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Acquisition of Long Pseudo Code in Dsss Signal

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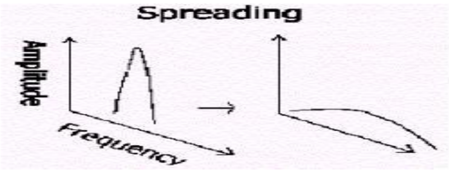
ABSTRACT: *Rapid pseudo-code is widely used in spread spectrum communication system, because it has a large data rate and a strong anti-jamming property. But it brings us large of difficulty to acquire it as its long period. A new method is proposed to solve this problem in this paper, which is based on the excellent correlation characteristics of the long pseudo-code. The new method divides the local pn sequence into four subsequences, and then each of the sequence is overlapped and accumulated to form four new sequences. Through simple operation of addition, the four new sequences produce two combined sequences as the new reference sequences. At the same time, the received spread spectrum signal's sample rate is reduced to a quarter of the chip rate. Use the results to do correlation with the two new reference sequences to capture the synchronous pseudo-code. This method not only rapids the acquisition speed, but also improves the precision of frequency offset compensation.*

I. INTRODUCTION

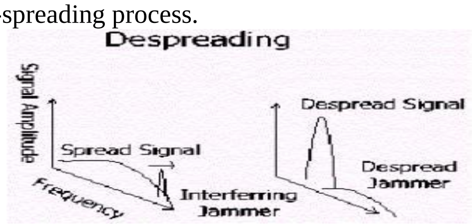
Direct Sequence Spread Spectrum (DSSS) is the most typical spread spectrum communication style in military and civilian mobile communications system. One of the primary functions of DSSS receiver is to despread the received pseudo-code. This is accomplished by generating a local replica of the pseudo-code in the receiver and then synchronizing this local pseudo- code signal to the one which is superimposed on the received waveform.

The carrier of the direct-sequence radio stays at a fixed frequency. Narrowband information is spread out into a much larger (at least 10 times) bandwidth by using a pseudo-random chip sequence. The generation of the direct sequence spread spectrum signal (spreading) is shown.



The narrowband signal and the spread-spectrum signal both use the same amount of transmit power and carry the same information. Synchronization of pseudo-code is unique in spread spectrum system, which includes two stages: acquisition and tracking.

At the receiving end of a direct-sequence system, the spread spectrum signal is de-spread to generate the original narrowband signal. **Figure** shows the de-spreading process.



II. LINEAR FEEDBACK SHIFT REGISTER-TO GENERATE PN CODE

A *Linear Feedback Shift Register* (LFSR) is a mechanism for generating a sequence of binary bits. The register consists of a series of cells that are set by an initialization vector that is, most often, the secret key. The behavior of the register is regulated by a counter (in hardware this counter is often referred to as a ``clock"). At each instant, the contents of the cells of the register are shifted right by one position, and the XOR of a subset of the cell contents is placed in the leftmost cell.

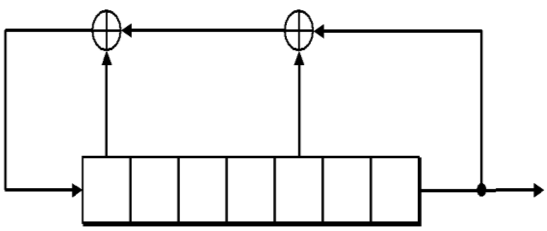


Figure : Linear Feedback Shift Register

III. RAPID ACQUISITION OF PSEUDO-CODE

To enhance the acquisition speed of pseudo-code and improve the precision of frequency offset compensation, algorithm is presented. Sample the input signal at a quarter of chip rate, divide the local pseudo-code into four subsequences, overlap and accumulate each subsequence to form a new sequence, and then use them to form two combined reference sequences. Do correlation of the two combined reference sequences with the input signal sequence to capture the synchronous pseudo-code. Fig. 1 gives the block diagram of this algorithm.

