APPLICATION OF GIS FOR THREE DIMENSIONAL ANALYSIS OF INTRA URBAN STRUCTURE

Kazutaka IWASAKI
Faculty of Information, Shizuoka University
3-5-1, Jouhoku, Hamamatsu-shi 432-8011
Japan
Phone & Fax: +81-53-478-1580
E-mail: *iwasaki@ia.inf.shizuoka.ac.jp*

Yuichi HASHIMOTO
Faculty of Letters, Hokkaido University
Kita-10, Nishi-7, Kita-ku, Sapporo 060-0810
Japan
Phone: +81-11-706-5555 Fax: +81-11-727-0142
E-mail: *you@chiri.let.hokudai.ac.jp*

KEYWORDS : GIS, Three Dimensional Graphics, Building Use Database, Quicktime movie, Obihiro City

ABSTRACT

Three dimensional database of building use in Central Obihiro City was created and displayed using three dimensional graphics and quicktime movies. Then intra structure of Central Obihiro City was analyzed based on this database using GIS and the results were also displayed using three dimensional graphics and quicktime movies.

1. INTRODUCTION

Three dimensional data such as floor-base building use can be stored as maps after being arranged by GIS (Geographical Information System) software. But these data are usually displayed only in two dimensional space and it is difficult to understand the distribution patterns of land use on each floor in a building intuitively. The results of trend surface analysis of the distribution pattern of building use or overlay analysis of assessed land value and building use are usually displayed in two dimensional space. These results might be easily understood if they are displayed in three dimensional space.

The objectives of this study are to create the three dimensional database of building use in Central Obihiro and to display one dimensional information in the database and the two dimensional information including the results of analysis, using three dimensional graphics and quicktime movies. finally the authors try to show a case study of creating a system analyzing the intra urban structure.

2. DATA AND METHOD

2.1 Data

Materials of three dimensional building use database in Central Obihiro City were obtained from the filed survey held in July, 1995. Land use on the first basement, first floor, third and six floor in the buildings was surveyed within the study area. polygon database was created in a workstation using ARC/INFO. In addition, the assessed land value data within the study area were collected and given as point data, then they were translated into contour data with 500,000 yen interval.

2.2 Method

At first, the three dimensional building use database in Central Obihiro City was created and displayed as three dimensional graphics on a personal computer system.

Then, trend surface analysis was made to reveal the building use pattern. Concretely, The area of each land use of each flour and the whole area of each floor were computed. And trend surface analysis was made for these dependent

variables. The X- and Y-coordinates of the point of gravity in each unit area are independent valuables.

Finally, overlay analysis was made to reveal the relationship between building use and assessed land value. 500 thousand yen interval contour data from 250 million yen through 850 million yen counter were created. Overlay analysis was made between these contour data and building use data. Building uses between each contour were then summed up.

3. CREATING THREE DIMENSIONAL GRAPHICS

3.1 Three Dimensional Graphics

Three dimensional graphics of building use was made based on the information picked up from the three dimensional database to reveal the land use of each floor in buildings. It is possible to obtain three dimensional information such as DXF file from the database created by GIS software (for example, Arc/Info by ESRI, USA), though, it is difficult to make landscape simulation of the interior of a city including the information of height of each building. Then, three dimensional maps of building use is created using Strata Vision3d (Strata, USA), from the two dimensional land use map of the internal city made by Arc/Info. Actually, it is easy to create animation from three dimensional map using the software and the three dimensional maps can be displayed effectively.

The process of creating three dimensional graphics based on two dimensional land use maps of the internal city which were put out by Arc/Info is shown in Figure 1.

