A semi-automated system for edge detection in remote sensing

УЧРЕЖДЕНИЕ РОССИЙСКОЙ АКАДЕМИИ НАУК
ИНСТИТУТ КОСМИЧЕСКИХ ИССЛЕДОВАНИЙ РАН

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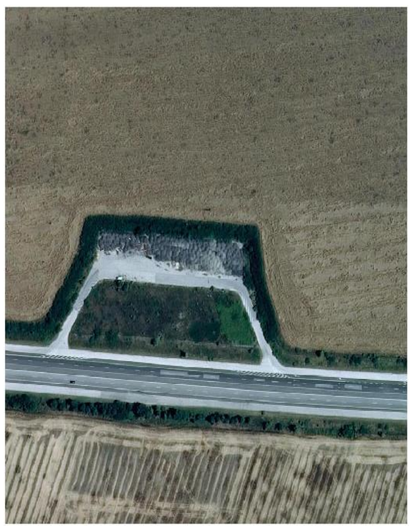
БАН ИКИТ

Introduction The remote sensing of the road infrastructure is using mathematical methods for digital image processing. They can be considered as separate components which can be united into a self-contained system. Efficiency in the remote sensing of road infrastructure depends on the quality of the methods used.

The semi-automatic road network extraction techniques have increased the rate of extraction of road networks. Consideration of possible algorithms makes it possible to choose the most appropriate one by identifying the factors that influence their implementation. Positive and negative aspects of the methods are examined in terms to assess their results as advantages and disadvantages.

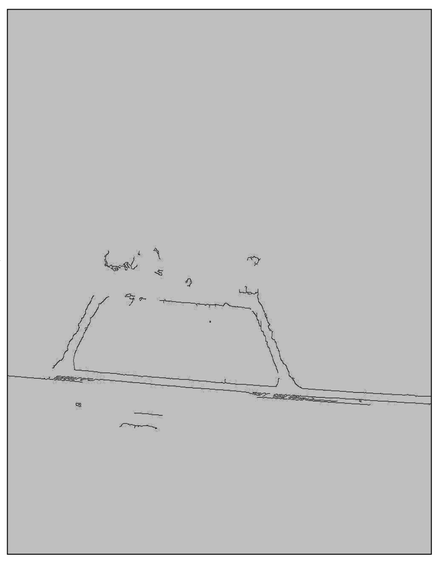
Road networks play an important role in a number of geospatial applications, such as cartographic, infrastructure planning and trafic routing software. When it comes to remote sensing, recognizing each object is a top priority. The identification of the object with a remote sensed image, for instance, is very important for the transport and for most of the economics spheres.



Original input image, 1000x1000, 1:5000, 300 dpi, 24 bit

Greyscale image

$$I_{gray}(x,y) = 0,299R(x,y) + 0,587G(x,y) + 0,114B(x,y)$$



Canny edge detection, Thigh=200, Tlow=600

Tilton best merge segmentation, spclust_wght=0,25

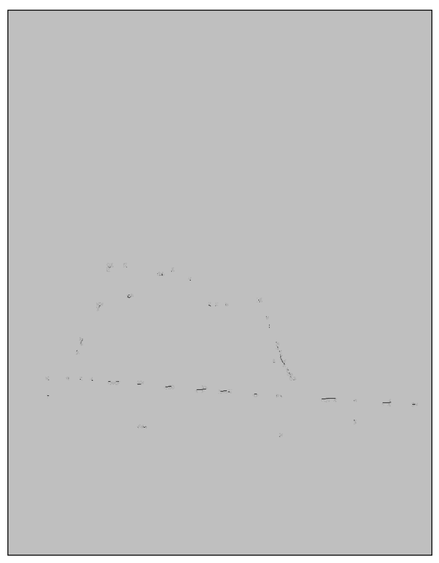
The Mahalanobis classifier is a single pixel spectral classifier that uses Mahalanobis distance function to calculate the separation between a candidade pixel and the training set sample in the colour space. The rod extraction, the training set sample is a road modeli containing a distribution of typical road pixels.

The mahalanobis distance allows different scales in each dimension and incorporates the correlation of variables through a covariance matrix. Those traits allow for a more accurate approximation than its Euclidean counterpart.

