The Availability of the Satellite Image Data in Digital Cadastral Map Production

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Key words: cadastre, remote sensing, land administration.

SUMMARY

New technologies can be applied in every branch of occupations nowadays. In this context, Turkey is concentrating an establishing a Land Registry and Cadastral Information System. The general objective of the project is to establish the Turkish Land Information System through out the country (TAKBIS). For this project(TAKBIS), digital cadastral maps are started to produce. And digital cadastral maps are being produced by terrestrial and photogrametric surveying.

Recent high-resolution satellite images provide an exciting new data source for geospatial information acquisition. This makes it possible to extract man-made objects such as buildings, roads and parcels from satellite imagery. So, in this research, images of Adapazarı side acquired from high resolution satellite imagery such as (1 meter) IKONOS satellite image. This image was geometrically corrected and vector data were produced acquired from image. At the end, the sensitivity of the high resolution satellite images compared to data produced by terrestrial surveying was investigated and the regions and zones it could be used was studied together with analysis of time, labour and cost.

ÖZET

Bilgi çağı olarak adlandırılan günümüzde, yeni teknolojiler tüm meslek disiplinlerinde uygulama alanı bulmaktadır. Tüm meslek disiplinlerinin ilgisini çekmekte olan Uzaktan Algılama teknolojilerindeki degişim günümüzde yüksek çözünürlüklü uydu görüntülerinin birçok amaç için kullanımına olanak tanımıştır(TAKBIS). Bilgi Sistemlerini oluşturan en önemli unsur veridir. Bu baglamda Türkiye' de ARIP ve MERLIS projeleriyle sayısal kadastral haritaların üretimine başlanmış ve TAKBIS oluşturulmaya çalışılmaktadır. Bu projelerde sayısal kadastral haritaların üretiminde fotogrametrik ve klasik yöntemle alınan veriler kullanılmaktadır.

Çalışmada, Adapazarı ilini içeren IKONOS(1m) pankromatik çözünürlüge sahip uydu görüntüsü kullanılmıştır. Yer kontrol noktaları kullanılarak görüntünün dönüşümü yapılmış ve görüntü üzerinden vektör veriler üretilmiştir. Yüksek çözünürlüklü uydu görüntülerinin klasik yöntemle üretilen verilere oranla hassasiyeti araştırılmış ve hangi alanlarda ve bölgelerde kullanılabilecegi irdelenmiş ve zaman, emek ve maliyet analizi yapılmıştır.

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1. INTRODUCTION

In Turkey cadastral works and registrations in the means of establishment of determination parcel boundaries and owners have been completed as 99 % for urban area and 88% for rural area by General Directorate of Land Registry and Cadastre of Turkey (GDLRC). Rural areas which are mostly mountainous and forestry are remaining. In most of the cadastral works completed areas are expected to be renovating in cadastral means.

A new project (TAKBIS) started for developing a Land Registry and Cadastre Information System. The goal of TAKBIS is to establish a countrywide cadastral information system by making use of DBMS and GIS software and to develop several application software required by the end users. This project is currently under development and it is anticipated that it will be successfully finished. Currently many projects are started with related to cadastral works and land registration for TAKBIS. For completing the TAKBIS, cadastral works and registrations must be completed.

The object of this paper is the estimation of the potential use of satellites panchromatic images, from satellite IKONOS-2 in cadastral applications for suburban regions, where the cadastral maps are design with terrestrial surveying.

For the realization of this, cadastral maps were produced using two different methods. The first method is to collect data from cadastral area with terrestrial surveying, while second led to an map production from satellite image with data extraction.

2. ADVANTAGES OF THE SATELLITE IMAGES

Setting out in orbit of the new generation of satellites, providing images with high resolution, which are available for civil purposes, widens considerably the areas of application of the satellite images. In some respects they compete with the aerial pictures, especially for small-scale mapping.

The use of satellite images has certain advantages, such as:

- The process of photographing of the land surface is continuous lasting for a period of 4 days. Owing to this the most appropriate image was chosen.
- The formalities for aerial photography and flight arrangement are avoided here.
- The use of satellite images is considerably less expensive than the aerial pictures.

3. TEST AREA SPECIFICATION

Test area is ADAPAZARI-Hendek, Karatoprak village which is located on western part of Turkey have been chosen. Size of test area is 2*2 km and has same characteristic of areas which is uncompleted initial cadastre. Geometric resolution is 1 meter and spectral resolution is 4 m of this image. More information about Ikonos images please visit; http://www.spaceturk.com.tr.

Main characteristics specifications of test area are;

- Some part of the area flat, plain and somehow undulating and rural areas,
- Some part of area open,
- Very dense parcel, infrequent parcel distribution and in the rural area forestry related parcels available
- Test area also reflects typical characteristics of uncompleted cadastral areas.