IV. ALGORITHM

In this paper, the rapid acquisition algorithm includes the following three parts

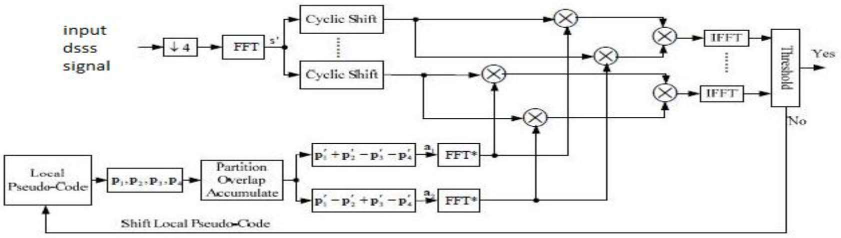


Figure 1. Block diagram of the algorithm.

1) Input Signal Processing:

a) Do down-conversion of the input signal and sample it at a quarter of the chip rate.

b) Pick up L points of the sampled sequence, and define as $s = (s_1, s_2, s_3, s_4, ...s_{L-1}, s_L)$

c) Calculate L -point FFT for sequence s to get s' .

d) According to the scope of frequency offset, do $2n$ times cyclic shift of the sequence s' , *n (=10)*times to the left and *n(=10)* times to the right respectively, and get $2n$ +1 frequency offset compensation sequences

2) Local Pseudo-Code Processing:

a) Pick up $4ML$ points local pseudo-code, define as

$p = (p_1, p_2, p_3, p_4, ..., P_{4Ml-3}, P_{4Ml-2} P_{4Ml-1} P_{4Ml})$, and divide it into four subsequences as follows:

$$p_1 = (p_1, p_5, p_9, p_{13}, ..., p_{4ML-3}).$$

$$p_2 = (p_2, p_6, p_{10}, p_{14}, ..., p_{4ML-2}).$$

$$p_3 = (p_3, p_7, p_{11}, p_{15}, ..., p_{4ML-1}).$$

$$p_4 = (p_4, p_8, p_{12}, p_{16}, ..., p_{4ML}).$$

b) Respectively partition the subsequences p_1, p_2, p_3, p_4 into M segments, and each of segments has length L . Overlap and accumulate the M segments, and get p_1', p_2', p_3', p_4'

c) Do the simple operation $a_1 = p_1', p_2', p_3', p_4'$, $a_2 = p_1' - p_2' + p_3' - p_4'$,
and get two combined reference sequences.

d) Calculate the conjugate of L -point FFT for a_1, a_2 and get sequences a_1', a_2'

3) Judgment:

a) Multiply the results a_1', a_2' by each frequency offset compensation sequence, and then do L -point IFFT to get $2(2n+1)$ correlation results sequences.

b) Detect the correlation peaks of the correlation results sequences, and compare the maximum peak of them with the threshold.

c) If the maximum correlation peak is above the threshold, decide that the synchronous pseudo-code is in the searching scope this time. Record the corresponding frequency offset compensation sequence's number l , here we name the sequence s_l' optimum frequency offset compensation sequence, and s_l s is the IFFT of s_l' .

d) Multiply s_l' by a_1', a_2', denote the IFFT of the results as b_1, b_2 , mark the two peaks in them as c_1, c_2 . Find out the subsequences according to the product of c_1, c_2

e) If $c_1, c_2 > 0$ the synchronous pseudo-code is in sequences p_1', p' , p_1, p_4 do correlation with s_l respectively to find out the matched sequence, and make the M segment in it do correlation with s_l further. Detect the correlation peak and find out the matched segment according to it, record the location of the peak. Contrarily, if $c_1, c_2 < 0$, the synchronous pseudo-code is in sequences p_2', p_3'.

f) However, if a correlation peak above the threshold not be detected, shift $(4M-1)L$ chips of the local code orderly, repeat the above process. When the optimum frequency offset compensation sequence's number is l , the frequency offset compensation value will be $f_1 = lf_s / 4L$. Supposing that the peak is in the j -the segment the k -the point of subsequence p_i , we can decide the synchronous point in p_i is $I=(M-j)L+(L-k)+2$. Consequently, the synchronous point in the local code is $J=(I-1)\times 4+i=[(M-j)L+(L-k)+1]+i$. This means the code delay is J-1 .

