A Study on Method of DGPS Applications for the Cadastral Surveying

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SUMMARY

In Korea, a DGPS beacon system was implemented at the coastal area for the marine ship navigation purpose at the beginning but it will be applicable for a variety of fields of geodetic, construction and bathymetry, GIS surveying and so on. The study focuses on suggesting the practical possibility of DGPS in the cadastral survey. To do this, several field tests have been conducted and the conclusions are as follows;

First, it was shown that the accuracy in horizontal components averages 74cm in the readjustment of arable land and 228cm, the forest, respectively.

Second, in the forest, the rate of Differential GPS Fix of Beacon DGPS is low, however HDOP(Horizontal Dilution of Precision) is high.

Third, DGPS doesn't cover the cadastral boundary surveying, however it will be expected that possibility to play a role as a part of device for the ubiquitous cadastre, such as finding control points and boundary points, connected with PDA, RFID on the site could be obtained. And also, this study shows that DGPS will be applicable for high-precision-position-based services like LBS(Location Based Service), and ubiquitous cadastral surveying.

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1. INTRODUCTION

The existent GPS land registration survey method is base on mostly Static Survey method using two-frequency receiver. And precise coordinate outcomes are produced through afterward treatment process.

Meanwhile many studies have been conducting to utilize RTK-GPS survey method which provides swiftness as well as convenience for land registration survey however it is difficult to be facilitated with this instrument because the instrument is expensive in price and big in volume.

The objective of this study is to make it possible to conduct the actual field job in the land registration sector with a far cheaper facility by utilizing DGPS technology replacing the existent two frequency receiver. This study also suggests the way to examine precision level, diverse availability and exploiting measures.

2. MODERN DGPS SATELLITE SYSTEMS

DGPS (Differential Global Positioning Service) is a navigational system using the GPS system of satellites that circle the earth plus ground stations with limited signal range. The combination provides greater accuracy than GPS alone. DGPS requires receivers for both GPS and DGPS signals. DGPS according to a system, it can classify together with the following table1.

< Table 1 > The classification according to a DGPS system

	LADGPS	CDGPS	WADGPS
Method	Code-base	Carrier-base	Code/Carrier-base
Accuracy	meter	Centimeter	meter
Coverage	~200 ㎞	20~30 ㎞	~1000 ㎞
Reference Data	RTCM 1/9	RTCM 18~21 RTCM 3 Raw Data	Error correction vector
Techniques	DGPS IDGPS	Kinematic (RTK/Semi Static)	WAAS
Applications	Navigation	Survey	Aviation
Reference Type	Single Reference		Multi-Reference

Wide Area Augmentation System, or WAAS, is a new satellite-based navigation system built by the U.S. government (FAA) for boating and supplementary navigation for aircraft. It is designed for aircraft landing and has position accuracy as good as 3 ~ 7 meters. This will be the best electronic navigation system for recreational users, with GPS a close second.

WAAS-enhanced GPS receivers will be not much more expensive than GPS receivers. This should be much more widely used than DGPS, which is only useful around the U.S. and Canadian coastlines. WAAS corrects GPS signals from the 24 orbiting GPS satellites, which can be in error because of satellite orbit and clock drift or signal delays caused by the atmosphere and ionosphere. GPS signals can also be disrupted by jamming.

WAAS consists of about 25 ground reference stations in the United States that monitor GPS satellite data. Two master stations collect data from this reference stations, assesses signal validity, computes corrections and creates the WAAS correction message. The corrected differential message is then broadcast through two geostationary satellites orbiting over the equator to all WAAS enhanced GPS receivers on the GPS L1 frequency. These satellite each cover a hemisphere, except for polar region. The receiver combines the GPS signals with the WAAS message to arrive at a more accurate position.

Currently, WAAS coverage is only available in North America. Access to the signal is free. WAAS signal reception is ideal for open land and marine applications. WAAS provides extended coverage both inland and offshore compared to the land-based DGPS. Also, WAAS does not require additional receiving equipment; DGPS does.

Other countries are developing compatible systems: the Japanese Multi-Functional Satellite Augmentation System (MSAS), and the Euro Geostationary Navigation Overlay Service (EGNOS). Eventually, GPS users around the world will be able to get accurate position data using similar systems.

