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**A PROPOSAL TO SURVEY THE STRUCTURING PROCESS IN URBAN AREAS IN OUR
COUNTRY: AIR LIDAR (LIGHT DETECTION AND RANGING)**

ABSTRACT

Today many successful applications are made in remote detection by different science branches. One of these applications is LIDAR technology which has recently shown constant progress. LIDAR, which has more advantages compared to classical photogrammetric methods, is commonly used especially in the fields of forestry, mining, coastal engineering, agriculture and urban planning through the help of laser scanning by plane system. In this study, application possibilities of LIDAR technology in urban areas and structure audit in divisions where structure stock is dense are analyzed.

Keywords: Geography, LIDAR, Urban, Structure, Planning

**ÜLKEMİZDE KENTSEL ALANLARDA YAPILAŞMA SÜRECİNİN İZLENİLMESİ İÇİN BİR
ÖNERİ: HAVA LIDAR (LIGHT DETECTION AND RANGING)**

ÖZET

Uzaktan Algılama konusunda günümüzde farklı bilim dalları tarafından birçok alanda başarılı uygulamalar yapılmaktadır. Bu uygulamalardan bir tanesi de son yıllarda sürekli bir gelişim gösteren LIDAR teknolojisidir. Klasik fotogrametrik yöntemlere göre son derece avantajlı olan LIDAR, uçaktan lazer tarama sistemi yardımıyla özellikle ormancılık, madencilik, kıyı mühendisliği, ziraat ve şehir planlama gibi alanlarda sıkça kullanılmaktadır. Bu çalışmada LIDAR teknolojisinin kentsel alanlarda, yapı stokunun yoğun olduğu bölümlerde, yapı denetiminin kullanım imkânları incelenmiştir.

Anahtar Kelimeler: Coğrafya, LIDAR, Kent, Yapı, Planlama



1. INTRODUCTION (GİRİŞ)

For whatever reason, the need for mapping the whole of the earth or some part of it is increasing day by day. The significant data in mapping are three dimensional coordinates (x,y,z) of the points on the earth. Coordinates are the unique characteristics that enable to distinguish an object from the others in terms of its location. The accuracy of the location is significant in all the researches about the earth. Coordinate designation on mapping is rather tiring and costly. It is highly significant to derive the coordinates in a minimum time and with the desired sensitivity. Today through the help of LIDAR technology, it is possible to derive three dimensional (3D) coordinates with high sensitivity. With the help of this advantage developed by LIDAR system, in making SAM(Numeric Area Model) and SYM(Numeric Height Model), LIDAR data is being used commonly in photogrammetri and remote detection fields [1]. LIDAR system prepares reliable data for 3D object modeling, building simulations, actual orthophoto generation and similar applications [2, 3]. Through the help of LIDAR technology which can produce faster and cheaper data compared to other data prepared by traditional geodesic or photogrammetric methods, the essential spatial data needed for different scientific discipline studies can be obtained. Besides, LIDAR scanning system which is also defined as ALS–Airborne Laser Scanning or ALSM–Airborne Laser Swath Mapping and which has been commonly used especially for the last 10 years will take a vital place in spatial data generation near future.

In this study, application possibilities of LIDAR technology in urban areas and structure audit in divisions where structure stock is dense are analyzed.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

Today, as in all developing countries, shanty settlements and construction control in urban areas is a crucial problem in our country, too. Uncontrolled internal and external migration and shanty settlements occurring related to this causes many problems. Some of these problems are security problems and problems in areas of planning, urban development, technical infrastructure. Shanty settlements and unplanned urbanization can be pervasively seen especially in big cities and metropol.

In this study, the LIDAR technology, a new technology used in the control of shanty settlements particularly in cities facing with an intense wave of internal migration is analysed. It was researched whether with LIDAR technology shanty settlements and unplanned urbanization could be prevented or not.

3. LIDAR(LIGHT DETECTION AND RANGING)

Passive remote detection systems are the systems where the energy emanated or reflected naturally from an object is recorded. Active remote detection systems are the systems where the energy spread from its own source and comes back is measured. Pictures taken with a flash are active detection while the ones taken without a flash are passive detection [4]. Like radar, LIDAR systems are also active remote detection systems. In order to define the land, laser light blows are used. Similar to passive microwave systems, LIDAR systems are also processed into a profile or scanning mode [5].

LIDAR, or known as Airborne Laser Scanning (ALS), operates in a way similar to Radar technology. However unlike Radar, it obtains data by sending laser signals as short electro-magnetic waves instead of radio waves. It sends thousands of signals to the earth per second and obtains 3D data directly by operating in an integrated way with

GPS/INS technology [6]. One of the most significant developments in LIDAR technology is accepted as its capacity to distinguish the signals sent as first and last signal data by LIDAR receivers [7]. With LIDAR technology, it is possible to obtain picture data classified according to their intensity degrees which are determined by making use of reflection intensity of laser signals. As shown in Figure 1, the objects near the land or land surface are darker while artificial or natural objects like tall buildings and trees are shown in bright colors. In addition to them, watery areas where there are no reflections of laser signals are white in the picture. With the improvements of the navigation systems used in LIDAR technologies, (GPS, INS) it is now possible to mention ± 30 cm accuracy in vertical and horizontal direction [8].

