The Simulation of Direct Spread Spectrum System based on Transmitted Reference Signal

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Abstract

Code synchronization is indispensable in the direct spread spectrum system because it can influence the incepting capacity directly. Transmitted reference is proposed in this paper to predigest the code synchronization circuit of the incepting machine in order to reduce the cost of time, energy and money for the development of the code synchronization technology. The software named Systemview is employed to simulate the transmitted reference direct spread spectrum system. The simulation results were presented with the condition of gauss noise and temperature. It demonstrates that the proposed simulation has significant effect and benefit in engineering.

***Keywords:** Direct Spread Spectrum System, Systemview, Gauss Noise, Transmitted Reference*

1. Introduction

Spread spectrum communication is an important embranchment in communication fields. It represents one of the developmental direction of channel communication system [1,2]. The Spread spectrum technology has many advantages, e.g. strong anti-jamming ability, good quality of keeping secret and convenient multitudinous address communication. Therefore the Spread spectrum technology cannot only possess important status in martial communication, but also infiltrates into the civilian domain of personal communication and computer communication. [3,4].

Recently, the Spread spectrum technology has become one of the most potential communication technologies [5]. The direct spread spectrum system is widely used at present, of which the best advantage can include anti-jamming ability, secret keeping, multitudinous address communication and compose net and etc [6]. Usually, when we analyze the capability of the spread spectrum system, it was assumed that the synchronization between transmitter and receiver is good. Actually, we must use very accurate oscillator and code synchronization circuit in order to assure the PN code between the transmitter and receiver for accurate synchronization. These processes are accompanied by great cost and complex degree of technology. Though we can use the frequency with skyscraping stabilization degree, it is still impossible to eliminate all instability factors due to the Doppler shift and multipath fading which can bring significantly blight to the synchronization of system [7]. Even for the fixed position of receiving and transmitting system, the change of transmission channel also brings on the change of code phase and carrier wave frequency. Therefore accurate synchronization is quite difficult in actual system. The synchronization of spread spectrum sequence can be separated to two phases: capture and trace. The rough synchronization can be achieved in capture phase. It confines the spread spectrum sequence phase to be different from the receiver and transmitter in a code patch or little scope of a code patch. How to achieve the celerity capture of the spread spectrum sequence reliably is a key problem that influence the capability of system significantly [8,9]. The methods of synchronization capture include glide correlation, synchronization head, leap frequency synchronization, matching filter synchronization and etc.

Systemview is designed by ELANIX Company of USA, it is a full scale and dynamic system analysis software which can be used specially to simulate and design for engineering and science system [10]. Systemview provides an advanced system analysis engine. The analytical objects are very comprehensive, including: simulation of digital signals dispose, filter, control system; the design and analysis of communication system; various currency mathematics model simulation and validation, and etc. In this paper, Systemview simulation software is employed to construct the direct sequence spread spectrum system with a transmitted reference signal.

