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Beidou GNSS Global Precision New Space-time Micro-system and Universal Intelligent Application

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Abstract

This paper mainly studies the application of Beidou ranging measurement signal evaluation and precision single point positioning. First, it analyzes the basic principles of Beidou distance measurement signal evaluation, and discusses three contents: signal-to-noise ratio, multi-path effect and Beidou precision single point positioning. Then, a Beidou GNSS precision positioning system structure is proposed and analyzed from the positioning principle, GNSS / INS / DR algorithm.Then, the specific application trend of Beidou GNSS is specifically analyzed. Finally, the positioning analysis and the future specific application of Beidou are summarized from the ranging signal evaluation and the development of Beidou positioning system.

Keywords

Beidou Ranging; Signal to Noise Ratio; Multi-path Effect; Single Point Positioning; Beidou Application.

1. Introduction

"beidou" with the Chinese people to space, modern Chinese people realize the ancestors using the big dipper identification direction dream, China's beidou also become a GPS, GLONASS after the third mature satellite navigation system, however, in today's information age, the us government of zte pledge almost destroyed our communications industry, we have to admit that China technology still and the world leading has a certain distance.Especially in the field of satellite navigation, until 2017 beidou meter navigation technology breakthrough, in economic growth shift, traditional industrial upgrading, driven by the old and new kinetic energy conversion, cm positioning precision will inevitably become many industries difficult to break through the technical bottleneck, low cost, high reliability and multiple system fusion cm level high precision navigation is blank in the world.Today, China related with satellite navigation system is in the development stage, colleges and universities and related research departments gradually improve the attention of the beidou system, using scientific research, strengthen the development and construction of beidou navigation system, carry out their respective research direction and focus on signal, beidou system and speed, etc., ensure the accuracy of GPS precision single point positioning, using the corresponding means, to ensure that the beidou navigation system can run smoothly in the field of domestic and international navigation.

2. Basic Principle of Beidou Distance Measuring Signal Evaluation

2.1 SNR

To realize the evaluation of the beidou distance signal, the receiver antenna to complete the operation, ensure the beidou satellite signal can be received, the electromagnetic waves can be converted into current signal and voltage signal, meet the requirements of receiver radio frequency and ensure that processing and front-end acquisition can be smoothly, to ensure that the receiver can determine the source of information, complete the reception of the beidou satellite signal.Secondly, it can be

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analyzed according to the actual performance of the receiver to ensure the reception frequency of the antenna signal. If it presents a relatively weak state, the strong and weak noise can be used to predict the actual quality of the signal, so that the quality of the signal can be evaluated by the signal-to-noise ratio.At this point, if the definition of SNR is planned as noise function N and signal function PR, the ratio between the two, the expression can be used:

$$\begin{cases} \mathrm{SNR} = \dfrac{\mathrm{PR}}{\mathrm{N}} \\ \mathrm{N} = \mathrm{KTB} \end{cases}$$

As shown above, where T is the noise temperature; the actual unit of N is planned as W; B is planned as the noise bandwidth; K is planned as the Boltzmann constant; thus the actual value is calculated as 1.38 * 10-23J/K.

2.2 Multipath Effect

The actual value of the receiver antenna can be determined by Beidou positioning, and the satellite emits the relevant electromagnetic wave, so as to calculate the electromagnetic waves that can be received and the signals generated by the surrounding objects.In this way, the reflection method can be used to ensure that the signal can stack by itself, and complete the antenna reception by reaching the direct wave one or more times near the antenna signal.This method reduces the error generated during the noise measurement, confirms the carrier phase and pseudo distance, so that the multi-path error will not appear a large phenomenon[1].