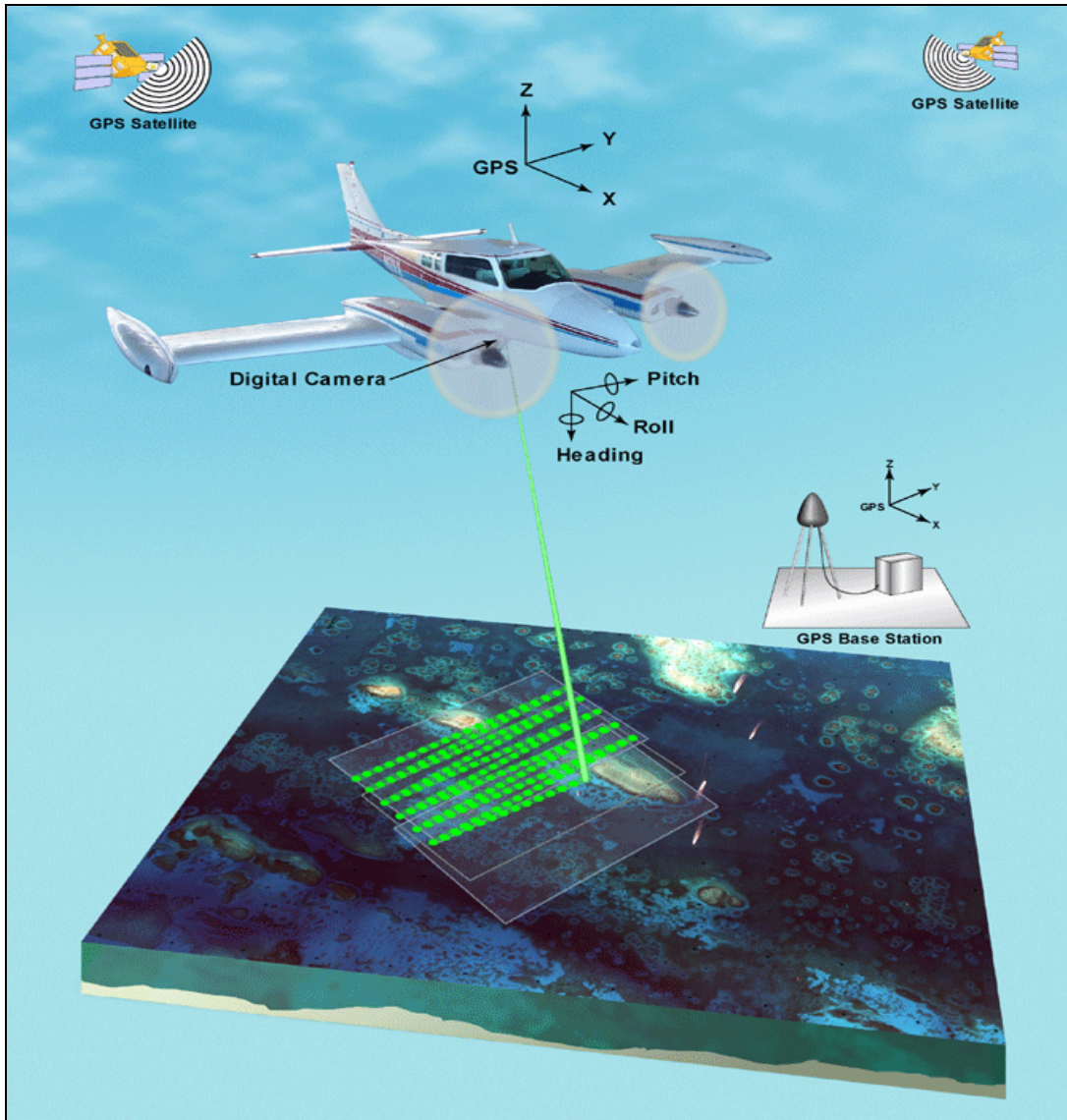


Figure 1. LIDAR (URL 1)
(Şekil 1. LIDAR (URL 1))