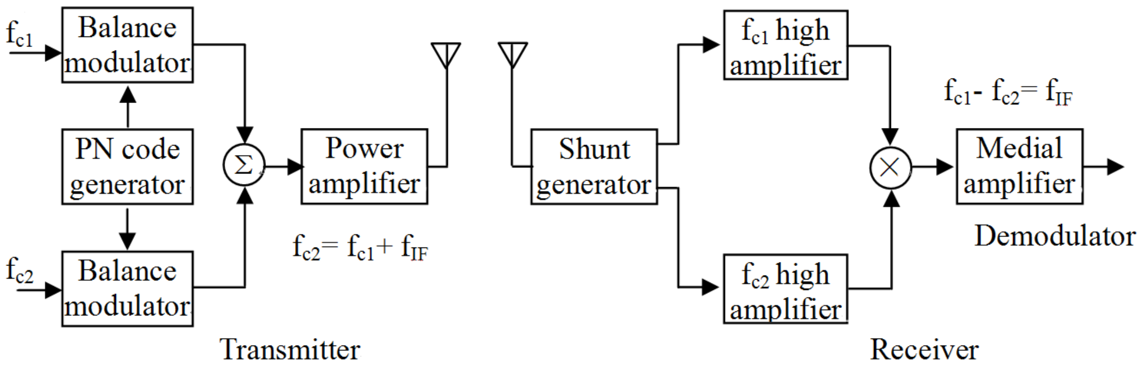

Fig. 1 Theoretical roadmap of the direct sequence spread spectrum

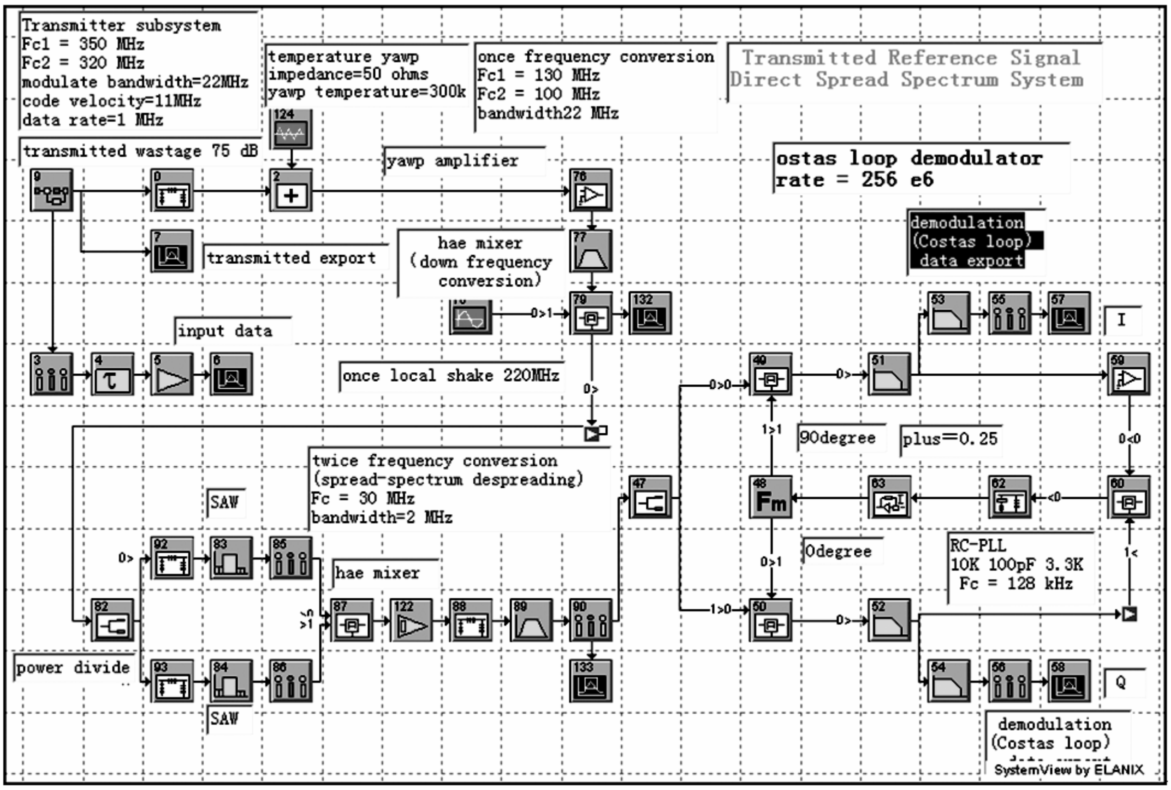

Fig. 2 The simulation model of direct spread spectrum system based on transmitted reference signal

2. Simulation Design of Transmitted Reference Signal of the Direct sequence Spread Spectrum System

The method of transmitted reference signal can be used to identify synchronization capture and trace. The receiver of transmitted reference signal cannot use the code generator and any other local reference oscillator. The direct sequence spread spectrum code reference signal is produced by transmitter, and transmitted with practical information signal at the same time.

