

VERIFICATION OF MANUAL ROAD EXTRACTION METHODS USING QUICKBIRD IMAGERY

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ABSTRACT:

Remotely sensed images are used for many purposes in today's applications. One of these is the feature extraction from high resolution satellite imagery. In this context, automatic and manual road extraction is the most important issue. The goal here is to show the fidelity of the QuickBird imagery foreextracting the road network with manual measurements. Then, verification of road extraction from image is compared to digital road database created from large scale topographing maps.

1. INTRODUCTION

The availability of high resolution optical imagery appears to be interesting for geo-spatial database applications, namely for the capturing and maintenance of geodata. Recent works show that the geometry of QuickBird or IKONOS imagery are accurate enough for mapping purpose up to scale of 1:5000 (Büyüksalih and Jacobsen, 2005). High resolution satellite imagery data has a lot of advantages and they can be used for updating the available maps. This can be applied specifically to follow the road networks and verify them in the topographing database.

During verification, the database objects are compared to the reference: the positional accuracy and the attribute correctness can be checked using the extracted objects. The completeness and temporal aspect is only considered partly as just commission errors are identified. In a following update process, new or modified road objects not included in the database are extracted. By this means also completeness and temporal correctness are fully considered (Gerke and Busch, 2005).

Every road extraction algorithm is based on an appropriate object model. Road models which are too generic have the disadvantage that their radiometric and geometric properties also fit to other linear features. If, on the other hand, the chosen model is too rigorous, a number of roads will not be extracted. One possibility to overcome this problem is to incorporate additional knowledge about the object itself in terms of local and global context (Baumgartner et al., 1997).

The extraction strategy is derived from the road model and is composed of different steps. After line extraction and processing, a weighted graph is constructed from the lines and gaps. Road network generation is carried out by calculation of "best path" between various pairs of point which are assumed to lie on the road network with high probability. The approach uses local (radiometric) information for line and gap weighting, and global (topological) information for network generation. Finally, the extracted road junctions within the network are simplified based on morphology. In the following a detailed description of each step is given (Wideman and Hinz, 1999).

Using the QuickBird pan-sharpened imagery of Zonguldak testfield recorded on May 2004, road networks were extracted manually and compared to the reference dataset integrated from the 1:1000 scale digital maps of the same

area composed from the 1:4000 aerial photogrammetry taken in 2005.

2. TESTFIELD AND DATASETS

Zonguldak testfield is located in Western Black Sea region of Turkey. It is famous with being one of the main coal mining areas in the world. Although losing economical interest, there are several coal mines still active in Zonguldak. Area has a rolling topography, in some parts, with steep and rugged terrain. While partly built city area is located alongside the sea coast, there are some agricultural lands and forests in the inner part of the region. Fig.1 shows the QuickBird imagery of the testfield taken in May 2004.

Important processing characteristics of QuickBird imagery is given in Table 1.

In the upper part of the QuickBird image, Black Sea is lying down and other parts of the image includes central part of the Zonguldak city which covers nearly 15x15km area with the elevation range up to 450m. When the images first received, they were analyzed for selecting suitable GCPs distributed on them uniformly. As a result of this determination, 43 distinct GCPs were measured by GPS survey with an accuracy of about 3cm. Since those points can be seen very well on the images, they were selected as building corners, crossings, etc. Because of the fine resolution of QuickBird imagery, many cultural features can be identified and used as GCPs. The manual measurements of GCPs' image coordinates were carried out by GCP Collection Tool under PCI Geomatica-OrthoEngine software package.

After geometric correction of QuickBird imagery (Jacobsen et al., 2005), it was enhanced by applying a pan-sharpening method (Wang and Zhang, 2004) used in PCI system. This method makes it possible to benefit from the sensors spectral capabilities simultaneously with its high spatial resolution.

2.1. On-Screen Digitized Vector Datasets

Digitizing is a way of conversion of information from analogue graphic maps to machine readable vector or raster formats. Many methods are used for the vectorizing process. In this study, on-screen digitizing approach has been used for conversion to the raster form. On-screen digitizing of QuickBird pan-sharpened image was realized using NetCAD software package. On-screen digitizing results of centre lines of roads are given in Fig.2.

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Fig. 1: QuickBird image of Zonguldak testfield.