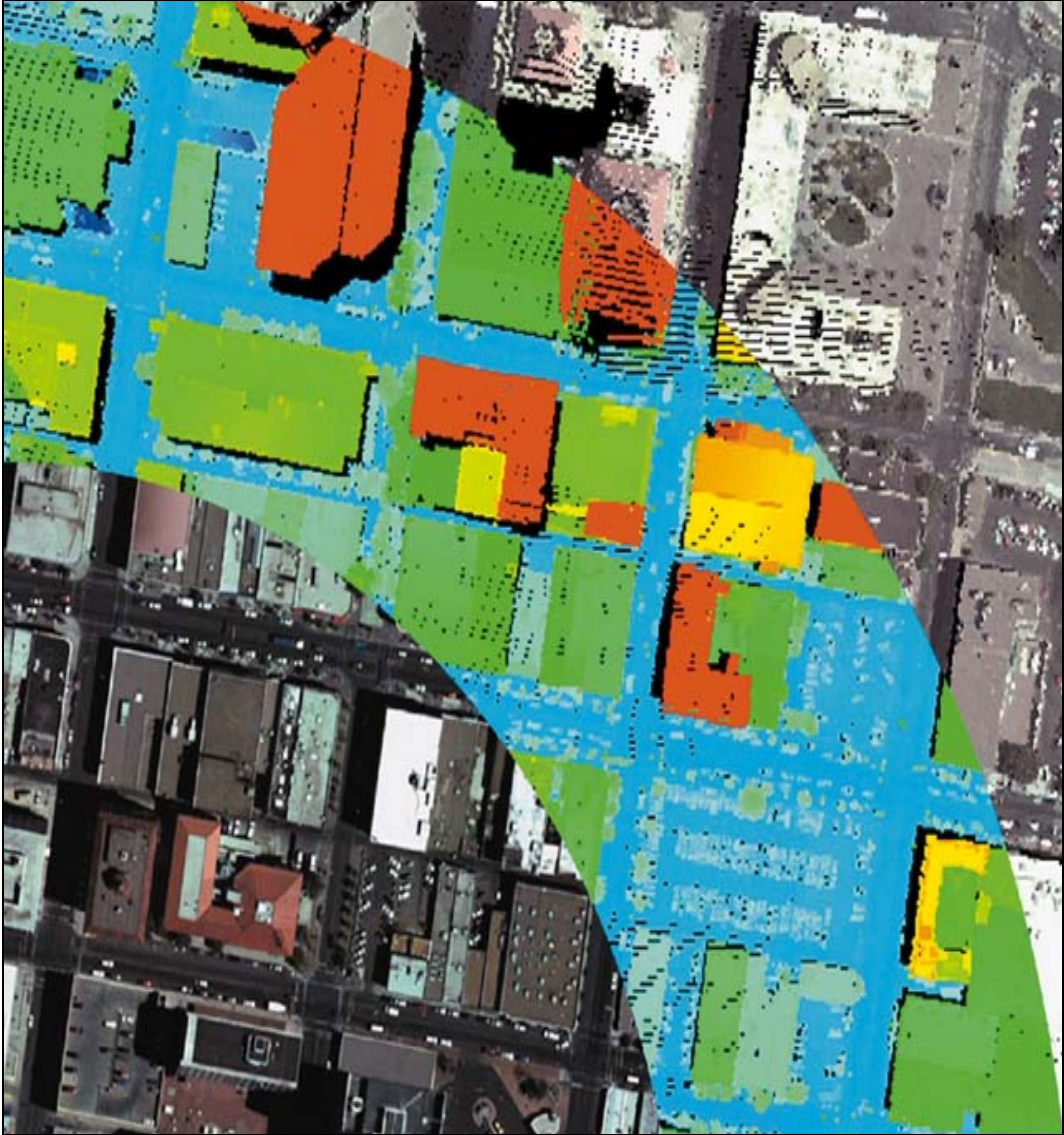


Figure 2. city centre LIDAR data sample) (URL 2)
(Şekil 2. (Kent merkezi LIDAR görüntüsü) (URL 2))

A LIDAR system consists of a laser scanner and a coolant; GPS and INS (Inertial Navigation System) tools. The time that passes in the circular trip that high-frequency infrared laser radiation emanated by a laser scanner on a plane takes from the plane to the earth is measured and recorded together with the location information of the plane at the time of laser wave's transmission. After that, three dimensional coordinates X,Y,Z) of location points are measured through the help of plane's location at the time of measurement and plane-earth vectors [9 and 10].

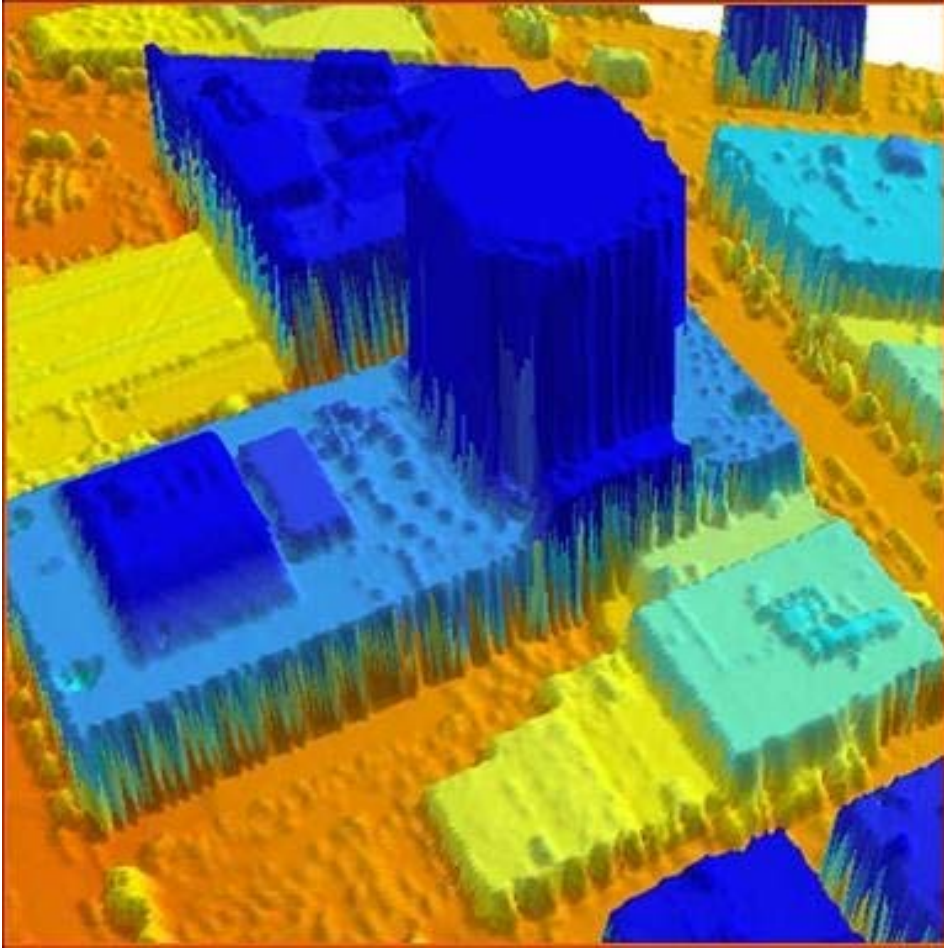


Figure 3. Earth layers (URL 3)
(Şekil 3. Yeryüzü yüzeyi (URL 3))