3. AN EXPERIMENT AND ANALYSIS

An experiment compares the results of the existing Carrier phase-based post-processing DGPS and a real-time code based DGPS at an arrangement area and a forests-and-fields area. It is a thing for verifying the application possibility propriety of a DGPS survey system.

Now, it is generally an object for precision land surveys. Although GPS Receiver (L1/L2) used by post-processing systems, such as a control point survey on base of the high degree of correctness. But it has the demerit many expense to purchase and users cannot use easily.

In this study, two categories of land use in accordance with the environment, the category of arranged crop field land and forest land was opted for experiment. This two categorized land was for the experiment of beacon DGPS which is a kind of code DGPS and is in service by The Ministry of Maritime Affairs And Fisheries, Korea and of MSAS of Japan which is a kind of SBAS type.

MSAS used a multiple-purpose traffic satellite, MTSAT (Multi-functional Transport Satellite) which is a geostationary satellite discharged by the National Space Development Agency of Japan and an aeronautics-and-astronautics research-and-development instrument. It started formal operation on June 28, 2005.

In this type supplemented data receiving is available by the L-Band corresponding receiver. The precision level is not known yet, but it is presumed to be similar with in case of WASS. However, Although South Korea and China belong to the receivable coverage of electric wave compensation information of MTSAT. Since there is no ground country, The degree of precision can fall a little.

This study opted Gimpo City and Bucheon City in Gyeonggi Province which are located near time standard station of the beacon GPS as the experimental locality .this study describes diverse locality determination experiments conducted at these localities.

3.1 Experiment Outline

It selected the experiment area which is a near from Beacon-DGPS Standard Office and also carried out various positioning experiments according to Work Environment. The research which saw through this is going to make comparative Analysis of the Positioning Nature Gained by RTK-GPS Etc, an existing supplementary control result and Beacon DGPS The Code GPS by using the Receiver for SBAS

For this reason, first they obtained the supplementary control result by stop survey (static GPS) which was constituted GPS An observation network by the supplementary control and Ministry of Government Administration and Home Affairs GPS observatories at experiment region. Second It computed the supplementary control result of redeployment-of-arable-land area by Beacon DGPS compensation data which carried out Ministry of Maritime Affairs and Fisheries. Third It computed the supplementary control result which carried by the receiver for SBAS, and Finally It compared and analyzed the degree of precision and the surveying station gained by each survey system.

The acquisition of control point coordinate consisted of Carrier phase based post-processing DGPS system using system 500(Leica co.). The initiative processing and analysis of the observed GPS primitive data was carried out using common software, TGO (Trimble Geomatics Office). It analyzed for the coordinate result based on the result of initiative-interpretation and the network control with TGO and carried out coordinate change for comparison with a figure of datum point.

3.2 Experiment Equipment

Equipment used for experiment is the following picture (Fig.1). It is one apparatus beacon DGPS so that it may be 5-1. DGPS equipment and SBAS equipment for reception were used

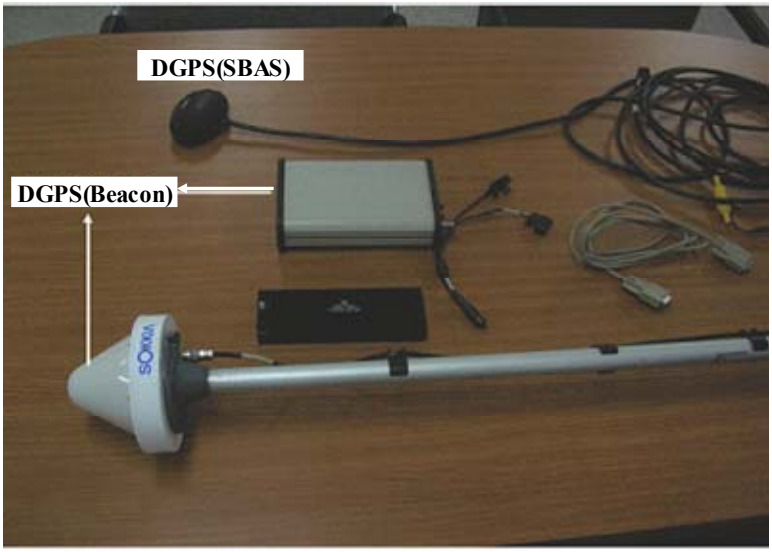

Fig. 1 DGPS equipment used for experiment

3.2.1 Beacon DGPS Equipment

Beacon DGPS Experiment equipment was used with one apparatus receiver Sokkia's DGPS. Because Axis3 unified with one set of a receiver and an antenna by 12 channels, Beacon with L1 GPS receiver and the satellite signal, there was no need the special cable used with the existing product. it can use.