As shown in Figure 1, fc1 and fc2 use the same spread spectrum code to modulate. Here fc1 is used to transmit information, whereas fc2 does not take information. After mixing two signals at the end of receiver, the signals can express intermediate frequency without spread spectrum. The working course of a transmitted reference receiver is the same as some other receivers that use local reference signals. The difference between transmitted reference and local reference is that the local spread spectrum codes are produced by transmitter and demodulated by receiver. As shown in Figures 2 and 3, the GOLD code is used as spread spectrum code. The departure of two carrier wave frequency is equal to the first middle amplificatory frequency. The correlation intermediate frequency signals are produced by mixing. The cost, weight and size must be limited in a receiver. The method of transmitted reference has obvious superiority, because it do not need spread spectrum code sequence generator, the circuit of code capture, the circuit of code synchronization, the circuit of code trace, and any other circuits which are correlated with code. The transmitted reference receiver has a thick skin due to the influence of Doppler shift, and can be compatibly used in the objects which have fast movement speed. However, the method of transmitted reference still has some disadvantages: its anti-jamming capability decreases; the reference signals of a receiver are produced by transmission, thus the yawp which can degrade system performance can be drew into. In this paper, the simulation system engrosses the bandwidth 22MHz. When the date rate is 1MHz, the theoretical plus is 13.4 dB. The reference signals are transmitted by channel, so the yawp is drew into. In current disturbance, the system execute wastage of reference receiver is not twice larger than the direct sequence spread spectrum system with local reference signal. Commonly, the wastage is 1-2 dB, the result of this simulation system is 3 dB. If we can choose appropriate code counts, we can get higher spread spectrum plus. When comparing this plus with profit produced by predigestion system, this wastage is inessential.

The worst condition is the occurrence of intermediate frequency interference which is the difference of two frequencies falls into the frequency band. When two interferential signals exceed half disturb tolerance of the system, the system will be blocked and cannot work. If the disturbance is eliminated, the system can resume to work and do not need any other direct sequence spread spectrum system synchronism to set up the process again. In order to handle the artificial disturbance, the best way is to protect intermediate frequency and make the intermediate frequency being changed in a certain range. When the system suffer from the artificial disturbance, the routine analysis of correlative spread spectrum system capability cannot be applicable for the system.

Therefore, when we design analogous system, we must adopt the high value of the intermediate frequency as quickly as possible. The intermediate frequencies cannot be less than the bandwidth of spread spectrum signals. At the same time, it is proper to use heterodyne correlator, and it can make the disturbance signals to act ahead of correlator, and it is unable to divulge to back circuit through correlator. The frequency answer characteristic of a SAW filter in the transmitter and receiver usually take the finite impact answer filter (FIR) to simulate. In order to improve operation speed of computer simulation, the pigtail counts cannot be selected accurately, so the parameter of simulative filter is not as good as the characteristic of SAW made in practical engineering.

