

The implementation of 3D urban cadastre based on aerial imagery by the real estate management ability in Tehran Metropolis

Mehdi Khoshboresh Masouleh *

M.Sc. Student in RS engineering, school of surveying and geospatial engineering, College of Engineering,
University of Tehran, Tehran, Iran

Saeed Sadeghian

Associate professor, Shahid Beheshti University, Tehran, Iran

Date of receive:95.05.29

Date of accept:97.03.27

Extended abstract

Introduction

Over the past two centuries, in many countries in the world, population density has dramatically grown in urban areas, resulting in cities to witness rising construction of multi-story apartment buildings and utilizing above and below ground spaces. Expansion of tower construction and development of infrastructure networks are among the obvious examples of using above and below ground spaces of cities. Today, in order to manage these complex structures, the urban managers use three-dimensional urban models to plan for the future of the city. The land information is considered as the basis for the development of each country; among other things, cadaster as a parcel-based land information system can accurately determine the status and location of the real estates. Unlike the traditional cadastral system, the 3D cadaster is capable of modeling such features as buildings considering the third dimension i.e. height, thereby establishing the access rights for owners, whether individuals or organizations. Currently, the real estate management model is one of the best and most efficient ones for the implementation of 3D cadaster, which is originally developed based on the unified modeling language (UML). Accordingly, the aim of the present research is to generate a 3D urban cadastral model using the aerial imagery to improve the real estate management in the metropolitan area of Tehran by taking an executive approach.

Materials and Methods

This is an applied research, therefore, in order to ensure that the results are close to the reality and to consider the current conditions of Tehran in terms of the information required, the instructions for the provision of spatial information of the municipality of Tehran are used in the scale of 1:1000 by the photogrammetry method and the coordinated instructions of the national mapping organization are used for the production of a 3D cadastral model. The study was conducted in the northwest of Tehran in zone 5, district 5 of Tehran municipality. Being located in the foothills with the favorable climate, convenient access and distinctive urban fabric has caused the region to have the highest growth in the population and physical body for the last two decades. Besides, the passage of the metro line 2 (the busiest metro line of Tehran) and the line 10 of BRT buses (including long bus lines) in zone 5 in the area of the second square of Sadeghieh and the heavy population density in this region are among the most important criteria for choosing this area for the implementation of research objectives. The data used in this research are divided into two

categories: spatial (geometric or situational) and descriptive data. Spatial data include aerial photogrammetric images (image pair) with 1:3000 scale using WILD-17126 cameras with the focal length of 303.40 mm and 0.5m contour interval under the UTM system, WGS84 reference ellipsoid and Ultracam XP digital camera images with the scale of 1:10,000.

Results and Discussion

Considering that the 1:1000 map of Tehran was prepared during 2010-2014 by the municipality of Tehran and used as a detailed map in Tehran city, the planimetric criteria and the matching of descriptive information and the criteria of height accuracy, field activity and production of accurate height data sets are done by land surveying of desired models. In order to evaluate the geometric accuracy of the model, the root mean square error (RMSE) and correlation coefficient (CC) were used. The results of the implementation on a total of three studied buildings show that the planimetric accuracy of the X and Y components were 1.451 m and 1.431 m for RMSE and 93.7% and 97.1% for CC, respectively. The accuracy of the height component with 2.605 m for RMSE and 66.5% for CC is consistent with the reference data. In addition, for analyzing the proposed research method, the model was compared with the object-oriented analysis, artificial neural network, manual digitization, and Khoshboresh&Sadeghian (2016) method, which was rated as appropriate, so that in only one case of planimetric accuracy and one case of height accuracy, the manual digitization method has better results than the proposed method.

Conclusion

Hence, it can be concluded that, although a 3D cadastral system has not been widely implemented in any country of the world, however, most countries seek to achieve such system by providing appropriate solutions, because as mentioned above, having such cadastral system, many problems related to land management and related crises can be solved. In this paper, the first prototype of 3D cadastral implementation in zone 5, district 5 of Tehran was analyzed using the large-scale digital aerial images. The results of this modeling show that the generated model matches the accuracy criteria properly.

Keywords: 3D Urban Cadastre, LADM, Aerial imagery, Urban management, Tehran metropolis.