereas the other segment is designated as the forest region seed and is set to one. Starting from the other region seed, the algorithm groups all adjacent regions with similar pixel value, i.e., those with mean magnitude differences below a given threshold. The result is a large, initial region. Then, starting from the first forest region seed, a similar procedure is applied to generate a large, initial forest region. The algorithm proceeds to investigate areas adjacent to the previously generated large region for a new segment that has a significant difference in magnitude. 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 forest and ciliary forest areas are categorized accordingly, and the fundamental result is a binary grid where forest grid points are assigned a zero value and ciliary forest grid points are assigned a value of one. The ciliary forest areas are extracted by using techniques such as, anisotropic diffusion detector, that is used to previously focus the edge structure. After this, is applied techniques well-known as vectorization, and polygonization to obtain polyline representations of the detected ciliary forest areas. The proposed method was carried out with the TM/Landsat-5 image on the 2009, bands 3, 4 and 5 were used. Visual verification applied in the experiments show that the method is promising, as it allows the classification and extraction of ciliary forest areas in the image.