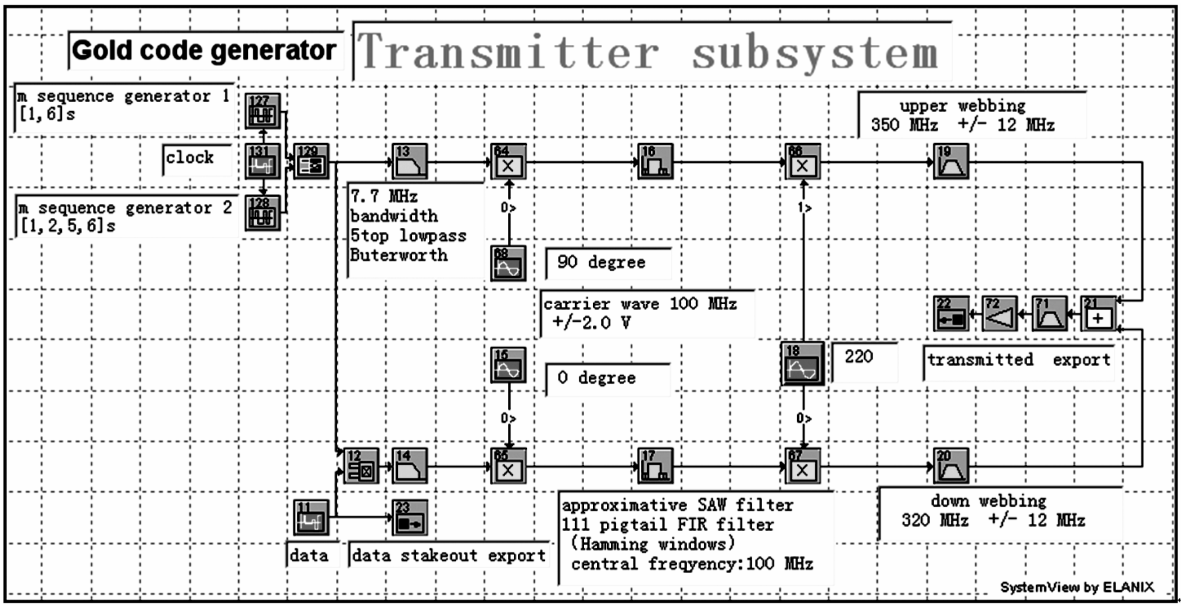

Fig. 3 Transmitter subsystem

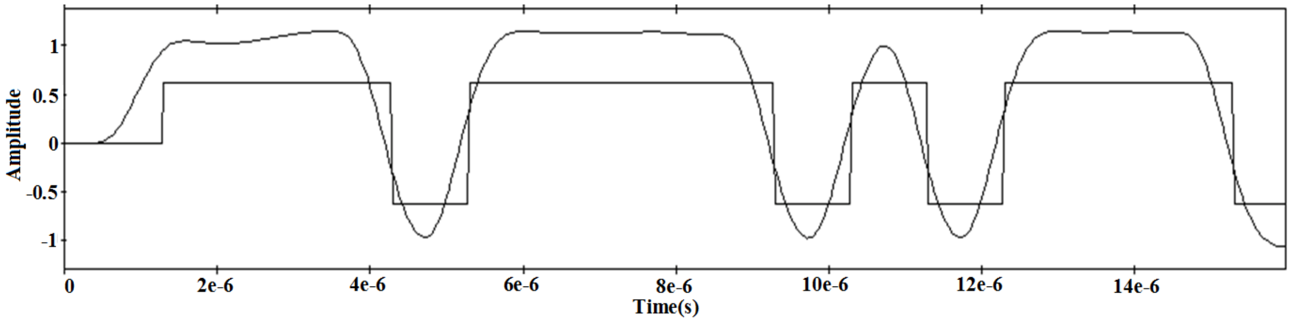

Fig. 4 The export signals add with original signals after Coatas loop demodulation

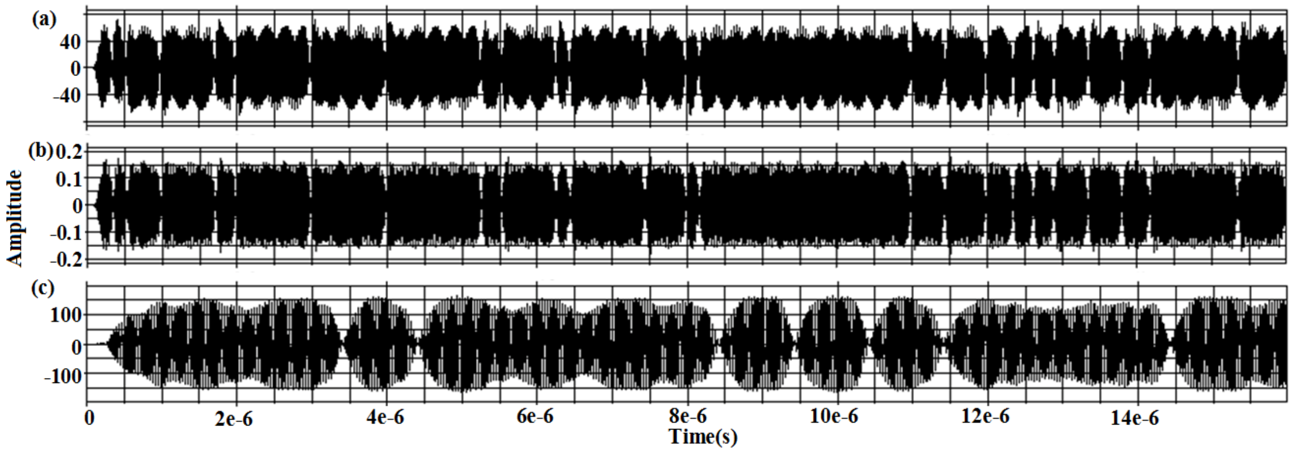

Fig. 5 The export wave: (a) of transmitter; (b) after once frequency conversion; and (c) after twice frequency conversion. Note that (a), (b) and (c) have the same horizontal axis.