Fig 2 Beacon DGPS One apparatus receiver Axis 3(Sokkia Co.)

3.2.2 SBAS Equipment

An Equipment used for the SBAS experiment in a satellite compensation system utilized CSI-wireless's Seres which could get SBAS (WAAS, EGNOS, MSAS) signal reception. Seres is a GPS receiver which 12 channels L1, a C/A code, and carrier phase (carrier phase) reception are possible and it is the receiver for integration which can be gained simultaneously SBAS and a satellite signal

Fig. 3 Seres SBAS Reception equipment (CSI-wireless Co.)

3.2.3 Data Link Equipment

RTK-GPS survey generally receives many influences to the output of a transmitter (radio modem). On this experiment, the medium for a compensation data transmission used Pacific Crest's PDL radio model. PDL has 2W Radio transmitter with RF output the direct-current country between 9V and 16V. It has the above transmitting range 10km.

Fig. 4 Compensation data-communications medium - PDL (Pacific Crest Co.)

3.3 Degree Experiment of Correctness

An experiment previously after carrying out a carrier post-processing DGPS survey carried out SBAS positioning and Beacon DGPS positioning experiment. Present, SBAS positioning is not generalized and is very trifling state. this positioning system does not build at home and serves but since the satellite base compensation data service system (MSAS) currently managed in Japan is used. It is an indispensable element for a smooth experiment to maintain the compensation data transmitting state between a receiver and a satellite.

Because this experiment had not had a precedence research example in the country, It experimented after examining beforehand the case where this experiment can generate procedure and the method. An arrangement area (Fig. 5) and region of the city (Fig. 6) it experimented. The base map is 1/1,000 numerical-value indication.

Fig. 5 land consolidation experiment

Fig. 6 region of city experiment

- The comparison of outcomes of DGPS from beacon DGPS and SBAS receiver each on the supplementary control point at land consolidation most precise1.28m, average 4.2m in case of beacon DGPS, most precise 18cm, average 74cm in case of SBAS receiver).

- The comparison and the outcomes of DGPS from beacon DGPS and SBAS receiver each, at forest land (at a tomb site): The analysis of the relation between the number of SVs(sattelite vehicles), HDOP(horizontal dilution of precision), and horizontal locality differential.

- The average differential GPS fixing rate: 21.76% in case of beacon DGPS, 94.42% in case of SBAS receiver, the average horizontal locality differential is 9.768m in case of beacon DGPS, 2.288m in case of SBAS receiver.

- The analysis of the relation between the number of SVs versus HDOP and average RMS of the fixed data through the analysis of original data.

4. METHOD PROPOSAL OF LAND OWNERSHIP SURVEY PRACTICAL USE

According to the experiment of a book, In the case of code DGPS, It will be a level ingredient if how many receiving environment is secured. RMS (Root-mean-square)'s the degree of correctness averages. Although it dose not utilizable for the land ownership survey which the following takes the high degree of precision 1m, it seems to be able to utilize for real time or quick geographical feature information construction, and the precision navigation field very in efficiency.

4.1 Application of Control point Management Cooperated with RFID Technology

Actually, In Order to carry out and patch to the Indication Field, it is Real-time Control point in spot. It is utilizable for the ubiquitous Digital Indication Field which cooperated with it being electronic marker (RFID: Radio Frequency ID) Etc.

There are many problems in management and investigation of the present in the investigation and administration of indication land datum point. It is installed in the area where land movement is expected at a land ownership survey package nature plan and a land boundary dispute dictionary prevention dimension, In order to manage and maintenance, it is investigating preservation and the forgetfulness situation once a year or more

Although it is being easy to check the position of a datum point around the center of the city referring a building, the address, a road form, etc, it is difficulty for a farm village area to investigate by reference network map because of no geographical feature in the surroundings

Every year the increase in quantity establishment of control point had it difficulty in investigating to a whole control point conducting on-site investigation in the period and it processes by the cage of being prefect without the package initiation investigation. There are cases in actually loss the control point but it recorded on the result table by the preservation state. it is very high in the frequency to loss damage of control point caused by water and sewage, and road pavement construction.

