APPLICATION MULTI - GNSS TO DETERMINE OBJECTS COORDINATES AND EVALUATION OF ACCURACY LOCATION

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In the 21st century, there is a question of the need to develop and improve the global navigation system, as well as its components, in accordance with the ever-increasing demand of the user, and the development of other systems based on the use of GNSS (global navigation satellite system). However, it requires improvement and equipment by obtaining receipt, sending, processing information in accordance with the need (satellites, modules, chips, chips, transmitters, etc.). An important role in the modernization of existing systems plays the creation of new GNSS constellations (with launches such as Galileo and Beidou), and reforming the old (such as GPS and GLONASS). Multi-GNSS has been created to perform tasks for upgrading and improving the existing global navigation system. This is a system that can calculate the speed and position of the object, also time receiving signals from satellites, which in turn are positioned in various navigation satellite systems. Taking into account the fact that new "multi-star" multi-range receivers are based on several signals (but they can use one frequency band), there is a possibility of determining and partial (complete) exclusion of the effect of ionospheric error on the resulting measurements (data). However, most commercial units of the GNSS mass market use only a simultaneous band to obtain positioning, speed, time (PVT): or GPS L1 C / A, or Galileo E1 and GLONASS G1. For example, chips (modules) that support multiple constellations, but only on one frequency band. This approach reduces the cost of designing and provides the lowest energy consumption, but neglects the advantages of broadband processing of signals, which provides increased reliability due to two simultaneous methods of frequency strip. Another approach to implement a lot of frequency decisions is to combine various chips for an analog interface and a digital base strip. One fully integrated single-character analog multi-band interface for simultaneous reception of GPS L1 / L5, Galileo E1 / E5 and GLONASS, which are also the advantage of this system.

Thus, the benefits of the Multi-GNSS system can be attributed:

1) Achieving large accuracy of positioning with an increase in the number of satellites involved in contrast to positioning exclusively GPS.

2) an increase in the protection against errors with a variety of frequency ranges, such as GPS L1 C / A and Glonass L1OF.

3) the possibility of adjusting (creating) positioning in difficult conditions (cities, darkened areas, etc.). Also where it is difficult to install GPS positioning.

Relevant applications from Multi-GNSS:

• Automobile navigation systems (navigation / information and entertainment systems, ECALL, ERA-GLONASS, etc.).

• Intelligent transport systems (monitoring of vehicles, etc.).

• Geographical information systems (computerized construction works, etc.).

• Location-based services (enhanced reality applications, etc.).

• Annexes with accurate time (time transfer, etc.).

• Systems for managing natural disasters (monitoring of seismic jumps and landslides, monitoring the dam, etc.). Which is especially important in countries that have the greatest level of natural disasters.

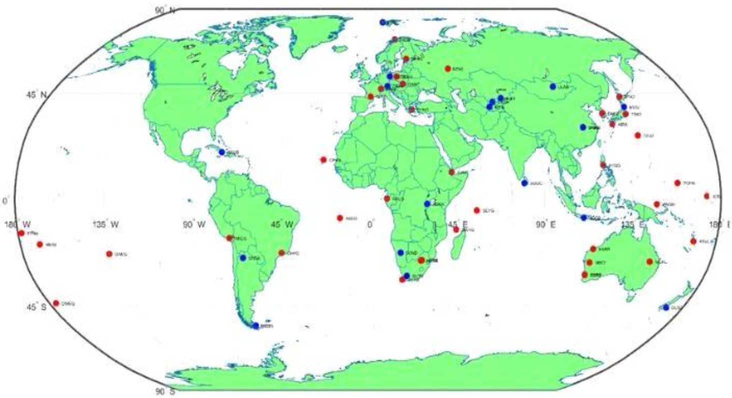

Fig.1. Map of Multi-GNSS multichannel stations.

Over the past few years, Multi-GNSS system actively developed in international space. Particular attention should be paid to the regions of Asia and Oceania - a unique place where the number of useful and modernized navigation satellites increases in much faster than in other parts of the world. We see a significant improvement in the possibility of location, navigation and time (PNT), support for hardware, software, algorithms and programs to meet users' needs.

To date, satellite systems are used everywhere in many spheres for simplifying human life and solving a large number of tasks associated with navigation, scientific research (cartography, geodesy, tectonics, radiation and much more), data transfer, communication, and communication. A number of other important tasks in the modern, rapidly developing technological world.

