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## 人工衛星と社会地理情報を使ってのパソコンによる 地域特性調査について

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### Regional characteristics Investigation by Personal Computer Using Satellite, Social and Geographical Informations

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#### Abstract

This paper describes on development of evaluation system for regional characteristics by a personal computer and its peripheral equipments.

This system has following five functions; (1) Data Collection (2) Data Compilation (3) Satellite Data Processing (4) Image and Statistic Data Display (5) Evaluation for Regional Condition.

System configuration is as follows; a NEC PC9801 series personal computer as a main frame, a digitizer as an instrument in order to collect vector data from maps and frame memory as instrument in order to generate full color composite image. All of soft wares are controlled by a main menu program and each function is also controlled by a function control program.

In order to verify the above system effects, the authors have executed the case study in Hachioji area. Statistic materials, town planning map, town boundary map, topographic map and Landsat TM data as satellite data were prepared for this analysis as basic information. Distance evaluation image as the raster data was produced by the position data that belong to vector information.

In this study, the relationship between land-cover condition and the other informations was obtained for each town in order to investigate the regional characteristics. Through this system development and analysis, following conclusions were obtained; (1) Several kinds of vector data production were realized by the data collection function (2) Combined analysis with satellite and geographic data was confirmed to do well.

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## 1 Introduction

In city and regional planning, estimation and acquisition of the phenomena, related to the actual implementation of the plan, is important for the actual works to do the plan smoothly and effectively. At first it is necessary to collect regional informations and analyze them quantitatively. They are statistics of population and number of shops, police boxes, post offices and factories from the annual report and statistical manual of the city and it's regions and also include the spatial data related to the geography. In case of development the evaluation system using these regional informations, it is necessary to deliberate what kind of informations must select and collect and how to integrate and process such vast amount of data systematically.

Especially regional habitants are very much concerned to the environmental problems such as natural destruction in both regional and global area. The data of remote sensing are necessary to get and analyze these related data in long range and wider area. In actual works, data of remote sensing are used effectively to classify the land covering vegetation condition in temporal change and to analyze vitality of vegetation as a estimation index of environment. Here in this paper, the analysis for investigating regional characteristics is discussed. This paper also describes the case study for its verification using this developed system.

## 2 System Configuration

### 2.1 Overview of System

The actual works consist of data collection and its editing, processing works of Landsat data and evaluation of regional characteristics.

As I mentioned in the introduction, the data used in this study are classified in two categories, such as the geographical positioning data mainly obtained from topographical map and the statistical numerical data acquired from statistical manuals. The latter can be easily stored each file in computer as the data base, but the former is assembled with the large amount of position data which can acquired by a digitizer equipment and its accuracy of position affects directly to the regional planning. In the data process of Landsat and evaluation of regional characteristic, the process result and Landsat data are necessary to be displayed on the screen of TV monitor. But as the display color is only eight classes in the graphic function of personal computer, pseudo-color method is obliged to use in practical case to display much more colors as well as the color composite with false color. To display the pseudo color, the frame memory was used as function extension. The digitizer and frame

memory function are the main peripheral equipments in our study thinking compatibility and transferring of the system.

