Simulation Spread Spectrum Signal Based on MATLAB

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ABSTRACT: In this paper, the structure and characteristics of the spread code and spread spectrum telemetry signal is analyzed in detail, the design language MATLAB simulation model based on spread spectrum telemetry signals and verify its correctness, for the study of acquisition and tracking algorithm provides a reliable source.

KEYWORD: Spreading; MATLAB; Gold

1 INTRODUCTION

Spread spectrum telemetry system has strong anti-interference, confidentiality, the advantages of multi-objective for monitoring and control, etc. (Vannee D.J.R et al, 2011), and therefore subject to more and more attention and a large number of applications; the same time (Van Dierendonck, 2006), greatly enhance the computer with signal processing capabilities to a general purpose computer the processing platform (Grant P.M et al, 2008), combined with modern signal processing methods, research spread spectrum telemetry signal acquisition and tracking algorithm and its software implementation (Hurd W.Statman, 2007), monitoring and control equipment to improve the versatility and simplify the complexity of monitoring and control equipment, has important practical significance.

2 GOLD CODE

Spread Spectrum System in aerospace measurement and control system, spread spectrum signal is achieved by spreading codes, spreading codes on the performance of the whole system plays a decisive role (Agurre S et al, 2009). Anti-jamming system, anti-noise, anti-fading, anti-interception, covert and confidential information, multiple-access communication and synchronization with the capture and spreading codes are all closely related to the design (Natali F.D, 2012).
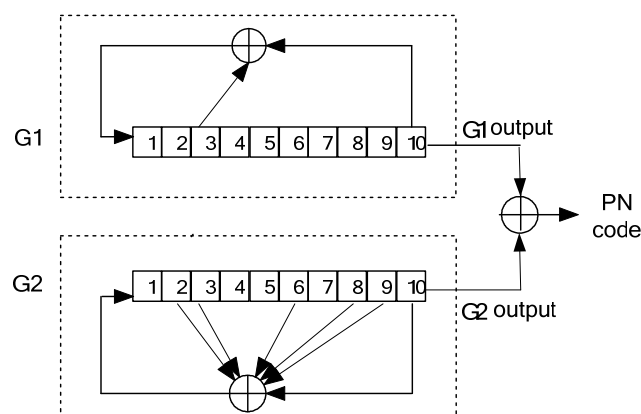

Figure 1. Gold code generator

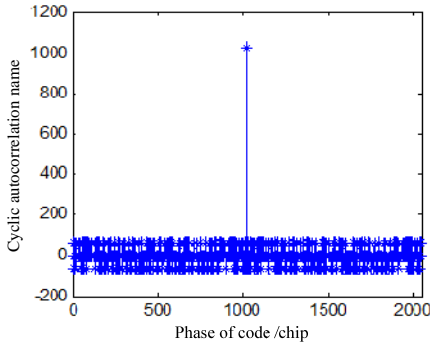Gold code sequence with 3-value cross-correlation function, its value is:

$$R(\tau) = \begin{cases} \begin{cases} -1 \\ -\left(2^{\frac{n+1}{2}}+1\right) = -t(n) & n \text{ is odd number} \\ 2^{\frac{n+1}{2}}-1 = t(n)-2 \end{cases} \\ \begin{cases} -1 \\ -\left(2^{\frac{n+2}{2}}+1\right) = -t(n) & n \text{ is even number} \\ 2^{\frac{n+2}{2}}-1 = t(n)-2 \end{cases} \end{cases} \quad (1)$$

Where,

$$t(n) = \begin{cases} 2^{\frac{n+1}{2}}+1 & n = 2k-1 \\ 2^{\frac{n+2}{2}}+1 & n = 2k \end{cases} \quad k \text{ is an integer, but is not a multiple of 2} \quad (2)$$

Gold code autocorrelation function is a function of three values, but with different frequency of occurrence.

For the case of n = 10, and only when, the auto-correlation function can only obtain maximum 1023; when other values, the cross-correlation value is -65, -1, or 63. Because of this nature Gold code sequence, the receiver can pass phase shift local pseudo-code to the received signal in the pseudo-code phase alignment to obtain high processing gain, it can be buried in the noise the signal detected.

(a). Autocorrelation function
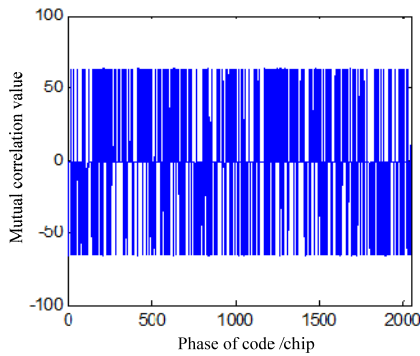
(b). Cross-correlation function

Figure 2. Autocorrelation and cross-correlation function Gold code sequence

Figure 2 is the autocorrelation function of the code length 1023 Gold code sequence and cross-correlation functions.