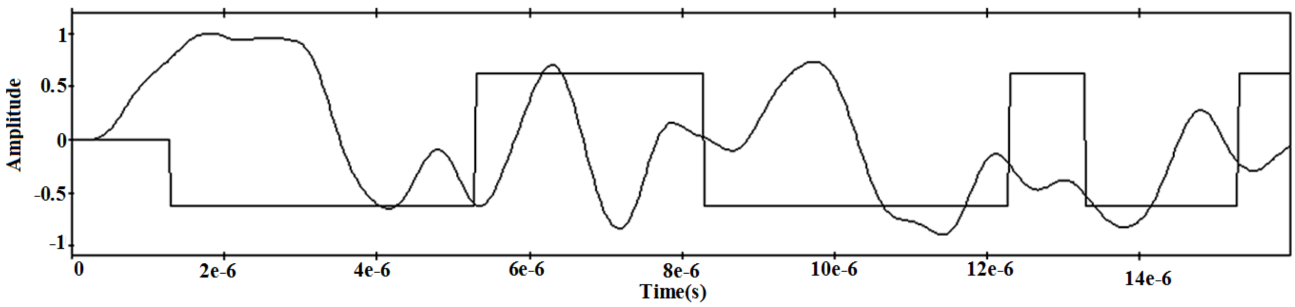

Fig. 6 The export signals add with original signals after Coatas loop demodulation

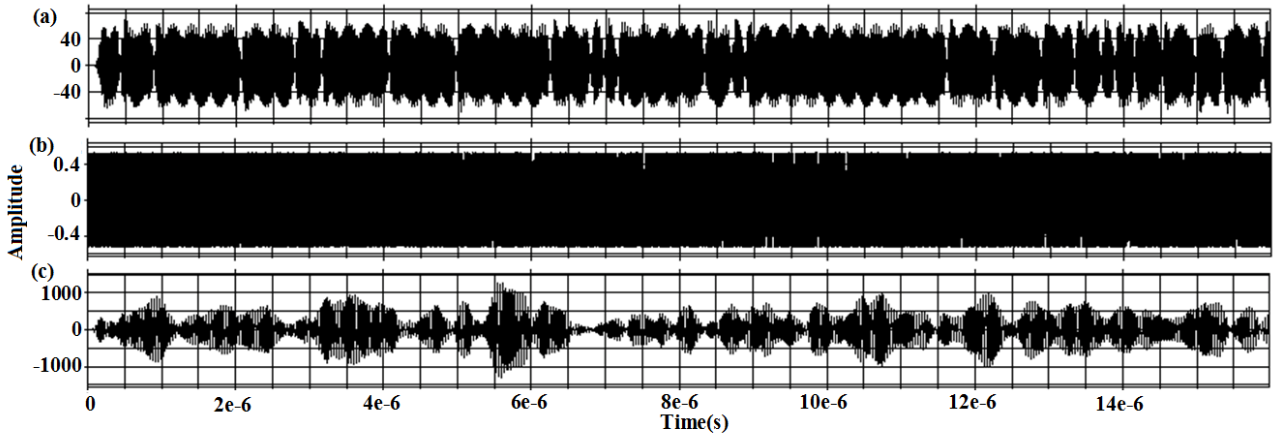

Fig. 7 The export wave: (a) of transmitter; (b) after once frequency conversion; and (c) after twice frequency conversion. Note that (a), (b) and (c) have the same horizontal axis.

3. Result and discussion

3.1 Simulation Result of Transmitted Reference Direct Sequence Spread Spectrum System at Temperature Yawp

From the Figures 4 and 5, it can be found that the input wave matches preferably with the output wave. Though the usage rate of available frequency is immolated under the transmission, the structure of transmitter can be predigested greatly. And the precision require of fake code generator decreases greatly too. By using high speed short list code, the higher spread sequence plus can be gained.

3.2 Simulation Result of Transmitted Reference Direct Sequence Spread Spectrum System at Gauss Yawp

As shown in Figures 6 and 7, the simulation results demonstrate that the transmitted reference direct sequence spread spectrum system can work normally under temperature yawp, but the output signals are already anamorphic under gauss yawp.

4. Conclusions

In this paper, Systemview simulation software is employed to simulate the direct sequence spread Spectrum system based on transmitted reference, and the simulation results of the system are presented under temperature and gauss yawp. The simulation results demonstrate: the direct sequence spread Spectrum system based on transmitted reference can work normally under temperature yawp, though the usage rate of practicable frequency is immolated through transmission; the structure of receiver is predigested; the precision of bogus code generator is decreased; and the higher spread Spectrum plus can be achieved by using high speed short sequence codes. The direct sequence spread Spectrum system based on transmitted reference cannot work normally under gauss yawp, so it is inadvisable to be used under gauss yawp.

Acknowledgments

This work is supported by the National High Technology Research and Development Program of China (No. 2012AA120601), National Natural Science Foundation of China (No. 11202044, No. 11072044) and the Fundamental Research Funds for the Central Universities.

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