2.3 Beidou Precision Single-point Positioning

According to domestic time as the benchmark, the accuracy of local reference signal is guaranteed, and the Beidou space signal is used to receive relevant information, so as to ensure the accuracy of Beidou precision single point positioning and realize the confirmation of data collection unit by connection.This ensures that there is no difference between phase observation and Beidou pseudo distance, thus setting the corresponding equation as:

$$\begin{cases} \mathrm{p} = \mathrm{P} + \mathrm{cdtr} - \mathrm{cdts} + \mathrm{dtrop} + \mathrm{dmult/p} + \varepsilon\mathrm{p} \\ \mathrm{L} = \mathrm{P} + \mathrm{cdtr} - \mathrm{cdts} + \mathrm{dtrop} - \mathrm{dion}/\varphi + \mathrm{P} + \\ \quad +\mathrm{cdtr} - \mathrm{cdts} + \mathrm{dtrop}\varphi + \lambda\mathrm{Ni} + \epsilon\varphi \end{cases}$$

As shown above, L can be set to the phase observation value according to the frequency, can be planned as the frequency of B, both units can be planned as m; exists as the clock difference of the receiver; is the satellite clock correction item; is the deviation value; is the flow layer delay; is different degrees of carrier; the error for the observation value; phase ambiguity$\mathrm{Pcdtrcdtrdion}/\varphi\mathrm{dtropdtrop}\epsilon\varphi\lambda\mathrm{Ni}$[2].

Therefore, the actual state of the Beidou measurement receiver has a certain correlation with the time benchmark, which can ensure that the standard time frequency signal will not be affected in the operation process, promote the collection of the computer and the related operation of the receiver, to ensure that the location deviation of the receiving antenna and the local actual deviation value, prompting the satellite orbit and clock difference and other related products[3].

3. Test, Analysis and Evaluation of Beidou Ranging Signal

3.1 Range Measurement Signal Assessment

Through the national time benchmark, realize the evaluation of beidou ranging signal, ensure the accuracy of precision single point positioning, and ensure the frequency in the standard time signal is controlled in 10MHz, make it can be placed in the national timing center clock room, and ensure

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the storage environment, temperature, humidity can meet the requirements, the temperature planning for 25 degrees Celsius, the humidity can be planned for 60%.On this basis, the Beidou data processing software can be used to complete various operations, and the accuracy of the data results can be guaranteed through experimental research[4]. In this context, first of all, the sampling method can be analyzed according to the daily Beidou observation data, and the time can be controlled within 30s to ensure that all signals can be received by the receiver, meet the signal-to-noise ratio requirements of the Beidou observation signals, and realize the analysis and processing of multiple paths.Second, according to the actual changes of the beidou ranging signal analysis, ensure the height Angle value is controlled within a reasonable limit, to ensure that the CEO satellite can maintain with the ground stationary state, make the range of satellite height Angle change is controlled in a small range, to make the satellite height Angle is planned within 3 degrees, realize the evaluation of the beidou ranging signal[5].

3.2 Beidou Precision Single-point Positioning

According to the March 2017 GPS observation data and beidou sampling interval analysis, in 30s, for example, create the international multi-mode GNSS experiment engineering data, precision clock products and precision track can run smoothly, and realize the receiver antenna coordinates, ensure the accuracy of precision single point experiment, to confirm the results of the data (as shown in Figure 1)[6].

