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Performance of LAS-CDMA System

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Abstract: Reducing interference in a cellular system is the most effective approach to increase radio capacity and transmission data rate in the wireless environment. Therefore reducing interference is a difficult and important challenge in wireless communications. Large area synchronous code-division multiple access (LAS-CDMA) is a proposed fourth generation cellular standard. Similar to cdma2000, the distinguishing feature of LAS-CDMA is the new set of spreading codes used to separate users in the wireless channel.

Keywords: LA Code, LS Code, IFW, Auto-correlation, Cross-correlation.

1 INTRODUCTION

Unlike Walsh functions, which are orthogonal only when perfectly synchronized, LAS- CDMA spreading codes are orthogonal in time dispersive nature of channel . The code used in today's CDMA scheme is the Walsh code, which is not too smart. Walsh codes have the orthogonality property among codes while the time shift t = 0 (i.e., no time shift t or time delay spread). However, in the mobile radio environment the signal arrival can have a long time shift. The property of Walsh codes cannot properly be applied to this environment. Now there is a set of smart codes that have orthogonality among the codes for time shift $t \neq 0$. LAS-CDMA (Large Area Code Division Multiple Access) employs a novel multiple access scheme, which is different from all the known traditional CDMA. The auto-correlation functions of all LAS-CDMA codes are ideal, and there exists an IFW (Interference Free Window), or a "zero correlation zone" (ZCZ) in their cross-correlation functions of access codes around the origin. Due to the existence of IFW or ZCZ, a LAS-CDMA system can have a much higher system capacity and spectral efficiency than that of a traditional CDMA In all traditional code division multiple access (CDMA) systems, their spreading sequences are subjected to intersymbol interference (IS1) as well as multiple access interference (MAI) due to multipath channels. Traditional spreading sequences, such as m-sequences, Gold codes, and Kasami codes, exhibit non-zero correlation levels in auto-correlations and cross correlations around the first access delay. This results in high MAI in asynchronous CDMA systems. Recently, a novel scheme of CDMA systems known as Large Area Synchronous CDMA (LAS-CDMA) which is based on the introduction of interference free window (IFW) around have been attracted to much attention. Hence, efforts have been invested in designing the LAS spreading sequences that exhibit zero correlation values within the relative delay-induced offset of the spreading sequences. The attractive family of LAS-CDMA spreading sequences is constituted by the combination of the so-called large area (LA) codes and loosely synchronous (LS) codes. LAS-CDMA has been proposed as one of the most promising CDMA schemes for fourth generation (4G) mobile communication systems. The features of .LAS-CDMA are that it adopts the code design of spread spectrum. The auto-correlation function is ideal, and the cross-correlation function has a little interferences and even has no interference some time (has no sub-peaks or has sparse sub-peaks), so it can increase system capacity by reducing the system interferences.

2. THE DESIGN OF LAS CODE

LAS code is made up of LA code and LS code which are called as two poles codes and it is new code using the Design of orthogonal and complemented codes, which has Zero Correlation Windows (ZCW). The most important Feature of this code is that it has biggest auto-correlation value at zero offset and other auto-correlation values are all zero at other offsets. Among all codes family, the cross correlation is also zero at the around of zero offset.

2.1 THE DESIGN OF LA CODE AND THE SIMULATION OF CORRELATION CHARACTERISTIC

LA code belongs to ternary i.e. it applies +1,-1 and 0 for coding. The generic shape is LA (L, M, K). L denotes the length of code, M denotes the interval among codes and K denotes numbers of code impulses. This code has fixed interference allowance. For example, LA (847, 38, 16) has sixteen code impulses, and p denotes the positions of impulses, k = 0, 1… 15, {Pk}= {0, 38, 78, 120, 164, 210, 258, 308, 414, 470, 530, 592, 660, 732, 808}