Practical application of one of the most prominent modern developments - Global Positioning System positioning systems (Global Positioning System), the accuracy of the location of the object depends on the extent of an error that occurs when measuring distances from the terminal to satellites. From the degree of influence of a number of factors, it depends on how definitely determines the location of the GPS receiver, this error will be one meter or a dozen, and even a hundred meters [7]. To factors that directly affect the degree of error can be attributed to the following:

1) Special error (SA) (used for civil receivers);

2) the quality of satellite geometry (location of satellites relative to the receiver);

3) gravitational influences (minor deviations from the orbit to be corrected);

4) the influence of the ionosphere (and the change in the magnitude of this impact during the day);

5) the influence of troposphere (and change in the magnitude of this impact during the day);

6) reflection of signals (scattering, overlay, attenuation);

7) the relativity of measuring time (based on the theory of relativity);

8) rounding and computing errors (various programs and calculation methods);

The typical accuracy of modern GPS receivers in a horizontal plane is approximately 6-8 meters with good visibility of satellites and the use of correction algorithms. On the territory of the United States, Canada, Japan, PRC, European Union and India are WAAS, EGNOS, MSAS stations, which transmit corrections for differential mode, which in turn allows you to reduce errors up to 1-2 meters in the territory of these countries. When using more complex differential modes, accuracy of coordinates can be brought to 10 cm. The accuracy of any CNS strongly depends on the openness of space, from the height of the satellites used above the horizon [6].

The accuracy of the synchronization according to Galileo signals is 30 ns with a probability of 95% on any daily interval. A separate parameter is transmitted to the discrepancy between GPS and GST scales. Regarding the measured accuracy of setting the location (coordinates) of a certain object, the Galileo satellite system will repeat the basic parameters of the GPS system in this direction.

On the example of GPS and Galileo systems, an accuracy of the location of an object (receiver) is evaluated in this paper according to the data recorded within three hours of continuous operation of the system. For further transformation and read information by the program, as well as the assessment of the estimated comparison of the accuracy and error of GPS and Galileo systems with actual work in not modulated, and a real environment with a plurality of factors affecting the process.

he ellipse of errors is an iso-contour of Gauss distribution and allows you to visualize a two-dimensional confidence interval. This confidence ellipse defines an area that contains 95% of all samples that can be obtained from the basic Gauss distribution. According to the results, we can conclude that the deviation and differences on accuracy (on the data record interval in three hours) are present. This is especially noticeable on the values that are small. 2 go beyond 99% line, which is classified as a period with deviations (certain factors affect accuracy). In our case, this factor was the number of satellites of the system, which were simultaneously located in the receiver's operation zone. Thus, on the schedule of deviations (Fig.3), you can observe the same deviations at the beginning of the measurement (in the area of operation a lot of satellites), with fairly good deviations in the center (the largest number of satellites in the receiver's operation zone at the same time), and quite strong deviations. During the data recording (the smallest number of satellites in the receiver's operation zone simultaneously) [5].

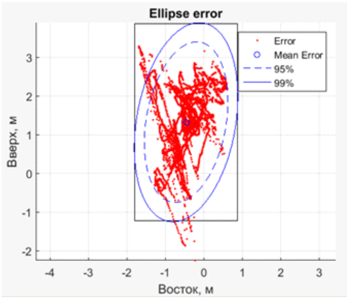

Fig. 2. Ellipse bugs

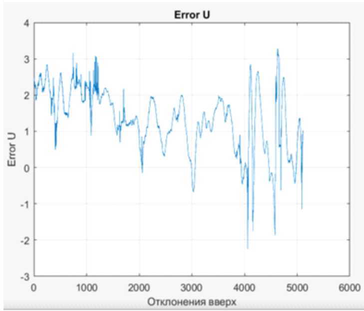

Fig. 3. A schedule of deviations

It is worth noting that a topocentric coordinate system was used. The beginning of the topocentric system is at a certain point of observations (in our case - the location of the receiver), and the axis is parallel to the corresponding geocentric coordinate systems.

Also, with these data to assess the comparison of the real and modulated result:

RMS is a statistical concept, a measure of deviation from mathematical expectation for a data set. How this set is formed - depends on the manufacturer. STD "Forecasting" acts as an assistant when working and analyzing the satellite data. From the features you can distinguish the assessment of information using a standard deviation method. Thus, by using the method of calculating the ellipse of errors, we can take into account a large number of factors during computations of various processes. That significantly increases the accuracy of computing and the results obtained.

References:

1. Величко М. Ю., Володницька К.А. Правила технічної експлуатації навігаційних комплексів державної авіації України (нац.док.). Київ н/Д: Видав-во Київ, Держ. Об. Пр., 2015. 3,4 с.

2. Мельников В. П., Клейменов С. А., Петраков А. М. Інформаційний посібник обслуговування: навч. посібник. М.: Флінта, 2016. 51 с.

3. Рубіль К. Д. Глобальні системи навігації. Одеса н/Д: Видав-во Одеса, зав.роз.тех., 2010.15 с.

4. Фельдман Г. В. Определение координат. Ростов н/Д: Изд-во. Рост, ин-та, 2012. 80 с.

5. Канаян К.А, Канаян Р.А. Навігаційні розрахунки. Харків н/Д: Видав-во Харк, ХАІ, 2017. 10 с.

6. Семенец В. О., Трухин М. П. Основи GNSS // ISSN 2409-5419 (2412—1363). doi: 10.24411 /2409-5419-2018-10070. С. 4-12.

7. Виговський С. О., Галаш М.П. Супутникова навігація. Харків н/Д: Видав-во Харк, ін-та, 2018. 12,20 с.

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