With air LIDAR technology, sensitive measurements can be made. In determining weather conditions and land height according to plane's location, approximately 3 to 30 cms margin of error; in flat lands without vegetation (horizontal direction) 5 to 50 cms margin of error can be possible [11].

There are different margins of error in different surfaces. On the surface of an open, flat land $\pm 0,15$ m; on the surfaces of near-flat, curved land with rare vegetation $\pm 0,25$ m; on hilly lands with rare vegetation $\pm 0,50$ m are margins of error (URL 3). On the whole, in x-y direction the widest 1 m distance margin of error, in z direction approximately 15 cms margin of error can be found [12].

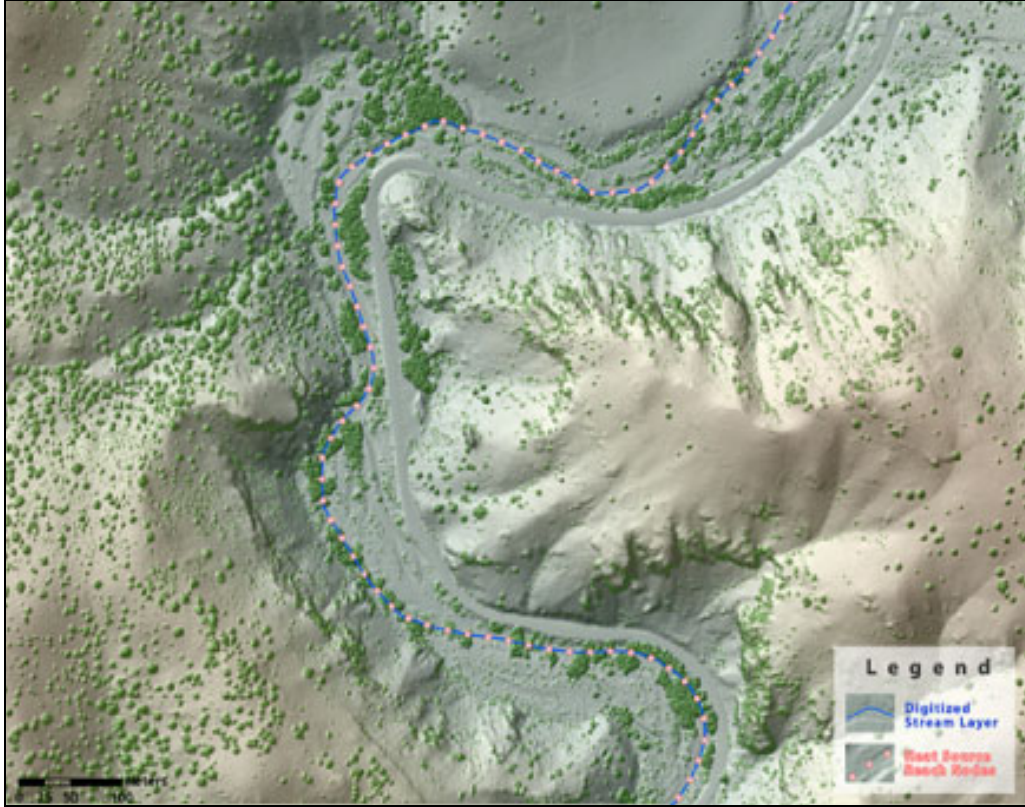


Figure 4. Motorway LIDAR view (URL 4)
(Şekil 4. Karayolu LIDAR Görüntüsü (URL 4))

The average research area is approximately 1 km (adequate reflection brightness, safety of laser look), the height of the plane on the platform from the earth is between 200-6000 ms. Cloudiness is a problem for clear flight conditions. Depending on the height from the earth, a change is observed in horizontal and vertical accuracy. Point diameter, spot (point-spot) distance is 1-5 ms [13].

The land surface mapping data LIDAR provides are far better than the ones provided by remote detection and other air systems. It is the most powerful scanning system in three-dimensional (x-y-z) distance measurement and defining the earth. By sensitively measuring the reflection time of the sent radiation by a near infrared (1064 nanometer) laser wave width, this technology stores the data in digital space. Compared to SAR views, it has a more capacity of detail defining in advanced surface modeling and showing spatial heights accurately (SYM). Numeric height models (DEM) acquired by LIDAR make it possible to put on the map a spatial unit of the earth and take quick decisions about the visual objects in this area (Figure 5).