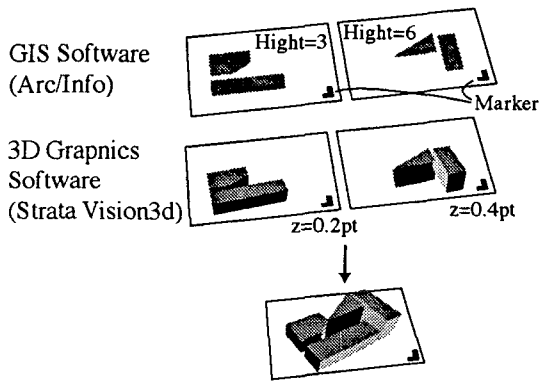

Figure 1. The process of creating three dimensional graphics.

As to the creation of three dimensional information, two dimensional graphics made by Arc/Info can easily read by Vision3d (Strata Vision3d), because Vision3d supports EPSF and Adobe Illustrator file format (you only choose "file", then "import" command on the display to import files). Then, texture which is the display defining the surface of the three dimensional model must de set up. Two dimensional graphics of each building use was made separately on Arc/Info to set texture up easily and lay the maps over on Vision3d.

The three dimensional model which was finally obtained, setting one floor height to 0.2 point, is shown in Figure 2.

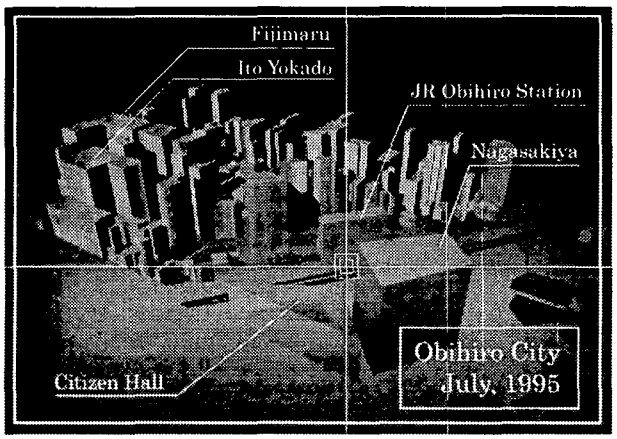

Figure 2. Three dimensional graphics of Central Obihiro City.

3.2 Animation

The view point of the three dimensional model which was obtained on Vision3d, can be freely set up and animation can be easily created. The process of making animation in which the view point goes around the model is described as follows.

The definition of the view point is placed using "Camera Tool". The location of the view point is defined as the location of camera, and the view angle is as the camera angle. To make "Camera Tool" go around the model, a circle should be drawn around the model, and the camera should go along the circle as shown in Figure 3. The operations after drawing a circle are as follows,

1. Choose "Path Translation" in "Animation" menu.
2. Set "new camera" as the object of "Path Translation".

"Rendering" should be operated to make quicktime movies as shown below.

1. Choose "Rendering"
2. Choose "Start Rendering"
3. Set each parameters.

"Lay Tracing" is chown as the rendering method in this study.

The animation is expected to be a better method than stationary graphics to display the results of spatial analyses.

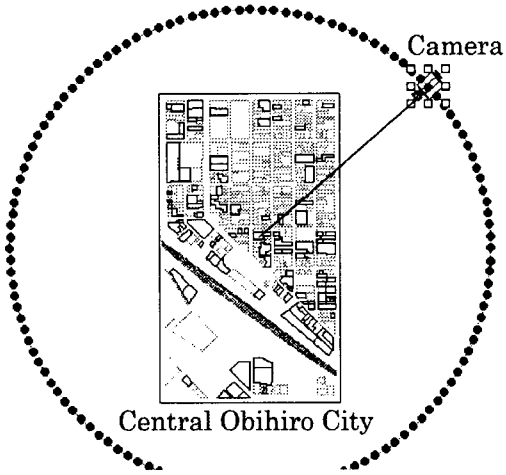

Figure 3. Camera Tool for creating three dimensional graphics.

4. TREND SURFACE ANALYSIS ON BUILDING USE

Next, trend surface analysis was placed to reveal the distribution pattern of land use in buildings. The independent variables are X- and Y-coordinates of the point of gravity in each unit area. The dependent variables are the whole area of one floor or all the floors of each land use. These variables were standardized before computing.