Date, Time	23/05/2004, 08:39:55 GMT
Nominal collection azimuth (deg.)	61.0
Nominal collection elevation (deg.)	85.9
Sun angle azimuth (deg.)	139.1
Sun angle elevation (deg.)	64.7
Nadir angle (deg.)	3.9
Image size (pixels in row, column)	24.572 x 25.500
Reference height (m)	265.66

Table 1: Characteristics of Zonguldak QuickBird image.



Fig. 2: On-Screen Digitizing Results of QuickBird pan-sharpened image.

3. RESULTS

On-screen digitized vector results information were compared with the 1:1000 scale maps and given in Fig. 3. It is important that, used image is in WGS-84 coordinate system; the 1:1000 scale maps are in national coordinate system. Therefore for comparison of the vector results, a transformation between both systems is necessary. The transformation has been made by chosen corresponding transformation points in both systems.

Numerical result from the comparison compared with the 1:1000 scale maps is given in Table 2.

From the Table 2, rod database following conclusions could be drawn:

- Main problem of the road extraction from the pan-sharpened QuickBird imagery is the trees which prevent extracting the objects under them.
- Some of the roads could not be extracted because of the blur, operator errors, operator ignorance and shadow effects. They are the other important obstacles in extraction of roads.

These prove that the quality of the image and the experience of the operator are important factors.

Number of note extracted roads from the imagery		Percentage (%) in total	Reason for not extracted roads from the imagery
45		60	Under the trees
13		17	Operator errors
5		7	Operator ignorance
6		8	Shadow
6		8	Blur
Total :	75	% 100	

Table 2: Results of not extracted the roads from QuickBird imagery.

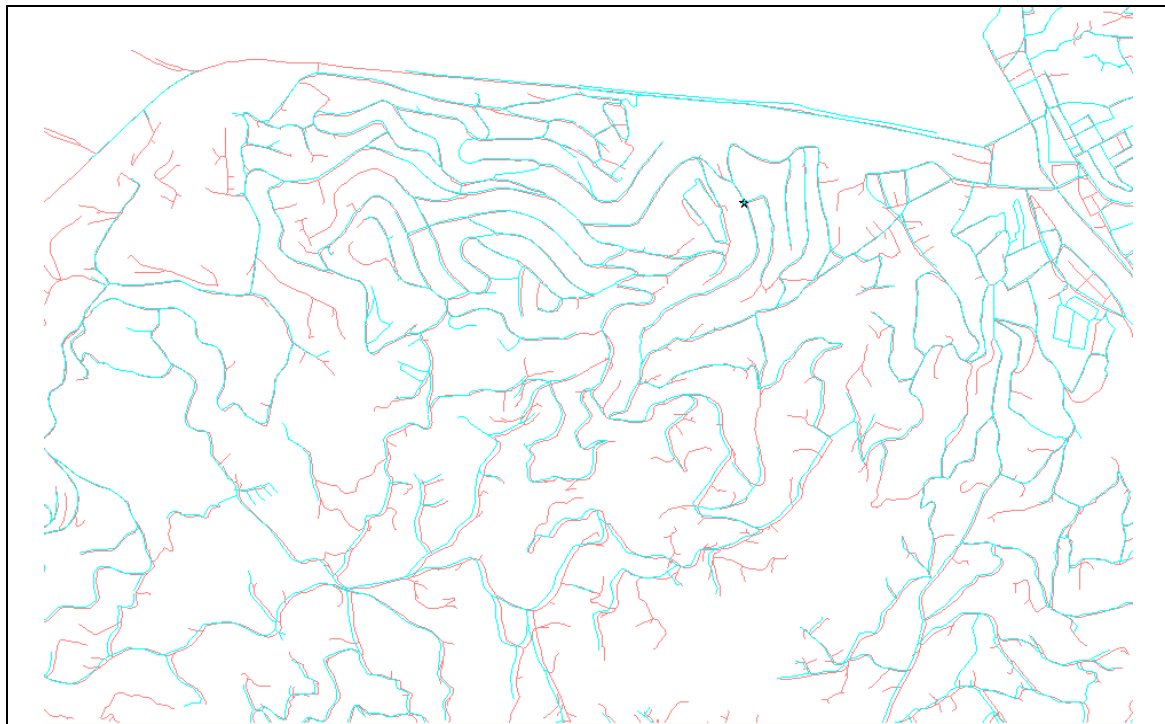


Fig. 3: Superimpose from of on-screen digitizing results and 1:1000 scale maps in MapInfo environment.

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