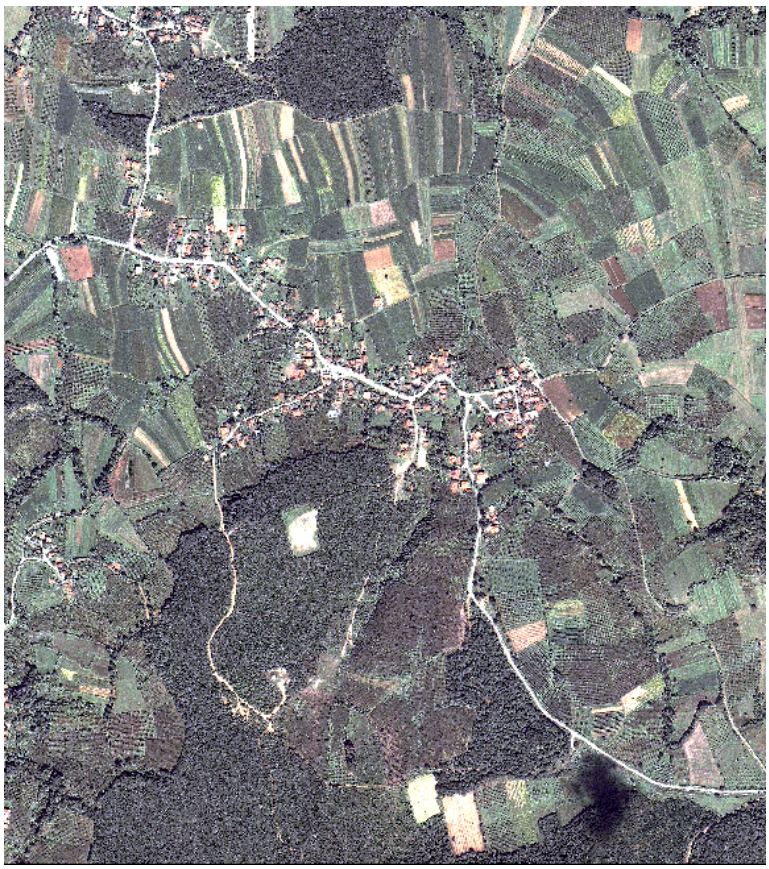

Image 1. IKONOS Space image test area

After densification of geodetic points in test area, satellite images have been taken in year 2002. Terrestrial map verification has been completed. As comparison critters terrestrial map data and satellite based data were used. In addition terrestrial based data measured by total station were completed to use a comparison.

4. PROCESSES

Ground control points were established in order to produce map by satellite imaging. All control points are signalized and measured by GPS. In the project area there are 8 signalized ground control points. After adjustment of GPS measurements accuracy of ground control points less then 10 cm.

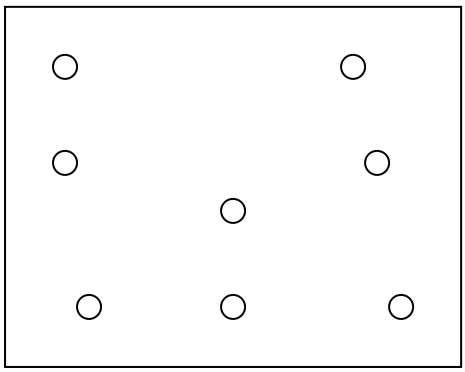

Figure 1. Ground Control Points

In the study carried out, the positional enhancement module (resolution Merge) and pan and rgb bands of the IKONOS image were combined and the spatial resolution of the pan image and the color information of the multi-spectral image were combined in ERDAS 8.6 software. Instead of the brovery and multiplicative methods, which do not maintain the radiometric values of the original multi-spectral image, the merge image, obtained with PC method by which the closest values to the input data are obtained, were used during the applications.

ERDAS 8.6 software was used during the rectification processes. This software helps the use of many geometrical correction methods. In the two-dimensional referencing for image, polynomial resolutions of different degrees based on the control points were used in ERDAS software.

The RPCs provided by the vendors could be refined in the domain of the image space or of the ground space, when additional control information becomes available. The RPC file contains rational function polynomial coefficients that are generated by the data provider based on the position of the satellite at the time of image capture. These RPCs can be further refined by using ground control points (GCPs).

Used for the high resolution satellite images, the RPC model helps the convertion to the object space in a geographical reference system from the image. After they were referenced with the land and image was used in the comparisons with produced topographic map by terrestrial surveying.

Image 2. Satellite image with topographic map that produced by terrestrial surveying

On the condition that the same control points were marked in the image, the rectification of the pan image was made with control points. And then parcel boundaries, buildings and forestry areas were exracted from satellite image. Extracted data that was produced from the rectified image and the topographic map were overlapped in ERDAS environment. And then the difference measure between topographic map and extracted data is determined.

Image 3. The difference between extracted data from satellite image ( )and topographic map that produced by terrestrial surveying( )

5. CONCLUSIONS

Satellite imagery does not need flight mission, photo laboratory processes, scanning and requires less ground works. But with satellite images it's not possible to collect correct parcel boundaries. In Turkey, boundary is very important for parcel owner.

Before providing images it is necessary to do ground control points establishment and signalization which are required 9-10 GCP for satellite photogrammetry. So to produce cadastral maps with satellite images is cheaper and is needed less manpower than terrestrial surveying.

An Ikonos satellite image cover approximately 4 km^2 on the ground. To survey this area, two weeks is needed to survey this area. . There are huge differences to process to produce cadastral map between satellite image and cadastral map by terrestrial surveying. On the other hand to provide satellite images are very faster than terrestrial surveying.

As a result when topographic map by terrestrial surveying and extracted map by satellite image are compare, the accuracy result that is measured is 3 m. It's very low accuracy for satellite imagery. Cadastral maps are needed high accuracy. So it is not possible to obtain high level accuracy maps with satellite images. Accuracy is the most important thing for cadastral maps. So satellite images only should use to control topographic maps that produced with terrestrial surveying.

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BIOGRAPHICAL NOTES

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