B. Acquisition Speed and Precision of Frequency Offset Compensation Analysis

From the acquisition process above we can find out the two subsequences in which the synchronous pseudo-code exists according to the value of c_1, c_2 . If $c_1, c_2 > 0$, the synchronous pseudo-code is in the sequences p_1, p_4 . On the Contrary, if $c_1, c_2 < 0$, the synchronous pseudo-code is in the sequences p_2, p_3 . Therefore, the searching scope of the subsequences from four reduces to two, and the precision of frequency offset compensation increases four times.

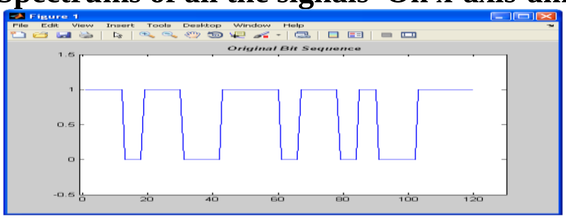
V. SIMULATION AND RESULTS

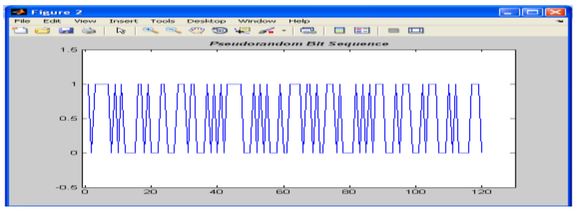
In this paper, we use the MATLAB simulation to verify and discuss the acquisition performance of the new algorithm.Select a pseudo-code sequence whose period is 16384, and assume the frequency offset f_d is 800Hz and pseudo-code delay τ is 650 chips. After do analog down-conversion of the input signal, sample it at a quarter of chip rate which equates to 1MHz. Select 1000 points of the sampled sequence. Pick up 8000 chips of local pseudo-code, divide them into four subsequences according to the acquisition process 2 and then divide each subsequence into 2 segments. After that, the length of each segment L is 1000 points, the precision of frequency offset compensation f_{prec} is 250Hz, and the searching scope of local pseudo-code is 8000 chips a time.

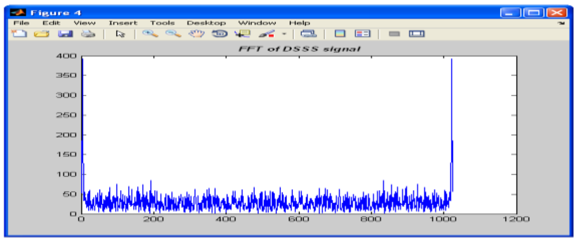
A. Optimum Frequency Offset Compensation Sequence

Do cyclic shift of the sequence s' . The number of shift to left and to right is both ten. The frequency offset compensation value is negative when shifting to the left, while the value is positive when shifting to the right. Multiply each of the frequency offset compensation sequences by a_1', a_2' respectively, and then get the correlation results sequences by IFFT, detect the correlation peak in each of them, find out the largest correlation peak above threshold and the optimum frequency offset sequence.

Spectrums of all the signals On x-axis-amplitude &y-axis-index







The peak, mentioned here and below, is the absolute value of the real part of complex correlation value. As is evidence from it we can know that the largest peak corresponds to the sequence -3, so the optimum frequency offset sequence is s'_{-3} , the frequency offset compensation value f_l and the residual frequency offset $d \ |f_d - |f_l||$ is 50Hz.

B. *Detect the Synchronous Pseudo-Code.*

Multiply sequence s_{-3} by a_1', a_2' separately. And then through IFFT get the correlation results sequences of s_{-3} with a_1, a_2 . Fig. 3 shows the correlation results of s_{-3} with a_1 , and Fig. 4 is the results of s_{-3} with a_2 .