4.2 Utilize for Standard Store Management

RFID is to solve management situation and problem of such a control point and is going to show the solution for management and utilization about Information over point systematically by inserting it is tag on indication control point cover.

4.2.1 RFID maker Manufacture

Manufactured RFID maker is largely composed of three sections: projection cover, tag-cover and underlay. Taking form the existing control point maker and Electric Wave Signal was Often Made to be Penetrated,

Fig. 7 Self-manufactured RFID marker

4.4.2 Embodiment System

Instead of Existing maker, RFID electronic maker is installed. Each UFID(Unique Feature Identifier) is allowed. This code is composed of reading a code through RFID equipment and checking the information on a point from a server through radio communications by a portable survey person.

It had the composition of constituted the system which cooperated with DGPS to find for searching a control point on the spot at this time. The overall system processing composition Island is as follows.

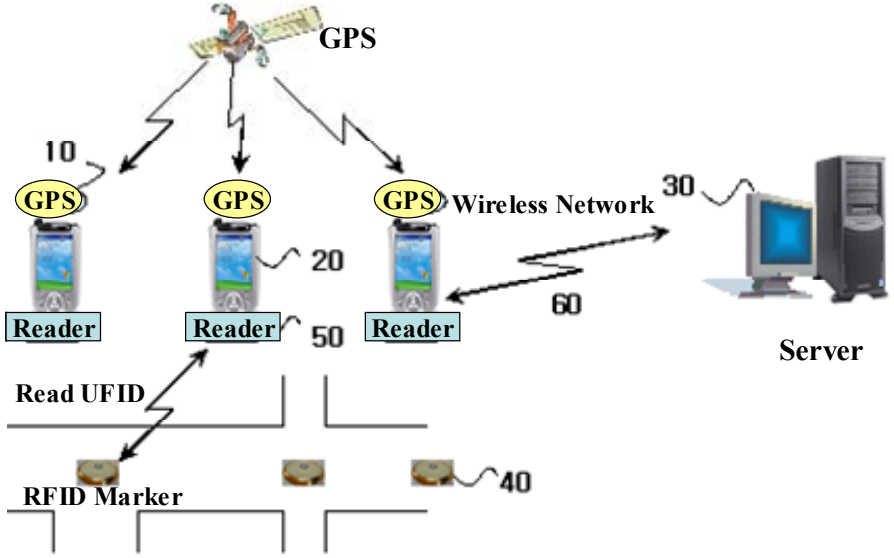

Fig. 8 Proposal system diagram

- A small GPS receiver (10) which receives an artificial satellite signal from GPS on the left upper portion. It carries in PDA (20).

- Send the position coordinates acquired from the GPS receiver to a server (30) through cordless communication (60).

- Control point outline-information which is in the circumference schedule radius of a position by the transmitting receiving from server (30) about a position Standard stores are displayed also for the numerical geographical feature by which was transmitted to PDA (20) and loading was carried out above.

- Checking a position at the control point which is going to look for this screen at a base, a user supports so that the maximum proximity may be carried out and it can search.

- Through (50) a RFID leader, it adhered to PDA (20) from the control point looked for. After recognizing peculiar ID of a control point, It checked for the information on the history

of transmitting receptacle point from a detailed control point with a control point server (30) through cordless communication (60), Then it is automatically updated a user inquiry information and can be indicated and registered a special unique matter etc.

- Because such a series of system environment can be immediately asked without the necessity of checking and investigating control point information beforehand on the spot, the correction matter and the contents of a check of the control point are immediately updated by real-time processing and are automated. The efficiency can be expected to separate control point investigation work and management.

5. CONCLUSION

By this time research, the suggestion is that the application of cadastral field can be used widely through DGPS experiment. The result of experiment showed the possibility of graphical cadastral survey, the searching for control point and navigation functions. Probably related experiment to which range for Application of Future were expanded more and carried out, the research on new application model development must be continue.

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BIOGRAPHICAL NOTES

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