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A Fully Automatic Bridge Extraction Technique for Satellite Images

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Automatic detection of artificial objects from satellite images are important source of information in many applications such as terrain mapping by remote sensing and GIS (Geographic Information System) applications. In this paper, a fuzzy based integrated algorithm for automatic detection of bridges over water is proposed. In the first step, the multispectral satellite image is given to a fuzzy based thresholding method to segment water regions from the background. Then, candidate bridge pixels are extracted according to area analysis and bridge extraction algorithm developed. The algorithm is formulated in such a way that, the method can be applied to any complexity levels and any spatial resolutions. Also, the method is not affected for different angles of inclination of the bridge. The approach in this paper, has been implemented and tested with different types of satellite images to validate the superior performance of the algorithm.

Keywords : Area Analysis, Bridge Extraction, Fuzzy Segmentation, Improved Hough Transform, Otsu's Thresholding.

1. INTRODUCTION

Automatic detection of geographical objects such as roads, buildings and bridges from remote sensing imagery is a very meaningful but difficult work. Bridges over water is a typical geographical object and its automatic detection is of great significance whether for military or civilian application.

A number of methods have been developed for bridge extraction from high resolution satellite imagery [1, 2] but they are based on detecting linear features after segmentation and can be applied only for very high resolution SAR images. SAR phenomena such as layover and occlusion burden the analysis and increase the false detection rate. Trias-Sanz et al., [3] suggest techniques to automatically detect bridges on small high-resolution panchromatic satellite images that rely on radiometric features (texture information) and geometric models. Using neural networks, they classify each pixel into several terrain classes. Although the approach is effective, there are several drawbacks to extending it to the general case. First, computation of texture parameters for a large image takes a significant amount of time. In addition, the analysis windows span more than one texture at the boundaries of texture regions and therefore, give imprecise classifications. This technique is unlikely to extract bridges over larger regions such as big rivers. Most existing methods are based on knowledge base, which is not derived automatically [4, 5]. But since these rules are developed by an observer, the methods are not well suited for all types of images. In [6] segmentation is greatly influenced by gray level value which changes with elevation angle of sun and turbidity of water. A fuzzy based thresholding method can be used for accurately segmenting water regions from background [7]. But the knowledge model proposed in the approach cannot be applied for

Figure 15. Bridge Detected SPOT5 Image (2.5-m)

Figure 16. Bridge Detected SPOT5 Image (2.5-m)

Figure 17. Bridge Detected SPOT5 Image (4-m)

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