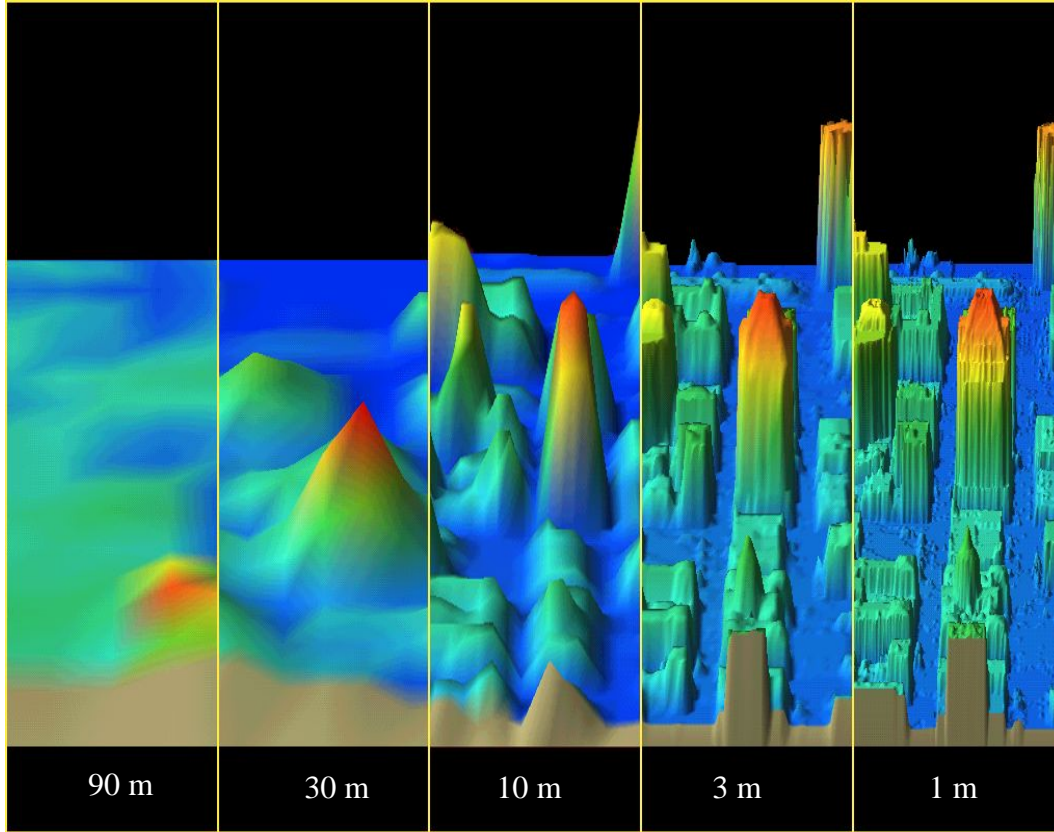


Figure 5. Visual depiction of the detail provided at five different spatial resolutions (URL 5)

(Şekil 5. Beş farklı spektral çözünürlükteki görüntünün detay tanımlamadaki gösterimi (URL 5))

4. USING AREAS OF LIDAR DATA (LIDAR VERİLERİNİN KULLANIM ALANLARI)

Using areas of LIDAR data are quite common. Land model, 3D city model, detection of coasts, detection of electricity line and forests are among these using areas. LIDAR scanning system which is especially common in three-dimensional surface measurement, numeric surface modeling, determining structural characteristics of land surface serves basically on these fields[12, 14, 15, 16, 17, 18, 19, 20 and 21];

- Numeric Mapping,
- Urban development (structural process, structure control, audit etc.),
- Disaster Planning,
- Transportation Planning,
- Substructure Planning,
- Natural Environment Analyzes,
- Numeric Land Models (DEM),
- Cartographic Maps,
- Land Use Maps,
- Water Resources and Distribution Maps,
- Analysis of Coast lines on the shores.

5. STRUCTURE CONTROL IN URBAN AREAS WITH THE HELP OF LIDAR DATA (LIDAR VERİLERİ YARDIMI İLE KENTSEL ALANLARDA YAPILAŞMA KONTROLÜ)

Today the countries are classified as “developed” and “developing” countries. One of the criteria that is used in classifying the countries as developing and developed is the position of settlement areas [22]. Parallel to the developments in technology and transporting service substructures, people living in rural areas are constantly moving to urban areas. In line with the increase in world population, this flow also triggers fast urbanization process. In industrialized countries, three-fourth of the population live in city center but in developing countries barely one-third of the population live in city centers. On the other hand, prior to year 2025 it is estimated that two-third of the world population will be living in the cities (World Atlas: 1998). Therefore, since migration towards cities will even be faster in developing countries, city administrators need to be more sensitive to these developments and be able to take quick decisions [23].