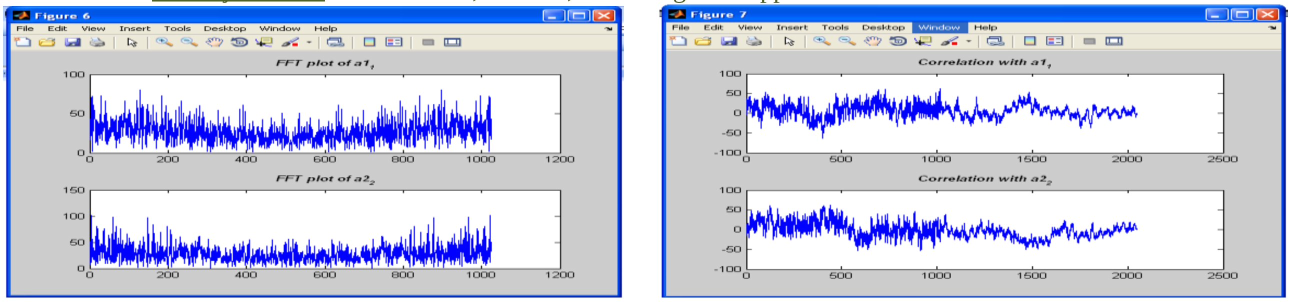


Figure Correlation results of s_{-3} with a1 anda2.

From the figures we can know that the peaks appear at the point of P(=839), and the product of the two peaks is negative. Therefore, according to the acquisition process 3), we can know that the synchronous pseudo-code is in the sequences of p_2', p_3'. Make the sequence s_{-3} s do correlation with p_2', p_3' respectively. Find that the peak appears in sequence p_3'. Then make the 2 segments in p_3 do correlation with s_{-3} separately. Find that the synchronous pseudo-code appears at the first segment. So the synchronous spseudo-code in p_3 is at the point $i=(M-1)L+(L-839)+2=163$ the synchronous point in the local code is $j=(i-1)\times 4+3=651$. This means the delay in local code is 650 chips, so the results are agree with what we have designed.

VI. CONCLUSION

This paper proposes a new method to rapidly capture the long period pseudo-code in DSSS communication systems.Through reducing the sample rate to a quarter of the chip rate, the precision of frequency offset compensation improves At the same time, doing partition overlapping accumulation to the four subsequences of local pseudo-code, not only extends the searching scope, but also rapids the acquisition speed fast Computer simulation proves that this method has a good acquisition property.

VII. ACKNOWLEDGMENTS

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REFERENCES

[1]. Yang C, Vasquez J, and Chaffee J. "Fast Direct P(Y)-Code Acquistion Using XFAST"[C], Proceedings.of ION GPS-99.Nashville, Sept.1999. pp. 317-324.
[2]. Jing Pang, Frank Van Graas, Janusz Starzyk, and Zhen Zhu. "Fast direct GPS P-Code acquisition"[C]. GPS Solutions. Vol. 7, Dec. 2003. pp.168- 175.
[3]. Minghao Tian, Yongxin Feng, and Chengsheng Pan. "Research of a Method of Diret Acquisition Based on P Code in Frequency Domine"[J].Acta Electronica Sinica. Vol. 35,No.3, Mar. 2007. pp. 549-552.
[4]. Tianqi Zhang, Zhengzhong Zhou, Xiaokang Ling, and Zengshan Tia "Approach to Blind Estimation of Lower SNR Long Code DS Signal"[J]. Signal processing. Vol. 24, No. 3, Jul. 2008. pp. 370-376.
[5]. Na Wang, Bangning Zhang, and Guomin Zhang. "Direct Acquisition Technique for GPS P(Y)-code"[C]. Wireless Communications,Networking and Mobile Computing , WiCom. Sept. 2007. pp.2985-2987.
[6].] Yaan Ren, Peng Wang, Weidong Xu, and Xinmei Wang. "Research development of the technique of direct P(Y)-code acquisition in GPS"[C]. GNSS world of China. Vol. 8, No.2, 2003. pp. 2-9.