

SYSTEM ARCHITECTURE OF THE TELEMATICS POSITIONING TESTBED

Youngmin Kim, Bongsoo Kim, Wansik Choi
Telematics & USN Research Division, ETRI
161 Gajeong-dong Yuseong-gu, Daejeon 305-350, Korea
kimarang@etri.re.kr, bskim@etri.re.kr, choiws@etri.re.kr

ABSTRACT:

The telematics positioning testbed is an infrastructure to test and verify positioning technology, the sub-component of telematics system. The positioning testbed provides the environment of performance analysis for acquisition of static and dynamic positioning information using telematics vehicle.

This testbed consists of onboard positioning system, positioning reference station and lab positioning server. The onboard positioning system equipped in telematics vehicle, consists of target positioning system, reference positioning system, and analysis tool. A equipment acquiring high precision positioning data obtained from GPS combined with IMU was set as a reference positioning system. Analysis tool compares observed positioning data with high precision positioning information from a reference positioning system, and processes positioning information. Positioning reference station is RTK system used for reducing atmosphere error, and it transmits corrected information to reference positioning system. Positioning server which is located at laboratory manages positioning database and provides monitoring data to integrated testbed operating system.

It is expected that the testbed supports commercialization of telematics technology and services, integrated testing among component technology and verification.

KEY WORDS: telematics, positioning, testbed

1. THE TELEMATICS POSITIONING TECHNOLOGY

The telematics positioning technology is technology for measuring position and velocity of itself. This is representative component technology of telematics, which this is being made efficient use widely at various telematics part - checking up position of the vehicle, course guidance, vehicle tracking, M-commerce, and so on. In the past, the positioning technology for checking up position of vehicle used INS(Inertial Navigation System) and DR(Dead Reckoning) such a method as position calculating by measuring movement distance and direction of the vehicle using sensor - gyroscope, accelerometer, and odometer. Recently, this technology is using such wireless positioning as position calculating by trigonometry using radio wave, which this wireless positioning can provide absolute positioning information as well as no cumulative error by time.

At this time, the development of wireless positioning technology is progressing toward direction using system applying the existing network, system applying the new independent network, and system applying the GPS(Global Positioning System). Generally, the method performing wireless positioning is could classify with method based network, terminal, dedicated network, and GPS, which this distributes as follows. First, there are AOA(Angle of Arrival) method calculating position by measuring arrival angle of signal from a terminal to a base station, and TDOA(Time Difference of Arrival)

method using relative difference of a wave arrival time from two base stations.

The performance of positioning system demanded at telematics terminal of a vehicle is having high quality, miniaturization, and light weight by steps. Specially, the light weight system of a vehicle's terminal have tendency devising a light contents through centralization of a map database as well as direction making lower power feeding and integrated circuit of hardware. Through these miniaturization and light weight system, the vehicle's telematics terminal is evolving into a portable information terminal be used when an individual go on foot as well as information terminal be used in the vehicle. And there is being risen necessity of the indoor and field positioning system considering portability.

2. THE TENDENCY OF TESTBED AND TECHNOLOGY AT HOME AND ABROAD

The GNSS(Global Navigation Satellite System) is system providing wireless positioning service using satellite in worldwide, which there is GPS of U.S.A and GLONASS of Russia.

U.S.A developed wireless positioning system using satellite, and finally accomplished perfect construction of GPS in 1993. In addition, Because U.S.A removed S/A(Selective Availability) of GPS Satellite in 2005. 5, the positioning accuracy was improved than the past. Therefore, the GPS application range will be increased

more. Russia operated positioning system having portion of satellite in monetary difficulties, but announced GLONASS-M plan that would completed perfect construction using long lived new style satellite. Also, Europe is pursuing GLLILEO project, is progressing development for furnishing commercial service since 2008. Australia is executing mobile marketing using LBS(Location Based Service) called Seeker Wireless through furnishing the positioning information of a moving user by SMS(Short Message Service) or user information change of web site. This service's feature not depends on GPS information, offers reliable positioning information applying network and handset using GSM(Global System for Mobile Communication), CDMA(Code Division Multiple Access), 3G technology. Japan generalized propagation of vehicle navigation system using GPS, which accumulated a foundation technology constructing the telematics testbed by furnishing free service for the main traffic report and navigation at government dimension since the late 1990s. Also, Japan is constructing a telematics model city, and is carrying out technology development and service related a traffic problem, environment, safety, information offer, and so on.

The sixty telematics companies of the whole world are taking part in the telematics valley of Sweden. This companies constructed telematics testbed at Göteborg of Sweden, these are testing and verifying various applications. And these are pursuing nourishment of telematics cluster providing business chance through mutual cooperation of various companies like automobile, terminal, mobile communication, component technology, and so on.

