S E N S 2 0 0 8
Fourth Scientific Conference with International Participation
SPACE, ECOLOGY, NANOTECHNOLOGY, SAFETY
4–7 June 2008, Varna, Bulgaria

QUALITATIVE ANALYSIS OF THE VISUAL INTERPRETATION OF SINGLE QUICKBIRD IMAGERY

Ahmed Ramzi, Roumen Nedkov

Space Research Institute – Bulgarian Academy of Sciences
e-mail: ahmedasi@hotmail.com

Keywords: *Visual interpretation, Data extraction, VHR satellite images, Large Scale Mapping*

Abstract: *There are many available sources of geographic data, such as areal photography, field surveys and paper maps. For most applications, satellite images are often the best practical way to acquire usable geographic information due to its characteristics. The key factor for information extraction is the very high resolution which makes QuickBird panchromatic or pan-sharpened images a very powerful instrument especially over urban areas where small details can be sensed by the satellite. The information extraction process can be carried out in an automatic or semi-automatic way by using more or less sophisticated algorithms that take into account the spectral, geometric, contextual and hierarchical features or simply by visual interpretation. The information to be extracted depends on the objectives of the analysis. In many cases, the focus is on man-made features such as roads, buildings and infrastructure. The level of detail of QuickBird data enables the detection of many features, not only buildings and roads, but also single trees, parking areas, sports facilities, etc.*

In this work, we study and evaluate in details the visual interpretation approach which is always the best way for information extraction for mapping. The result of this research shows that not all objects can be identified with sufficient accuracy and clearness. There is limitation imposed by the resolution of the satellite image. So, when the objects are not clear and cannot be identified properly, other sources of information must be used.

Aims:

1. Evaluating the dectabiliy levels of different classes of features from two dimensional panchromatic QuikBird image using visual interpretation.
2. Providing image interpreters with image interpretation key which help them in their visual analysis task.

1. Background

Very high resolution space imagery such as IKONOS, QuickBird and EROS is essential for a large scale mapping; QuickBird is the satellite that offers the most powerful solution for information extraction and mapping in a wide range of applications. the QuickBird sensor is one of those. It offers images with a spatial resolution of 0.61 m (panchromatic) and 2.44 m (four multispectral bands). Feature recognition is very important to GIS users. It is determination of different objects on the images and classified. These objects are then used to build GIS topology useful for map making and modeling. Much useful information can be obtained by visual examination of individual image bands. Here our visual abilities to rapidly assess the shape and size of ground features and their spatial patterns (texture) play important roles in interpretation One of the most important characteristics of an image band is its distribution of brightness levels, which is most commonly represented as a *histogram*. Increase the interpretability of grayscale images by using the Contrast Enhance- ment procedure Automatically classification techniques of satellite images is allocating every image pixel we want to classify, to a certain type of land cover. Several approaches were tested, taking the spectrally heterogeneous nature of urban areas into account. We emphasize that the approach presented in this paper is completely dependent on Visual interpretation of object we want to recognize.

2. Objectives of the Research Work:

Three main objectives related the understanding of Visual interpretation of single QuickBird:
1-To study the visual interpretation from QuickBird 0.599 m resolution, panchromatic standard ortho-ready Level-2A.

2-To asses the qualitative analysis of information extracted for large scale mapping.
3- To evaluate the level of dectability of different features classes from two dimensional panchromatic QuikBird image using visual interpretation.

3. Test Site and Data Sets:

The test area is Kafr Az-zayat region, Egypt. It is a largely urban area that contains buildings, a network of main roads as will as minor roads and green areas. The terrain varies from 4 m up to 10 m above M.S.L (mean sea level) through the area. The test area is covered by QuickBird, 0.599m resolution, panchromatic standard ortho-ready Level-2A date 2005-09-06. The total area=33 km^2. Also, the study area covered with maps scale 1/2500 produced from aerial photos. A well distributed ground control points (GCPs) and Check Points (CPs) over the territory of Kafr Az-zyat, were measured.

4. Methodology

The methodology of producing large scale maps from very high resolution satellite images involves many steps to get the final GIS reedy base map according to the specifications. These steps are:

- Data collection
- Pre-processing of satellite images
- Enhancement
- Developing interpretation key
- Vectorization and Editing of Satellite Image Features:
- Data revision process
- Adding height information.
- Quality control, Field revision and verification Accuracy assessment
- Evaluating the produced map

In this study we will evaluate the level of dectability of different classes of data available in hand two dimensional panchromatic QuickBird image. And this evaluating will be done based on an developing interpretation key. The developing interpretation key will be for QuickBird images and can help on interpretation of similar study area. The devolved key will used mainly to coordinate the work of the interpreter, to obtain homogeneous results and to minimize the field work.

Pre-processing of satellite images

The QuickBird image was geometrically corrected with a second order polynomial function, using the 12 GCPs from GPS measurements . The total RMS error on GCPs and CPs meet map scale 1:2500.

Enhancement

Image enhancement techniques improve the quality of an image as perceived by a human. There exists a wide variety of techniques for improving image quality. The contrast stretch, density slicing, edge enhancement, and spatial filtering are the more commonly used techniques. In our case the corrected image was clear and no need to make enhancement.

Interpretation Key

The success of an interpretation of remotely sensed images strongly depends on the knowledge of the interpreters and how this knowledge is used within the interpretation process. The development of an interpretation key is a prerequisite for a reproducible interpretation of all kind of remotely sensed images. An interpretation key can be defined as a legend that describes the object categories and their characteristic features on the images.

First the visual interpretation of geometrically corrected QuickBird images will be done based only on novice interpreters and experienced interpreters. At the end a comparative study will be done between the produced maps and the existing maps. Then the developing interpretation key will be done based mainly on the existing map, field check and will be supported with snapshots for all types of f classes and subclasses.

