

Design and Implementation of Positioning Software System based on Non-navigation Satellites

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ABSTRACT

The current social life and military operations have higher and higher requirements for location service performance. The existing GNSS signals are vulnerable to failure, and it is necessary to study other positioning technologies as a backup. Non-navigation satellite signals have great potential, and only a small amount of funds can make it to provide positioning services. The basic algorithm of static positioning based on non-navigation satellites has been verified. In order to solve the problems of low execution efficiency and a lot of manual labor requirements, this paper optimizes the positioning algorithm, studies the Time To First Fix (TTFF), and develops positioning software based on C/C++ language.

The completed research includes the following points:

(1) Doppler extraction and processing of non-navigation satellite signals. This paper uses local carrier correlation and maximum likelihood estimation methods to extract the time and Doppler information of the signal, and classifies the Doppler information by source according to the timing.

(2) Identification of non-navigation satellites numbers. Based on the TLE file and the SGP4 orbit model, this paper realizes the prediction of status and visibility of the satellites, matches them with the Doppler classifications, and automatically recognizes the satellites numbers.

(3) Implementation of positioning based on non-navigation satellites. This paper uses the iterative solution of the positioning equation and Doppler to estimate the best time correction term, selects the appropriate observation epoch according to the characteristics of the multi-satellite distribution, and uses the additional positioning information to monitor the self-integrity, and realizes the positioning technology based on non-navigation satellites.

(4) Research on the TTFF of the positioning based on non-navigation satellites. This paper tests different aspects and analyzes the main influencing factors and relationships of the TTFF.

(5) Design and implementation of positioning software based on non-navigation satellites. The article develops a complete Windows C/C++ program based on the non-navigation satellites positioning system. It adopts a front-end and back-end separation and modular design for easy updating and optimization, which realizes the one-key configuration of the interface

program, the visualization of Doppler information and positioning results.

This paper has completed the design and development of positioning software based on non-navigation satellite signals, which has important theoretical research significance and engineering application value for improving the performance and execution efficiency of non-navigation satellites positioning algorithms. The software adopts front-end and back-end separation and modular design, because of taking into account the scalability of the system, and adapting to future multi-constellation applications. In addition, the interface is intuitive and easy to operate. The tests of the collected real non-navigation satellites (Iridium) signals show that the positioning software based on non-navigation satellites designed in this paper can independently realize high-precision positioning functions, and has great development prospects.

Keywords: Non-navigation Satellite, Positioning Software, Doppler positioning, Time to First Fix