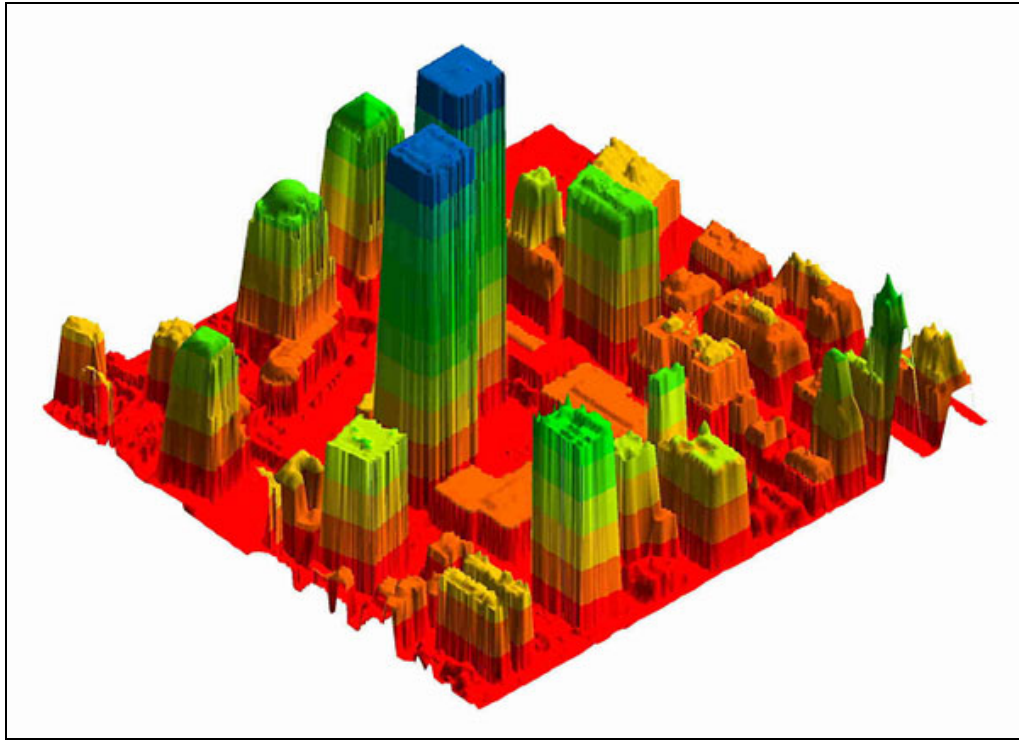


Figure 6. An urban area numeric height model made by Lidar technology (URL 6)

(Şekil 6. LIDAR Teknolojisiyle oluşturulmuş bir kentsel alan sayısal yükseklik modeli (URL 6))

Particularly in un-developed countries, one of the most important structural problems is the problem of shanty settlements. In the contiguous of the cities, shanty houses having no substructure (road, water, electricity, development, cadastre etc.) are rapidly built in literally one single night [24]. This situation brings with itself economical, social, physical, financial and technical problems as well. In local administrations where the development plans and cadastral substructure are outdated and where auditing is weak, structure density and auditing restrict city-dwellers' life standards and their attainment of the services.

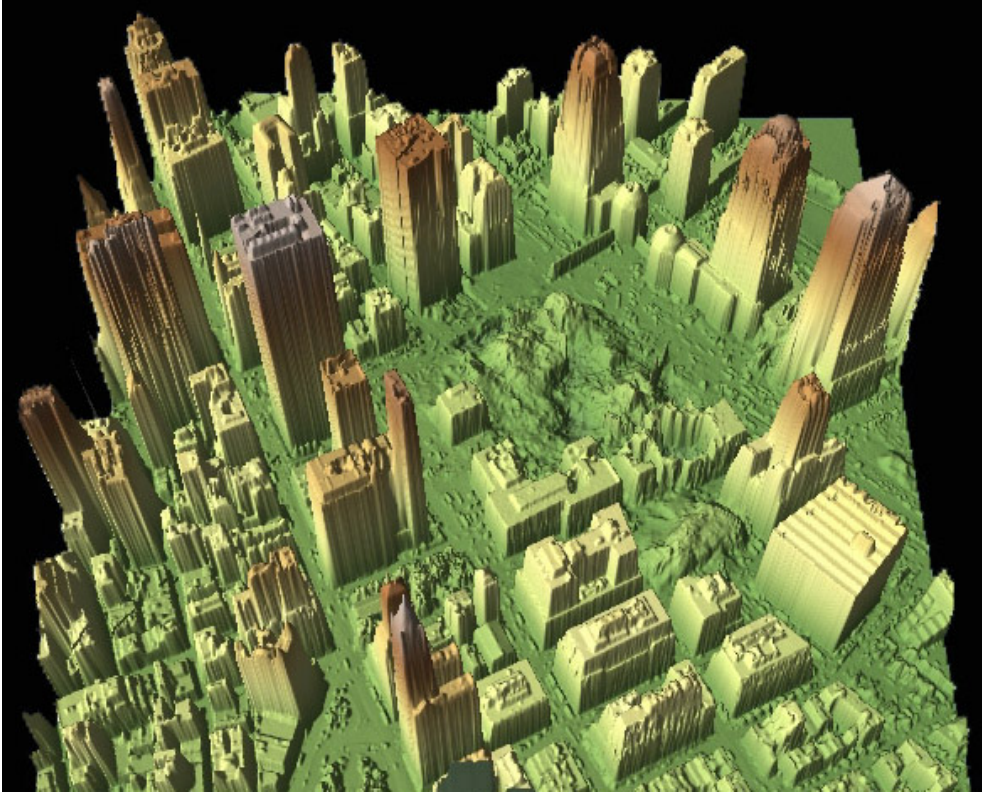


Figure 7. An urban area numeric height model made by lidar technology (URL 7)
(Şekil 7. LIDAR teknolojisi ile oluşturulmuş bir kentsel alan sayısal yükseklik modeli (URL 7))

Obtaining earth surface modeling with LIDAR numeric area models is a new and independent technology. At the same time, since it is reliable, questionable and open to details that can be continuously added, it makes it easier to do computer-supported data processes. One of the basic reasons of urbanization problems is the irregular urbanization caused by deficiency in planning.