3 SPREAD SPECTRUM SIGNAL

Spread-spectrum signal using QPSK modulation in general power imbalance that UQPSK modulation. Modulation principle is shown in Figure 3.
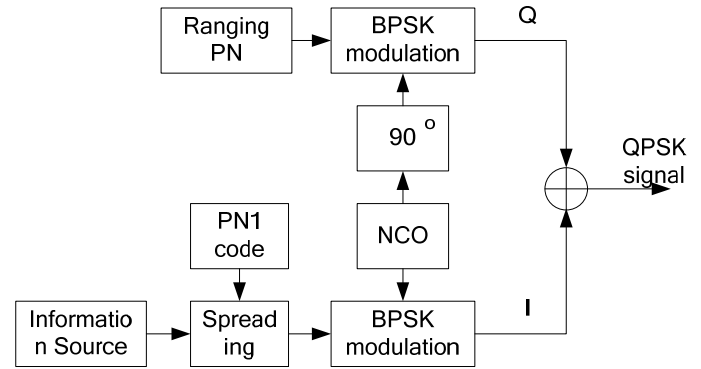

Figure 3. Schematic spread QPSK modulation scheme

Wherein the I branch modulation telemetry information using spreading Gold code of length 1023, Q modulation branches truncated m-sequence of length 256 as 1023 * Ranging code transmission of the data I assign a higher signal power branch . Short code used to guarantee precision ranging, and the long code for defuzzification.

Mathematical expression of the QPSK signal is:

$$S(t) = \sqrt{2*(0.91)P_S}\,PN_I(t)d(t)\cos(2\pi ft + \phi) + \sqrt{2*(0.09)P_S}\,PN_Q(t)\sin(2\pi ft + \phi) \qquad (3)$$

4 PRE-MODULATION FILTERING

In this paper, the pseudo code rate 5.115Mchips/s, bandwidth of 10.23MHz, so shaping filter 3dB bandwidth of 5.115MHz, set off with a 6MHz, roll-off factor of 0.45. The shaping filter 56 Order, its amplitude-frequency characteristic and phase-frequency characteristics shown in Figure 4:
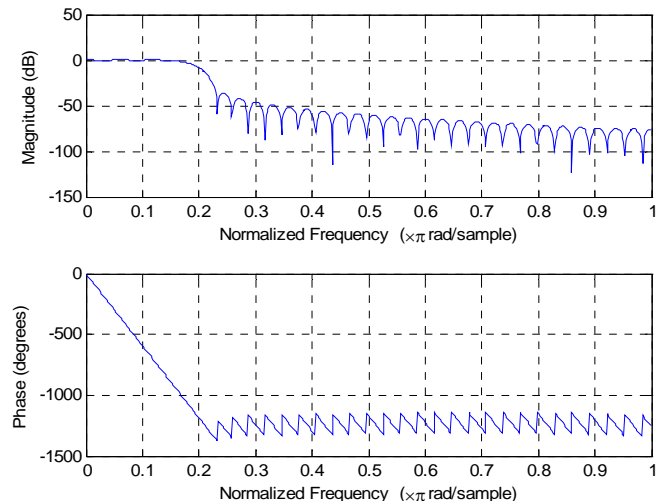

Figure 4. The amplitude-frequency characteristics and phase-frequency characteristics

Figure 5 respectively after shaping filter after time domain and frequency domain waveforms:
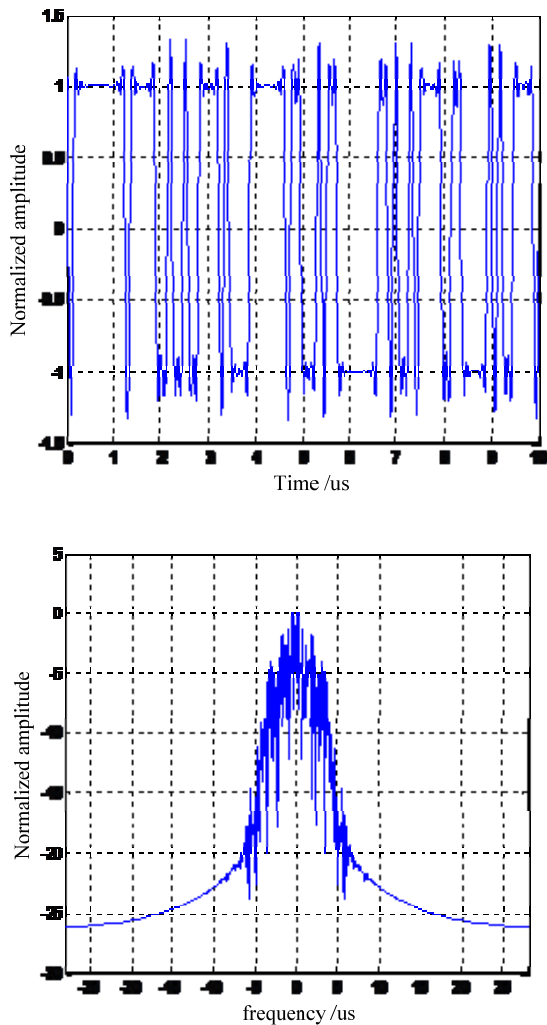

Figure 5. Time domain and frequency domain waveforms after shaping filter

5 SUMMARY

This chapter of the spread spectrum telemetry signal characteristics and structure of constructed based on spread spectrum telemetry signal MATLAB simulation model, and its correctness was verified for the study of the spread-spectrum signal acquisition and tracking algorithm of the foundation.

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