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Semi-automatic extraction of different-shaped road centerline from MS and pansharp IKONOS images

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According to necessity and importance of using accurate and update spatial information of road network for traffic management, automatic vehicle navigation, natural hazard assessment and critical decision making, extraction and updating road feature from aerial and satellite images are of fundamental importance.

In this work we develop semi-automatic road extraction system for updating and storage road network data bases and to reduce charges and also keeping or increasing precision and speed of information extraction in comparison with field work and GPS usage. Combination of some of the existing road extraction techniques such as spectral and spatial data clustering, morphological functions and graph theory is used in this proposed system.

Input data of the proposed road extraction system are multi-spectral and pansharpened IKONOS images of Lavasan city in Iran (with respectively 4 and 1 meters spatial resolution). The proposed system investigates capability and amount of system success in extraction of different shaped roads such as straight, spiral, junction and square. No additional data is needed in this system except for what was mentioned.

In the proposed method, primarily the input image is spectrally classified by use of Fuzzy C-Means (FCM) clustering technique and road class binary image is obtained by definition of threshold value. This technique (FCM) tests different distance function types in performing FCM clustering and finds the most precise and fastest one. Afterwards, quality of detected road features is improved using morphological opera-

tors like dilation, erosion, opening, closing, bridge and etc. Our approach proceeds by performing spatial cluster analysis using k-means technique and hence road center line nodes are attained. In this step, effect of choosing different number of cluster centers in spatial domain for comprehensive road shape estimation is investigated. Finally by use of graph theory and minimum spanning tree (MST) and defining an appropriate cost function, these key points are connected and vector road centerline is obtained. These road vectors can be directly imported into GIS environment in different formats for updating digital road maps.

The main advantage of this proposed system is achievement of it in extracting different shaped roads and attaining acceptable precisions in order to updating road maps. The only drawback of this system is limitation in completely extraction of road center line in place of squares and closed loops. So supervision of human operator for completing missed links and closing the loops is inevitable.

Attaining mean overall accuracy (OA) of 98.2% and Kappa coefficient of 86.26% in classification of image to road and non-road classes, and also mean RMS error of 0.64 pixel in comparing automatic extracted road centerline with manual extracted one, are a good criterion of proposed system success in semi-automatic extraction of road.