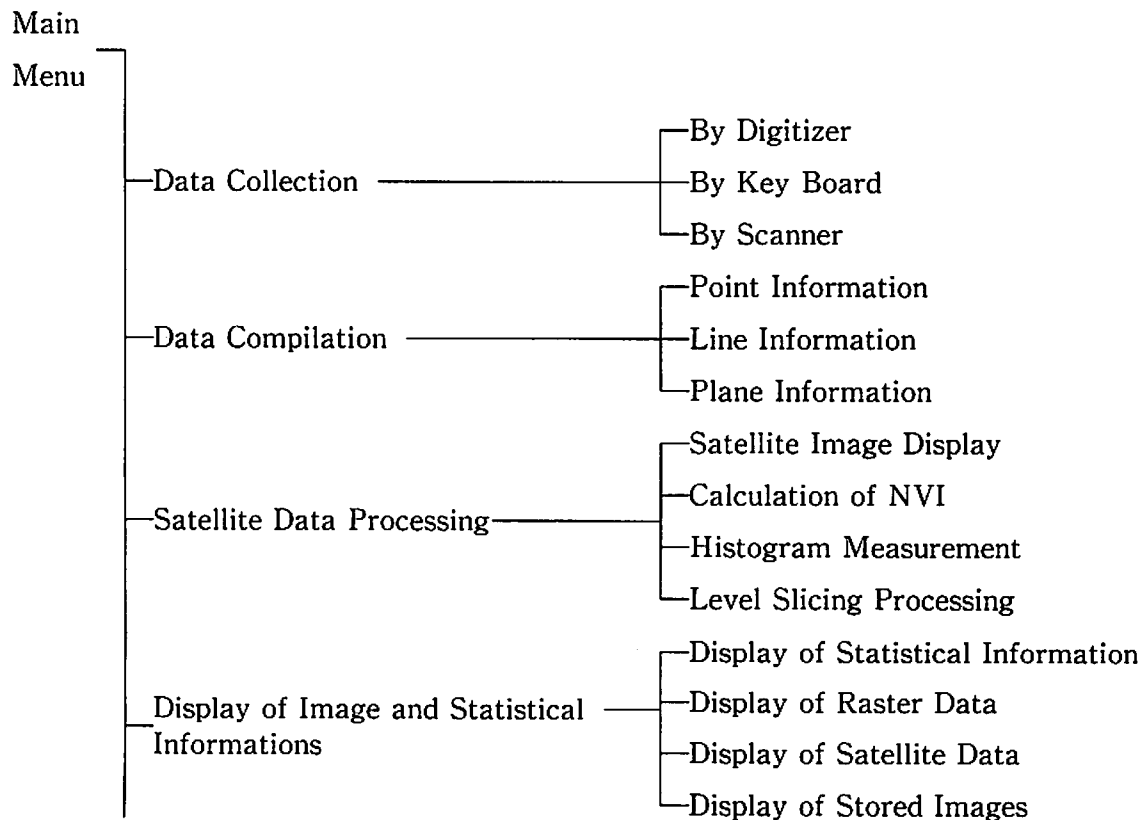
### 2.2 Hardware Configuration

As the personal computer, NEC PC9801 was used and as the digitizer, KD5050 model 2 of Graphtec Company and as frame memory, the super frame of Sapience Company.

The range of reading in digitizer extend within square area of about 500 mm size length and the reading accuracy is guaranteed in maximum  $\pm 0.025$  mm. Therefore, the data acquisition of positioning is capable of the topographical map published in the Geographical Survey Institute.

### 2.3 Software Configuration

Each process function has a software and as a whole integrated program are formed. In general, BASIC language is used in all programming but partly machine language. This system has been assembled taking advantage of merit of BASIC language having the its many graphic commands. All programs as well as the process function are controlled by menuprogram. Therefore the analyst can select optionally the process program from menu program in response to the necessity. The parameter also can be changed by the dialogue process of man-machine type. Fig 2. 1 shows the software configuration.



from satellite data, then land cover is classified with four vegetation cover conditions. This result is displayed on graphic display. As there is flicker display function between frame memory and graphic display, the integrated color image and the process result of level slice are alternatively displayed to put the result to practical use and the processing result is stored as bit pattern.

#### **2.3.4 Display of Image and Statistical Information**

The retrieval and its display of fundamental data are performed to evaluate the regional characteristic. In the display of statistical information data, statistical quantity of each town can be referred from their data file made in the process of data collection. In the display of raster data file, the images transferred into raster in the process of data compilation are displayed. The process in the display of satellite data is the same one as included in the process of satellite data. In the display of same images, the images stored by bit pattern are stored.

In this case the graphic images are displayed on the screen. After that, they show interchangeability with frame memory in the form of flicker display.

#### **2.3.5 Evaluation of Regional Characteristics**

Each fundamental data acquired through the following functions such as, data collection, compilation and satellite data processing are used for evaluating the regional characteristics. The evaluation procedures for each town are as follows ;

- (1) Town evaluation by statistical informations
- (2) Overlay processing
- (3) Masking Operation and its result summation
- (4) Integrated result summation

Concerning to the first item of processing works, the evaluation is executed from the statistical informations of each town and the result is classified in several grade. From the each town data in image data form, the town data of each grade are retrieved and displayed in color images and the town data also displayed at the same time.