ERTICO pursued 3GT(3rd Generation Telematics) project since 2002. A formed consortium of terminal, mobile communication, and automobile company constructed telematics testbed, which is testing mutual compatibility of service on terminal platform. At this time, this testbed is constructed by consortium organized with Belgium, France, Italy, Germany, Sweden, and Netherlands.

Generally, the internal positioning technology depends on only GPS technology. The study about seamless positioning technology for positioning service at signal block area is not enough. The Samsung Electronics is developing cellular phone positioning technology based mobile communication network, A-GPS(Assisted GPS) technology based GPS, and combining technology of these. Also, this company is developing indoor positioning technology using signal intensity of WLAN(Wireless Local Area Network) and PNS(Personal/Pedestrian Navigation System) using inertial sensor with Seoul National University. The National Defense and Science Institute developed the integrated GPS(Global Positioning System)/INS(Inertial Navigation System) positioning technology. The Navicom developed GPS receiver using to Mozen as telematics service of Hyundai-Motor, and GPS/DR(Dead Reckoning) algorithm based Host, is furnishing this. The

federation of LG electronics, ETRI(Electronics and Telecommunications Research Institute), Navicom, Micro Infinity, and Phychips is developing high precision positioning component realizing SIP(System in Package) with GPS L1/L2C RF(Radio Frequency), baseband chip, MEMS(Micro Electro Mechanical System) Gyroscope chip.

3. THE DEVELOPMENT OF THE TELEMATICS POSITIONING TESTBED

The telematics positioning testbed is technology for performance test and verification of positioning system(module) a part of telematics system component technology. This provides commercialization of telematics technology and service.

The positioning testbed get divided into indoor and field testbed. The indoor testbed furnishes environment of performance analysis for acquisition and monitoring of static positioning information. The field testbed furnishes environment of mobile test analysis for dynamic positioning information with telematics test vehicle.

In the positioning testbed, we embody RTK and the reference positioning test equipment using vehicle. Also, we develop the positioning accuracy operating system for this testbed, test methodology and test procedure about positioning equipment. Here, the positioning accuracy operating system acquires and processes the positioning test data of the reference and target positioning equipment in real time, compares and verifies with performance of each positioning system, and perform storage and management of the positioning test data.

The performance estimation method of positioning testbed compares and analyze performance of the target positioning system(equipment) on base the high precision positioning information having positioning error by less than ten centimetres. This information is acquired from RTK system and integrated IMU(Inertial Measurement Unit)/GPS system.

The block diagram of positioning testbed, constructing in this paper, is shown at figure 1.

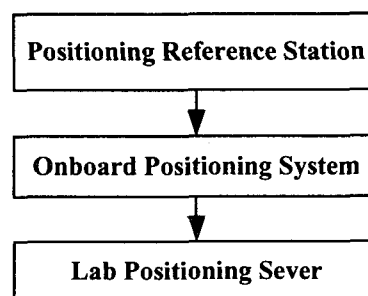


Figure 1. Block Diagram of the Telematics Positioning Testbed

This telematics positioning testbed consists of Positioning Reference Station, Onboard Positioning System and Lab Positioning Server.