In previous studies, the different results were shown according to the difference of the shape or the distribution of town blocks, because the land use data such as the areas of floor of each use are collected in each town block. When mesh data are obtained, the results might be different according to the difference of mesh size or town block size. The floor areas of each land use in buildings are computed using the running mean method (Figure 4). The stable results can be obtained after removing the small fluctuations of the areas which are caused by the locations of mesh block lines. Comparing the raw 50m mesh data of each land use and the buffering 50m mesh data, the latter showed the better results in the first to tenth trend surfaces as shown in Figure 5.

Figure 6 shows the seventh trend surfaces computed when the whole areas of land use summed up for each buffer were used as the dependent variables.

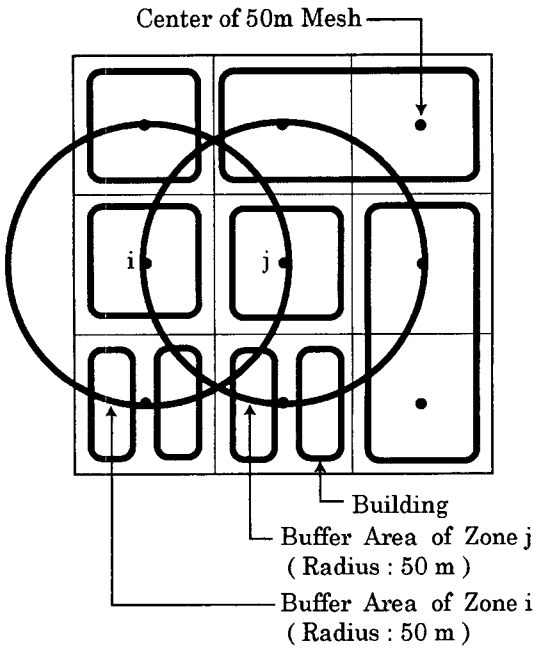

Figure 4. Buffer area of building use database.

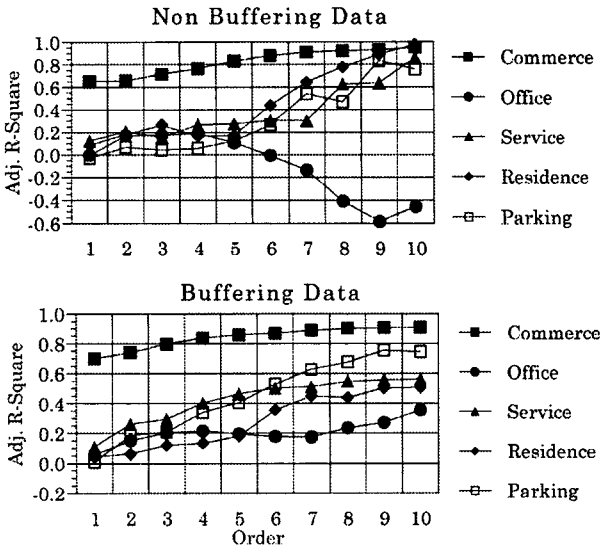

Figure 5. R-square of trend surface model (1st floor).