In the second item concerned to the overlay processing, the overlaying addition calculation is performed using the two kinds of images already finished the processing works and the result is displayed in color following the classified grades.

In the third item, also the two kind of images of processed fundamental data, are used for masking operation, the one is for target, the other is for masking information and the result of adding calculation is displayed in a list. Then occupied coefficient (percent of pixel number occupied by the specific substance) are printed out in printing machine.

In the fourth item, the occupied coefficient of data value processed as images is calculated

and the result is printed out.

The result images of all processing works except the last item mentioned above, are capable to store in a form of bit pattern.

### 3 Example Analysis by This System

To examine the good and bad points of this system, the authors have tried the actual analysis using this system.

#### 3.1 Test Area

The test area covers in the same one sheet area as the national topographical map "HACHIOJI (scale 1/25,000) published by the Geographical Survey Institute (G. S. I). Construction Ministry. In this area, Hachioji built up area extends in the northern part in this map and the boundary of Sagamihara City is in the southern part. In the direction of South to North, the No. 16 national road and Yokohama Line of Japanese Railway Company are passing through, especially, recently the transfer of university to this area from center of Tokyo have brought the new land development and resulted the environmental change for aiming the new-era city planning. The area can reach in one hour drive by car forward western direction from center of Tokyo and still it is included in the great Tokyo area as the industrial zone and residential area. Therefore it is the good test area to compare the land-use control as a city with present land-covering.

#### 3.2 Data Collection and Compilation

The following data were collected for evaluating the regional characteristics.

- (1) City planning map, scale 1 : 20,000 published by Hachioji city authority
- (2) City map covering all Hachioji, scale 1 : 25,000 published by Hachioji city authority
- (3) City statistics data including all city general informations
- (4) National standard map of Hachioji, scale 1 : 25,000 published by G. S. I. Construction Ministry

From the city planning map of Hachioji, the following five kinds of the boundary numerical data are collected and transferred the vector data into raster form in order to use as plane data.

- (1) The first order restricted residential district
- (2) The second order restricted residential district
- (3) Residential District
- (4) Urban development area
- (5) District planning zone

The districts from (1) to (3) item are included in the land-use control district in district zone area. The districts from (4) to (5) are included in city planning district. Here the land-use control district is the area where the control is performed depending upon the usage purpose such as industry, commerce and residence. The control is executed mainly for the building of school, amusement facility and etc. . The city planning district is the designated area where needs to reserve to maintain the living and industrial environment in good condition of the control of land-use and city facilities are not adjustable. The first order restricted residential district defines as the designated area to protect the better residential environment and this area is allowed to build the flat level house. The second order restrict residential districted is allowed to build the medium and high storied houses. The residential district controls for the usage and utilization of the building different from the first and second order restricted residential district are controlled for the building structure.

The urban development area is the areas where are already built up as a city or is needed to give the priority for city built-up planning. The district planning zone is the district where is not efficient to cope with present city planning law and building standard law covering from the street zone to residential zone. This aims at controlling the plan to build up the city area where fulfilled a certain level of standard circumstance.

The city map of covering all Hachioji city was used to get the numerical boundary of thirty-seven towns in Hachioji city and such vector data was transformed into raster for using as the plane informations. The national topographical map published in G. S. I., Japanese Government was used for collecting the following three kind of informations and the distance evaluation images were made for utilizing as the plane information.

- (1) Geographical coordinates of elementary school (Point Information)
- (2) Geographical coordinates of station (Point Information)
- (3) Geographical position of national road (Line Information)

The distance evaluation images were obtained for three items mentioned above. This result image display in different colors for six steps which each steps width is almost 150m from the center of them. This six steps means 900m width which aims at surveying in this case. This width and steps can select depending upon the purpose of evaluation and test field condition. The city statistical data of Hachioji provide the numerical list of population, area, park, a number of shop employee.

These are recorded in secondary memory of computer as data bank for forming the data file.