Vectorization and information extraction

Vectorization was done manually on screen based on the developed interpretation key. According to the required map scale (small, medium and large), the geographic database requirement for GIS application differ. In this research we study producing large scale base maps for the selected study area, QuickBird single panchromatic image urban data has been used for generating 1:2500 scale base maps. The requirement information for large scale mapping for GIS applications are “built-up areas”, “roads”, “railways”, “water”, tanks, green areas and trees, poles, bridges and “un-built areas”,

The level of detail of QuickBird data enables the detection of almost features that can be used for large scale mapping. But not all features can be identified and recognized easy there are levels of detectability, identification and reorganization. So, we will measure these levels of detectability for the selected study area.

Data revision process

Revision of map vector data Integration of vector and raster data Image processing Topology editing

Digital contour editing

In our case no need to draw contour lines because it was cultivated area but only needs some spot heights

Quality control Field revision and verification Accuracy assessment

Field revision_including road names, landmark types and names.. Spot heights must be measure in case absent of another sources of information.

5. Results

In summary, the results show that:

1. built-up areas

All buildings private and government with their categories, residential, educational industrial hospital, schools, mosque , church and cemetery.

- Residential areas can be identified by the pattern that they make in conjunction with the roads. Individual houses and other buildings can also be identified as dark and light tones.

2. Roads

All roads with their categories and width dual carriage road, main paved road, secondary paved road, unpaved road, alley, track, and river-bank)

- All oads are visible due to their shape (straight in many cases) and their generally bright tone contrasting against the other darker features. Roads with width from 1 t0 4 m not esiy to identfy.
- track is quite easy to identify because of its characteristic shape.

3. Rail lines

All Rail lines with their categories railway single track, railway double track

- In general all railways lines are difficult to identify because it is dark tone contrasting against the other darker features.

4. Water

All water bodies and All streams (perennial/ephemeral)

- the river is also easy to identify due to its contrasting tone with the surrounding land and also due to its shape.

5. Tanks

- verhead tanks, surface tanks, wells, etc.

6. Green areas and trees

tress and vegetation cover with categories green areas, grass, swamp trees (palm trees , orchard tree , other types of trees), bush

7. Poles

Poles of Electric power line and Radio transmission antenna, Telecommunication network

- all poles are difficult to identify

8. Bridge

- Bridges are identifiable based on their shape, tone, and association with the river - they cross it.

9. un-built areas (Terrain elevation)

- It is impossible to identify the terrain elevation by a single scene (without a stereo-pair).

The results shows that the possibility of Recognition of man-made features of several classes of objects with dectabiliy classification rates higher than 80%. This means that we have in this case study 20% defect of the produced mps cut must be covered from another sources of information.

6. Solutions:

To product complete map from mono QickBird images according to the Egyptian specifications we must used alternative methods or solutions to complete the rest of requirements which in our case represent 20%. The sources of information which can be used.

· Data from the cadastral information (old maps)..
· Field survey
Observations of confused objects and to add contours lines and spot heights by traditional survey techniques..
· Field checks to get all the interoperated items and names of targets.

7. Conclusions:

The following conclusions can be outlined:

- From single QuickBird panchromatic satellite imagery. The dectabiliy rates higher than 80% of man-made features.
- Using additional data from different sources and from field surveying is essential to complete all elements of the produced maps.
- The developed interpretation key is only valid for a geographic region with similar land cover units and for similar images within this area. The key has to be adapted for other regions and other types of images.

References:

1. Hofmann P. & Reinhardt W., (2000). The extraction of GIS features from high resolution imagery using advanced methods based on additional contextual information – first experiences.
2. In: ISPRS, Vol. XXXIII, Amsterdam.
3. Meinel G.; Neubert M. & Reder J., (2001). The potential use of very high resolution satellite data for urban areas: First experiences with IKONOS data, their classification and application in urban planning and environmental monitoring. In: 2nd International Symposium on Remote Sensing of Urban Areas. Proceedings. Regensburg, Germany: Institut fur Geographyan der Universität Regensburg, 196-205.
4. Volpe F. (2003***)*** – Mapping information from space with QuickBird satellite data – Third International Symposium on Digital Earth, Brno 2003
5. Rossi L., F. Volpe (2003) – QuickBird high-resolution satellite data for urban applications – II GRSS /ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas, Berlin 2003, pp.1-3
6. Chungan Lin, Ramakant Nevatia, (**1998),** Building detection and description from a single intensity image, Computer Vision and Image Understanding, v.72 n.2, p.101-121, Nov. 1998 [doi>10.1006/cviu.1998.0724]
7. Guindon B., (2000), "A framework for the development and assessment of object recognition modules from high-resolution satellite images," *Canadian Journal of Remote Sensing*, vol. 26, no. 4, pp. 334-348, 2000.
8. Benediktsson J. A., M. Pesaresi, and K. Arnason, (2003), "Classification and feature extraction for remote sensing images from urban areas based on morphological transformations," *IEEE Trans. Geosci. Remote Sensing*, vol. 41, no. 9, pp. 1940-1949, 2003.
9. Sohn G. and Dowman I. J., (2000), "Extraction of buildings from high-resolution satellite data," in *Automatic Extraction of Man-Made Objects from Aerial and Space Images (III)*, pp. 345-355, Swets & Zeitlinger B.V., Lisse, The Netherlands, 2001.
10. Lee D.S., J. Shan, and J. S. Bethel, (2003), "Class-guided building extraction from Ikonos imagery," *Photogrammetric Engineering and Remote Sensing*, vol. 69, no. 2, pp. 143-150, 2003.