Due to the reasons such as unavailability of country environmental plans for each region and low applicability possibilities of the available development plans (due to the reasons such as restoration, modification etc.), our cities have had to cope with the results of irregular urbanization.

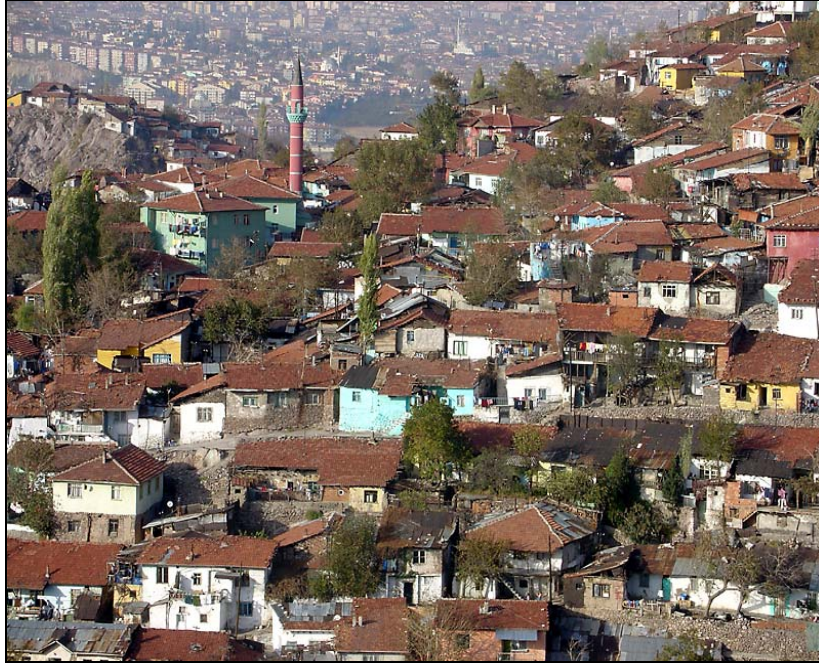


Figure 8. Sample of irregular urbanization (URL 8)
(Şekil 8. Kent içi çarpık kentleşme örneği (URL 8))



Figure 9. Sample of irregular urbanization (URL 9)
(Şekil 9. Çarpık kentleşme örneği (URL 9))

The data obtained by air LIDAR studies offers an accurate base for following the formation in city-environment relation, formation, and transformation and area distribution steps. Air LIDAR data with high resolution provides detailed and accurate information possibility in solving the substructure problems of road, transportation, water, sewage, rain water drainage which are all important for the life standards of city-dwellers.

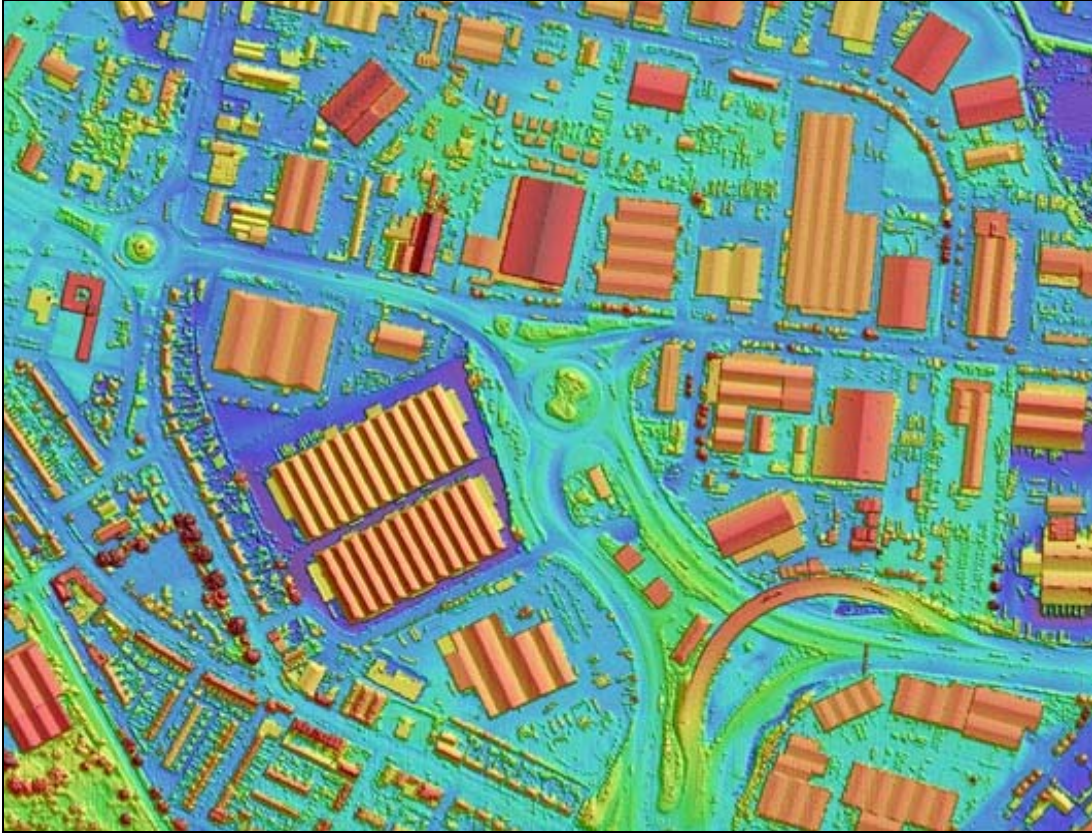


Figure 10. Structure following in urban area with the help of lidar data (URL 10)

(Şekil 10. LIDAR verisi yardımıyla Kentsel alanda yapılaşma takibi (URL 10))

Today there are many industrial and trade businesses in city centers. Since these businesses are irregularly and loosely founded, they became reasons for irregular urbanization.