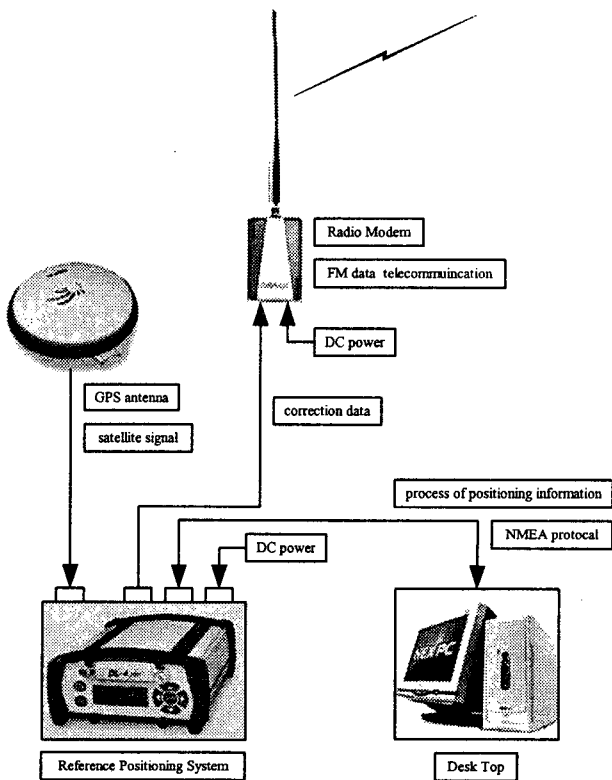


Figure 2. Configuration of Positioning Reference Station

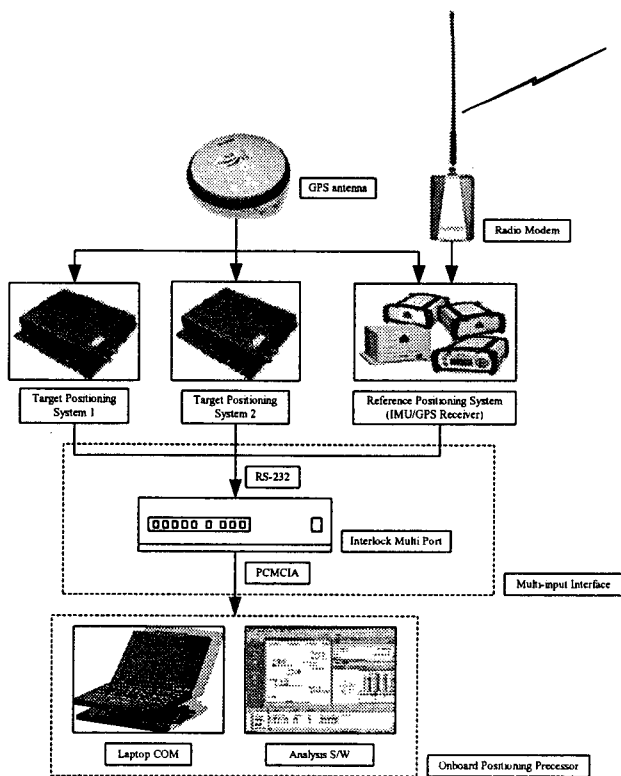


Figure 3. Configuration of Onboard Positioning System

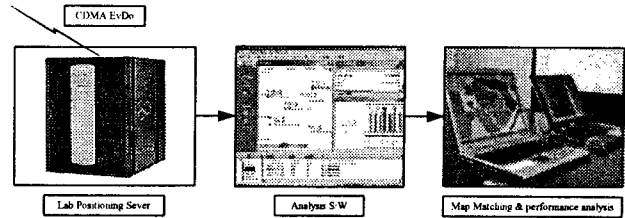


Figure 4. Configuration of Lab Positioning Sever

The configuration of Positioning Reference Station is shown at figure 2. This is RTK(Real Time Kinematic) system, transmits correction data for reducing atmosphere error to Reference Positioning System of the Onboard Positioning System.

The configuration of Onboard Positioning System is shown at figure 3. This is equipped in telematics test vehicle, consists of target positioning system(module), Reference Positioning System, and analysis tool. Here, the Reference Positioning System is equipment acquiring high precision positioning data obtained from integrated GPS and IMU(Inertial Measurement Unit). The analysis tool analyzes and processes the positioning information.

The configuration of Lab Positioning Sever is shown at figure 4. This is located at laboratory testbed, manages positioning database and provides monitoring data to integrated testbed operating system.

The development purpose of positioning testbed operating technology is that verifies utility of positioning system(module) about telematics service through performance test using the test instrument and the operating system. The detail content of this runs as follows.

- Realization of high precision positioning testbed using telematics positioning technology
- Performance test and verification of the positioning system(module) using the positioning testbed
- The test objects are the reference positioning system and the target positioning system(module)
- The operating system technology based GUI(Graphic User Interface) contain test management, test execution, and testbed management

4. EXPECTED OUTCOME AND CONCLUSION

The principal ability and feature of the positioning testbed is that provides high precision position and time information(the basis of the positioning testbed) from middle class integrated IMU/GPS and the reference positioning system using RTK for providing correction data. And this is that executes positioning accuracy test, TTFF(time to first fix) test, performance verification test and normal operating test of a target positioning system.

. Also, this testbed is having utility and effect that provides test environment for performance verification of a positioning system(module) like that high precision reference positioning information in error by less than ten centimeters, environment for real time monitoring and performance analysis of a time synchronized reference station and a target positioning system(module).

REFERENCES

B.S. Kim, S.Y. Lee, I.S. Jang, J.W. Lee, S.G. Hong, Y.M. Kim, W.S. Choi, J.H. Park, 2005. 6. "Status Report of Telematics Testbed Technologies," Electronics and Telecommunications tendency analysis.

H. Y. YOO, T.G. Kim, 1999. 8. "A tendency of wireless positioning technology development," korea radio promotion association.

T. G. Sung, 2003. 7. "Telematics and Wireless Positioning Technology".

N. K. Kim, 2003. 6. "GPS Receiver Performance Verification Method".

ION STD 101 Recommended Test Procedures For GPS Receivers Revision C : 27 January 1997.