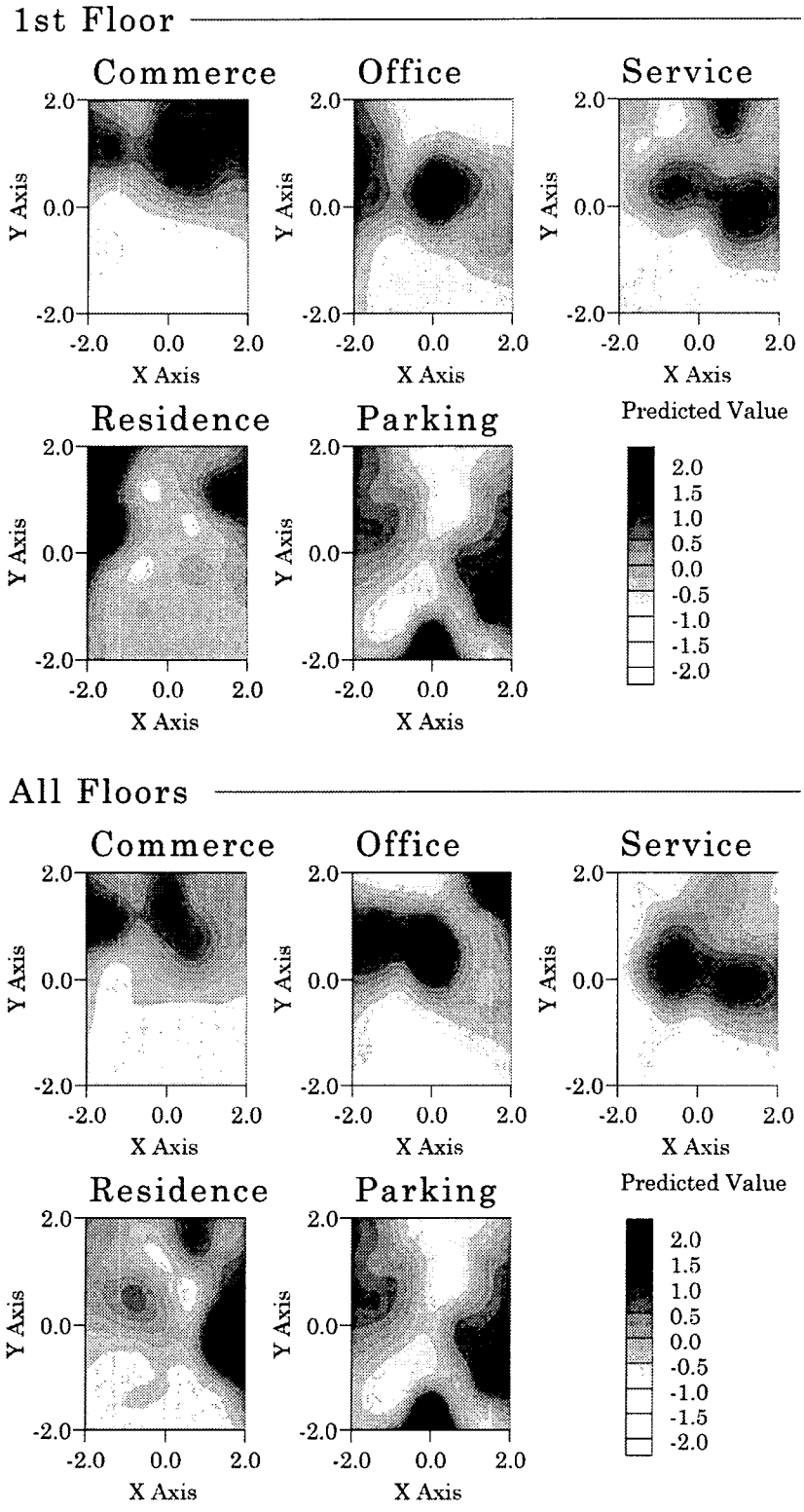

Figure 6. Predicted value of 7th order trend surface model.

5. OVERLAY ANALYSIS OF LAND USE AND LAND VALUE

Finally, overlay analysis was made to reveal the relationship between land use and assessed land value. The contour data of land value with 500 thousand yen interval were computed and were laid over on land use data in buildings. The results are shown in Figure 7.

6. CONCLUDING REMARKS

In this study, the authors showed the system of creating the three dimensional database of building use and displaying one dimensional information in the database or two dimensional information including the results of spatial analyses, using three dimensional graphics or quicktime movies. and they added the functions of analyzing the intra urban structure to the system and showed the results of analyses using motion pictures.

The results obtained in this study are creating the system of analyzing the intra urban structure, displaying the results with animation or computer graphics and making the use of the function of spatial analysis possible using GIS software. The authors examined the trend surface analysis and proposed a new method of urban analysis and added that function to the system of urban analysis.