### 3.3 Satellite Data Processing

The Landsat TM observed on Oct. 9, 1986 was used for analysis as a satellite data. As the preprocessing, the geometric correction was carried out for the area of 512 pixel x 400 line

on the general purpose computer. This shows the same area as the topographic map which corresponds to the plane data for analysis. The floppy disk used in this study records the data of band 2, 3, 4 and 5 out of TM seven bands.

The NVI (Normalized Vegetation Index) was calculated and surveyed the regional vegetation-covered condition.

The following formula was used for calculation :

$$\text{NVI} = \frac{\text{Band 4} - \text{Band 3}}{\text{Band 4} + \text{Band 3}} \times (\text{gain}) + (\text{offset}) \dots \dots \dots (1)$$

Here (gain)=100 and (offset)=50 and

Band 4 is the data of near infrared band and

Band 3 is the data of red band for visible region

The result of NVI calculation shows in histogram, one small peak in low value region and two big peaks in the more higher value region. This means, the NVI shows the gradual higher value in a order of water, non-vegetation and vegetation and coincide to the distribution of these items. Therefore the four classifications such as water, vegetation, non-vegetation area 1 and 2 were executed using the distribution curve by level slicing processing. (Here Non-vegetation area 1 and 2 classified depending upon the distribution of peak value) Comparing this result with the false color image corresponds to built-up city area and the residential area surrounding the built-up area.

### 3.4 Evaluation of Regional Characteristics

The following two processings have been executed, town evaluation by statistical informations, Masking operation and the result summation. There are main characteristic points in this system.

In the former process, each town evaluation for population density was analyzed as one example. This processing orders are as follows ; (1) Calculation of population density from population and area (unit ; ha) (2) Grade for each town by the above population density data (3) Coloring for each grade using town boundary raster data (4) Computation the statistics for the result of grading. This result concluded, the highest density area is mainly located around J. R. Hachioji Station. The other high density area is in Kinugaoka district where the area of town corresponds to New Town development area. That means, this residential area corresponds to the same area as Kinugaoka district of an administrative zone. Most of towns in southern part shows the low density.

As the next step, the relationship of population density and vegetation covering was examined by combining the result of grading of population density and NVI. As the results,



the high density towns coincides in general to the non-vegetation area. This means, the large buildings and factories are condensed in this high density districts. In the low density area, most of area is a vegetation area, but only few area confirmed to be non-vegetation area. Comparing the topographical map and its result, this area corresponds to the campus and facilities of university.

In the second analysis, the relationship between land-use control zone and vegetation condition was investigated. The first order restricted residential district shows the higher percentage of vegetation zone than the second one. This conclusion comes from the fact, the first order controls to the zone related to the low height building and the second to the medium and high building.

#### 4 Conclusion and Future Trend

In this newly developed system mentioned in this paper, there are mainly three processing categories, such as data collection, satellite data analysis and evaluation of regional characteristics.

In the process of data collection, the geographical numerical informations could acquired easily from the topographic map and the other materials by using the digitizer. Data transformation from the vector data into raster data have efficiently completed by using three kinds of data type such as point, line and plane informations. The statistical data were filed up each town in the form of data base, but in the processing works to transform from vector data to raster, the execution time was constrained because of having used the graphic plane and BASIC language of personal computer. This still remains to revise this system in future.

In the processing works of satellite data, the land coverage condition was obtained by level slicing processing using NVI. In future, the temporal change of vegetation coverage is to be surveyed using the above simple method, but in order to survey the more detail land-coverage conditions, another method such as multi-spectral classification must be assembled in this system. In this small scale and low cost system, it is enough to use practically because anybody even a layman can manipulate following the manual note. And also the high level engineers, can follow this system by adding the new program and new system created by themselves.

In the evaluation processing of regional characteristics. The main points of this system are as follows: Using the different types of data such as processed satellite data, geographical and statistical informations, the integrated analysis was completed. Especially by displaying

the color coded image based on the result of grading by the statistical data and the false color image from satellite data on the screen in a form of flickering way, the relationship between statistical data as an non-visual data and land-cover condition could be discussed by the sense of visual.

This system has been developed in a continuing form as a series of tool from the data collection to its processing. The analysis, described in this paper, is only one example for the system applications. There are still some revising points compiling to the new age of computer and other analysis method. The authors hope to have your suggestions and advice on this matter.

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