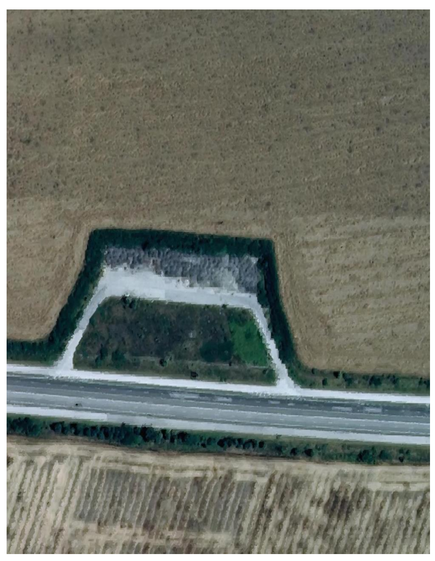
The goal of the selforganizing road map is to provide an approach to road centreline delineation from highresolution imagery that is independent of conventional edge definition, and can meaningfully exploit multispectral imagery. The premise is to analyse elongated regions in a global manner, in which case, the redundancy of information improves tolerance to missing information and noise.

The SORM approach is a two-stage procedure in which spatial cluster centres are first identified with a standard ‘flat’ clustering technique. Preliminary results indicate robust modelling capability when considering elongated regions in the presence of clutter.

Since spatial clustering finds localised centres-of-gravity at the resolution of Voronoi regions in the input space, it is not sensitive to adverse effects from edge fragmentation. It can also be viewed as a mid-level grouping technique in which geometric accuracy is maintained compared to grouping methods that lead to coarse localisation.

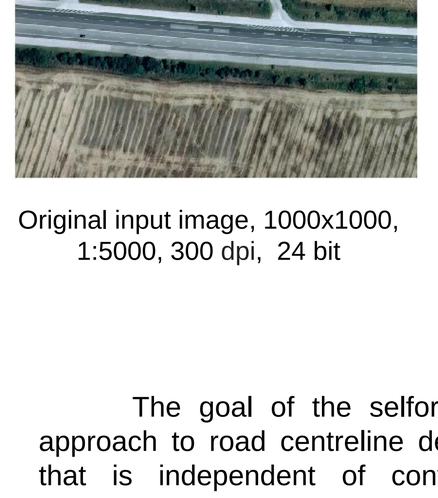


SUSAN edge detection, Nmax=30 000, T=100



Felzenszwalb and Huttenlocher tree merge segmentation, sigma=3, det_value=30, min_size=4

Mahalanobis classification

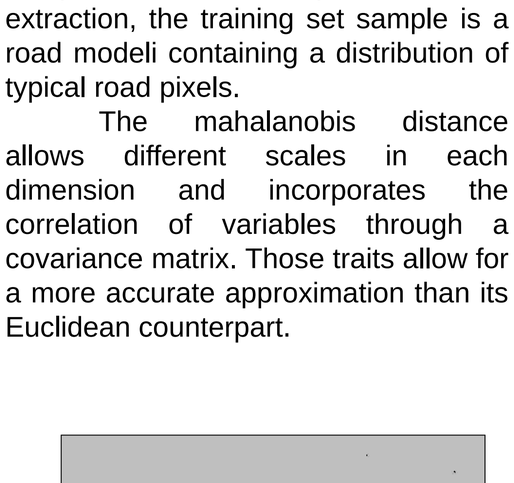


Selforganizing road map

Classified image containing 18 units of closiness

Classified image including 26 intersactions

Classified image including 9 road types



Classified image containing 2 units of equality

Conclusions The study of the network of any issue is important for the economics of each country. The efficacy of the remote sensing itself is directly connected to the capabilities of the applied edge detection method. The idea of this paper is to exploit, view and develop to larger extent the possibilities which are offered by Canny and SUSAN edge detection methods. A short overview about every one of them is shown and discussed. The two chosen methods are compared. In these terms the most effective one is chosen according to the facts connected with the applying of the method. Experimental results as examples are shown to illustrate the advantages and disadvantages of the methods. The obtained results of the edge detection are classified by Mahalanobis or by Bhattacharyya method, depending of the capabilities of the chosen method in terms to create a self-organizing map which allows the semi-automated system to recognize the object from a remote sensed image. Essential tool in such an aim take under account the self-organizing software system for analysis and conclusions. For real implementation of such system is needed algorithms from different levels, which are discussed, to be chosen. Applying them over the initial image is done by careful and precise varying of the parameters. Future plans are created based on the results.

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