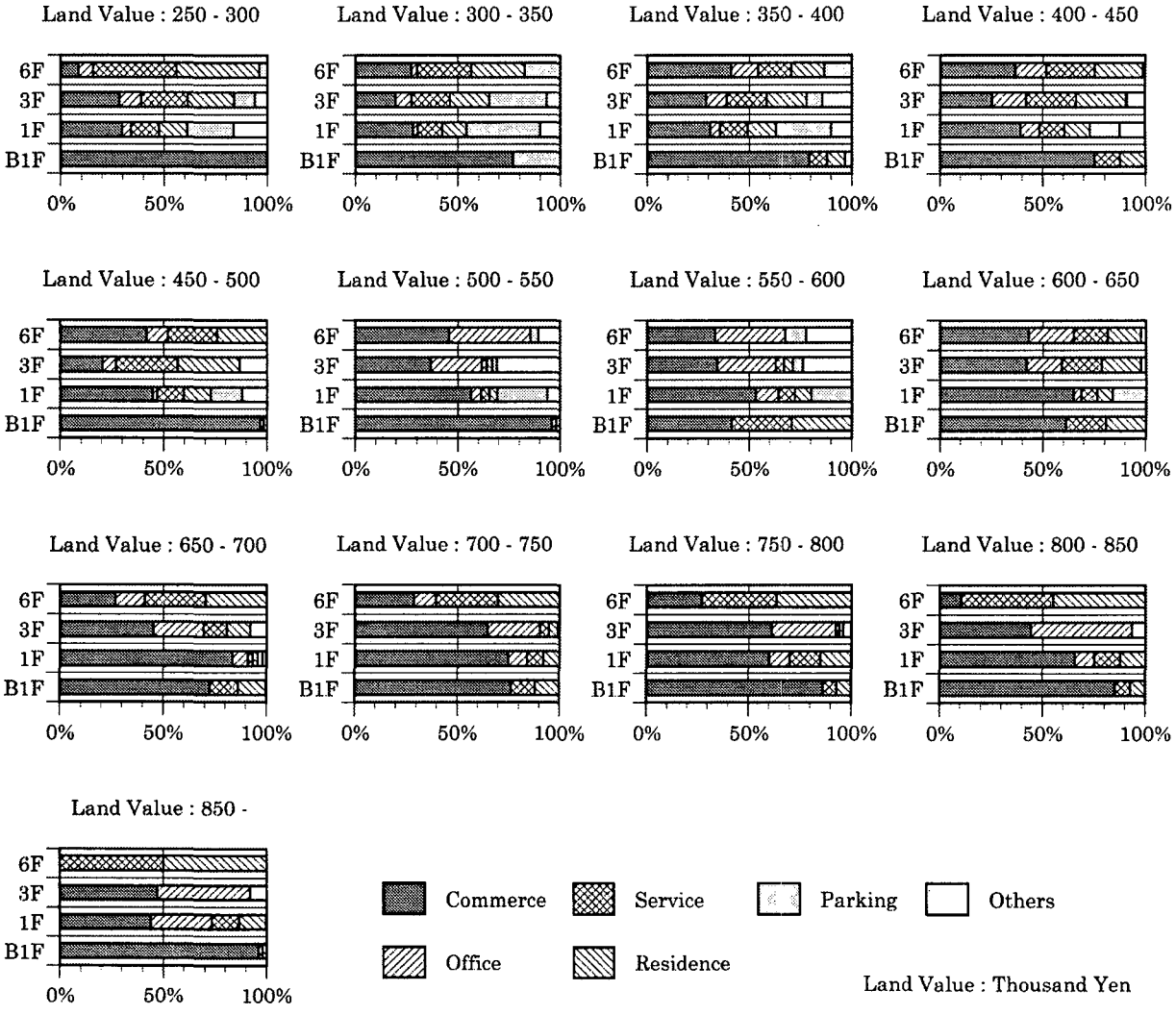

Figure 7. Proportion of building use by land value.