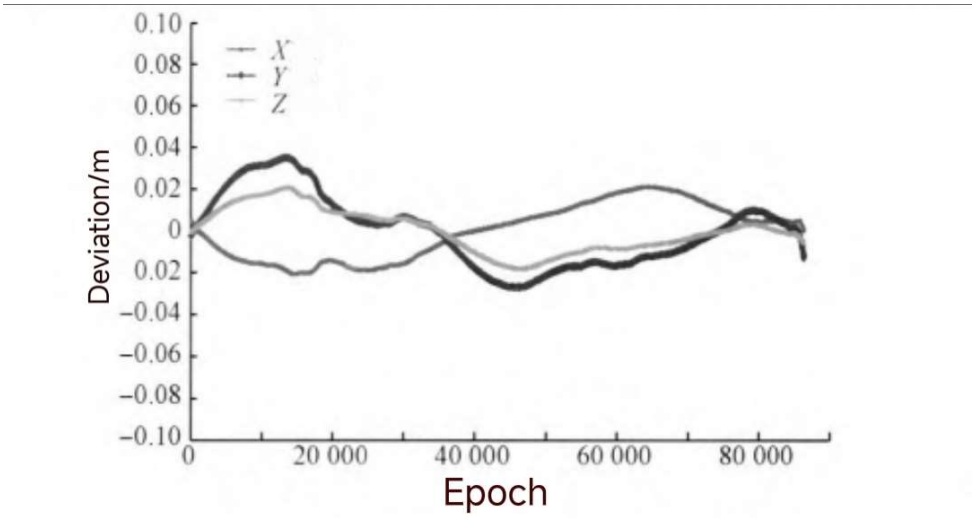

Figure 1. Beidou Precision single-point positioning error diagram

As described in the figure above, the actual value of each coordinate of X / Y / Z in the Beidou precision single-point positioning can be mastered, and the errors can be confirmed according to the specific directions of the three.Thus, we can understand that the deviation value of X and Z can maintain within 2cm in the direction, so that the precise positioning of GPS can be planned as a positioning error, thus ensuring that all parameters are retained at mm level.Then ensure that the positioning error in different systems exists in the form of the standard deviation value.

Secondly, it is necessary to use the method of positioning analysis to master the precision single point positioning accuracy, meet the operation of most Beidou systems, ensure the accuracy of Beidou precision single point positioning, and meet the actual demands of most users.

4. Precision Positioning Analysis of Beidou GNSS

4.1 Beidou Positioning Principle

The central control system sends an inquiry signal to the satellite and satellite II to the terminal user equipment in the service area via the satellite forwarding der.The end user equipment responds to the

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inquiry signal of one of the satellites, sends response signals to both satellites at the same time, and forwards them back to the ground Beidou control center system via the satellite.The ground Beidou control center system receives and demodulates the wireless signals sent by the terminal user equipment in real time, and then conducts the corresponding data analysis and processing according to the requested service content of the user terminal equipment.The ground Beidou control Center handles the positioning request sent from the user terminal, and the ground Beidou control Center system immediately detects two time delays: the ground Beidou control center sends an inquiry signal, which is sent by a satellite to the user terminal device and the user terminal deviceResponse signal, the delay time from the satellite to the control center and the delay time from the satellite I to the control center.Because the ground beidou control center and the two beidou satellite position are consistent, through the fourth step of the delay time can calculate the user terminal to the first beidou satellite, and the user terminal to the sum of the two satellites, so as to know the user is in a sphere with the first satellite for the center of the ball and with the two satellites focus on the ellipsoid between the intersection. The ground accurately calculates the coordinate position of the user machine The ground Beidou control center system queries the elevation value of the user terminal from the digital topographic map stored in the computer, and the user terminal is on a certain ellipsoid surface parallel to the earth reference ellipsoid surface.Therefore, the ground Beidou control center system can finally calculate the 3-dimensional coordinates of the user's point, which is encrypted and sent to the user by the exit signal.

4.2 GNSS / INS / DR Algorithm Analysis

GNSS / INS / DR agile precision measurement and control microsystem mainly studies the design of low-cost and high-precision four-system single-frequency GNSS / INS / DR module, high and low frequency shunt algorithm ensures high sampling rate and no delay differential positioning of dynamic data, single-frequency RTD and RTK efficient solution problems, studies GNSS / INS / DR tight combination algorithm, and studies the kinematic constraint scheme in the combined navigation algorithm.In view of the high cost, high power consumption, large volume and poor real-time dynamic, the existing on-board navigation and positioning accuracy can not meet the requirements of lane-level positioning, intelligent control and fine management, GNSS as time synchronous dual GNSS chip splicing, INS S / INS / DR agile precision measurement and control microsystem architecture, and design the corresponding microprocessing unit.

5. Trend Analysis of Beidou GNSS Intelligent Application

The proposal and establishment of the national comprehensive PNT (navigation, positioning and timing) system will effectively solve the problems and difficulties faced by the expanded application of the Beidou.As 5G base station construction, big data center, artificial intelligence, industrial Internet national policy, countries will further strengthen the construction and development of related industries, beidou system with a new generation of 5G communication, artificial intelligence, big data depth fusion, such as intelligent transportation, fine agriculture, precision logistics, autonomous driving beidou industry application of new mode, new forms, make beidou service everywhere, anytime.The future application form and development direction of BDS will be reflected in the following aspects.Further promote innovation and efficient fusion mechanism, realize beidou, GPS, granas, Galileo GNSS system, beidou positioning, visual navigation, inertial navigation technology fusion, in melting technology, data, network, financial platform linkage communication, truly with beidou as the core of the space and space information service efficient connectivity sharing, and have interference, cheating, continuous, stability and high reliability, prompted the beidou system in wisdom city, intelligent transportation, precision logistics, and other industries cross-border fusion application.Beidou is combined with 5G communication, location service and GIS (geographic Information System), breaks through the seamless indoor and outdoor positioning technology of 5G integrating Beidou and location services, and continuously improves the seamless space-time information service from outdoor to indoor, ground to underground, and seabed to deep space.In the