Air LIDAR technology is a more different and developed technology than classical photogrammetric data generation. The physical conditions of the research area are vitally important in data generation with classical photogrammetric methods. The slope of the research area and its surface structure affect data quality. Data generation is only possible in day hours when the cloudiness is in its minimum level. The climate has a strong effect in data quality. Snow coverage on the surface or strong rain and wind change the quality of the view. Moreover classical photogrammetric data do not contain information concerning the floor's height. In order to form numeric height model (SYM) for area floor, raw data need to be supported by some processes.

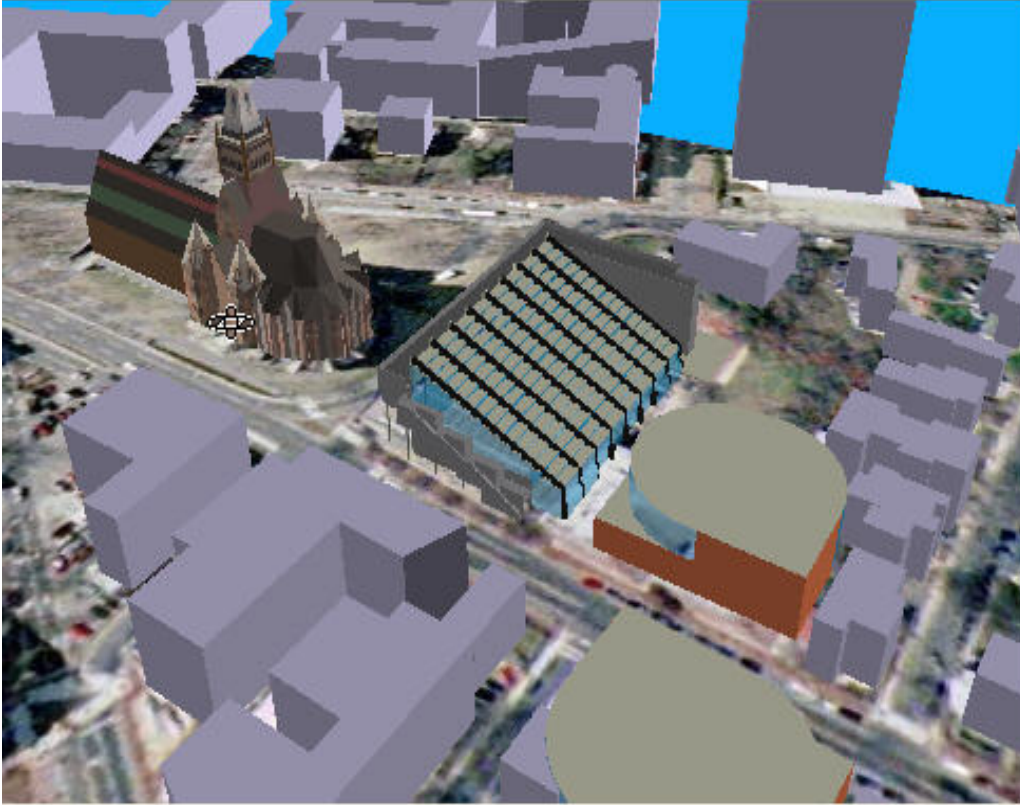


Figure 11. A SYM obtained by adding numeric structure lines to modeled (SAM) (URL 11)

(Şekil 11. Modellenen arazi modeline sayısallaştırılan bina hatlarının eklenmesiyle elde edilen görüntü (URL 11))

However with LIDAR technology, regardless of land structure and specifications, in every weather condition and each time of the day, numeric area models (SAM) can be formed. Particularly the researches that will be made in urban areas emphasize the importance of LIDAR technology. Numeric height data referenced geometrically in an accurate and suitable way enable exact structure control in urban areas.

6. CONCLUSION AND SUGGESTIONS (SONUÇ VE ÖNERİLER)

The 21st century we are living in is defined as the age of technology. As a result of the technological developments, compared to previous years it is now possible to obtain more up-to-date, sensitive, economical and fast data acquisition. It is a necessity of our age to use LIDAR technology in urban areas, especially for structure controlling, since this technology is much more advantageous than the maps prepared by classical methods. Intense emigration from rural to urban areas resulting from various reasons in all developing countries today brings about settlements which do not conform to rules. These illegal construction settlements make the controls which should be done from the surface of the earth difficult due to some reasons. In case that local administrations do not fulfill their responsibility in construction control in urban areas LIDAR technology makes it possible to control the central institutions. Unfortunately, to try to prevent the shanty settlements only by laws is inadequate in our country. So, to carry out the construction control in urban areas properly we should benefit from the technological developments as much as possible.



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