Analysis of Anti-Multipath Performance Based on Traditional Acquisition Algorithm of BOC Signal

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***Abstract*—At present, multipath interference is still an inevitable natural influencing factor for high-precision navigation and positioning. The signal transmitted by the satellite is reflected and refracted by the interference of the surrounding environment, which will cause certain error interference to the phase and pseudorange of the direct wave signal. In order to analyze the degree of interference caused by multipath errors in the signal acquisition process, and compare the anti-multipath performance advantages of the acquisition algorithm. In this paper, starting from the formation principle of multipath signals. Based on the analysis of the code loop phase detector technology of incoherent lead minus lag (EML), the MATLAB simulation analysis platform is built, and then The comparison and simulation experiment of multipath error of sine BOC modulation signal and cosine BOC modulation signal is carried out for two traditional acquisition algorithms which are ASPeCT acquisition algorithm and SCPC acquisition algorithm. The simulation results show that the anti-multipath performance of the ASPeCT acquisition algorithm is better than that of the SCPC algorithm.**

Keywords—binary offset carrier (BOC), multipath interference, SCPC, ASPeCT, EML

I. INTRODUCTION

With the continuous development and progress of the Global Navigation Satellite System (GNSS), The increasing number of signals makes the frequency band resources increasingly tight. To solve this problem, a new modulated signal form—Binary Offset Carrier Signal (BOC) is proposed. Compared with the traditional binary phase shift keying modulation signal (Binary Phase Shift Keying, BPSK), this signal system has a higher frequency band utilization rate and relieves the frequency band congestion to a certain extent. Multipath is an unavoidable factor affecting the positioning accuracy, and it is particularly important to process signals in a multipath environment. Signal acquisition is the first step of signal processing, so it is of great significance to study the acquisition of signals in multipath environment[1]. This paper takes the traditional acquisition algorithm as the starting point to analyze the anti-multipath performance of the algorithm[2].

II. SIGNAL MODEL

A. Modulated Signal Model (Heading 2)

The process of BOC modulation is to add a BOC modulation link before the carrier modulation of the BPSK modulation process. The spectrum of the baseband signal after spread spectrum modulation is re-allocated, so as to meet the design requirements of GNSS signal spectrum separation. Its baseband signal $S_x(t)$ is expressed as follows[3][4]:

$$S_x(t) = \sum_{k=-\infty}^{+\infty} b_k \mu_{T_C}(t - kT_C)\varepsilon(t) \tag{1}$$

In the formula, b_k is a pseudo code sequence with a value of ± 1, T_C is the chip width; $\mu_{T_C}(t)$ is a rectangular pulse signal with a width of T_C; $\varepsilon(t)$ is called BOC modulated subcarrier signal, which is divided into two types: sine subcarrier $\varepsilon_{\sin}(t)$ and cosine subcarrier $\varepsilon_{\cos}(t)$, The expression is:

$$\varepsilon_{\sin}(t) = \mathrm{sgn}(\sin(2\pi f_S t)) \tag{2}$$

$$\varepsilon_{\cos}(t) = \mathrm{sgn}(\cos(2\pi f_S t)) \tag{3}$$

This paper takes modulated signals $BOC_{\sin}(1,1)$ and $BOC_{\cos}(1,1)$ as examples to analyze the anti-multipath performance of the acquisition algorithm[5][6]. Figure 1 and Figure 2 are the phase discrimination curves of $BOC_{\sin}(1,1)$ and $BOC_{\cos}(1,1)$ respectively under the condition that the correlator interval is 0.05chip[7].