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field of public application, breakthrough real-time dynamic high precision navigation map, build diversified travel service system, through time and space-time information "the last kilometer" service, with key industry application as traction, through innovative social governance mode, deepen the public life position service application, promote the scale application of mass consumption, form from intelligent terminal to platform to industry application complete link, intelligent, continuous and reliable beidou space-time information service.Breakthrough high precision low cost safe trusted intelligent terminal, research and development of low power consumption, low cost, fast positioning beidou chip and its IP core, make the beidou intelligent application terminal presents miniaturization, miniaturization and flexible [16], truly realize beidou terminal autonomous controllable and flexible, in forest fire prevention, disaster relief, agricultural machinery, offshore fishing, and other fields to realize beidou intelligent terminal portable and flexible application, has a wide application prospect and application value.The combination of Beidou with the Internet of Things and 5G communication will greatly promote the realization of the interconnection and interoperability of the Beidou intelligent terminals and the Beidou application system.Breakthrough combined with narrow band Internet of things protocol series of low-power beidou technology, and use the beidou B2a signal broadband multiple path detection and eliminate technology [17], greatly improve the positioning accuracy of complex scenarios, form "beidou + Internet + 5G" guide integration solution, implementation in smart city, intelligent logistics, security monitoring, wisdom, agriculture, asset supervision, environmental monitoring scale application, all beidou applications.Beidou combines with artificial intelligence, 5G, cloud computing and big data, Breakthrough in the Beidou chip, gyroscope, odometer and other multi-sensor fusion positioning technology, Comprehensively improve the positioning accuracy, availability and multi-path resistance of PNT services, Break through the multi-mode and multi-frequency Beidou / GNSS chip with high performance, high precision and miniaturized unmanned systems and meet the general standards of automotive electronic systems, To realize the intelligent perception, intelligent processing and intelligent service of spatial and temporal information with Beidou as the core, Form the high-depth application of Beidou high-precision technology in intelligent connected vehicles, unmanned aerial vehicles, small robots, intelligent wearable devices and other fields, We will greatly improve the intelligent application level of Beidou.

6. Conclusion

In conclusion, in order to ensure the smooth development of beidou distance signal assessment and precision single point positioning, should pay attention to the domestic time reference system, using multimodal measurement receiving equipment, to realize the determination of the relevant data, to ensure the beidou observation data frequency signal to noise ratio and the accuracy of multi-way effect, facilitate the use of precision clock difference and beidou precision orbit.If it is not implemented in place, it will inevitably increase the difficulty of Beidou distance measurement signal evaluation.Therefore, a precise single-point positioning algorithm can be used to confirm the actual position of the receiver antenna, and thus to ensure the smooth deviation estimation of IGST.The Beidou system is a national strategic emerging industry, one of China's important information infrastructure, and an important guarantee for China's information construction, providing a strong driving force for promoting and promoting economic and social development.The comprehensive completion of the BDS has further established and consolidated China's international position in the field of satellite navigation, promoted competition and cooperation in the global navigation system, promoted the common development of the system, and is of great significance to enhancing China's space capacity and promoting the building of a space power.In order to better application of beidou, our country should further intensify beidou application policy support, promote the application of beidou in industry standards, under the framework of deep integration, expanding beidou fusion application breadth and depth, at the same time increase the whole source navigation, integrated core technology research and development, constantly promote beidou industry application and industrialization development, promote "beidou +" and "+ Beidou" fusion innovation application

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development.At the same time, we can consider implementing more active and open multilateral and international cooperation to open up broader space for the application of Beidou.

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