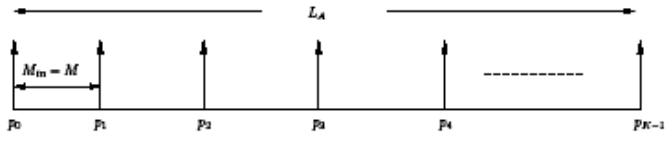


Fig.1.: LA code representation

Now given two group LA codes, the code of Code1 chooses {1 , 1, 1, 1, 1, 1, 1, 1, -1, -1, -1, -1, - 1, -1, -1, -1}, and the code of Code2 chooses {1, 1, 1, 1, 1, 1, 1, 1 , 1, 1, 1, 1, 1, 1, 1, 1}, interval among the codes

represents the number of zero inserted between the two pulse position so that zero correlation zone is created. The position of above mention codes is uniform. Simulation diagrams of the auto-correlation function and cross-correlation function as shown:

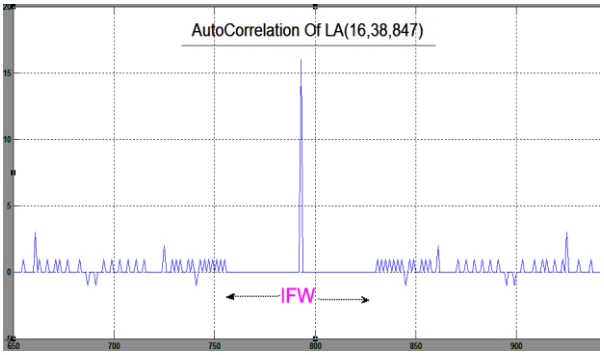


Fig.2.1: Auto Correlation of LA code

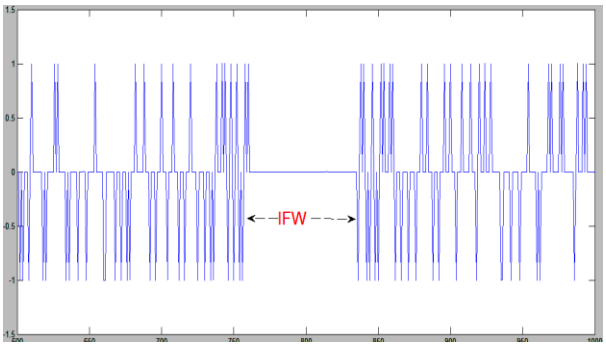


Fig. 2.2: Cross correlation of LA code

According to above design and simulation, we can get the features of LA code as followed: (1) the peak of Auto-correlation function is L (here is 16). (2) It has zero interference windows. The auto-correlation value is impulse in the window and the cross-correlation value is Zero. The length of this window is 2N0+1 (N0 is the smallest length of zero numbers). (3) It can spread spectrum and time at the same time. (4) It also can eliminate the access code interference (ACI). When LA code brings many advantages, it also has some disadvantages and the biggest one of disadvantages is low duty ratio which is L/N.

2.2 THE DESIGN OF LS CODE AND THE SIMULATION OF CORRELATION CHARACTERISTIC

LS code has such functions that it can eliminate ISI and MAI. It is made up of the codes which are orthogonal and complemented codes. Suppose that the codes which are orthogonal and complemented are c1, c2, s1, s2, and they are binary which have the length of N. Thus the constitution formulations of LS code are as follows

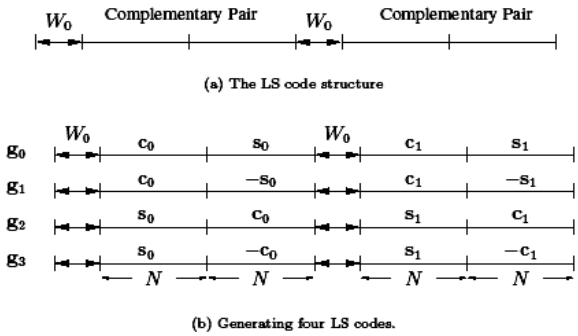
:

$$g1(n) = c1(n) + s1(n\text{-}N\text{-}W0)$$
$$g2(n) = c2(n) + s2(n\text{-}N\text{-}W0)$$

Here $N = 2n$, and W0 is the numbers of zero among c and s sequences.

According to above design scheme, two group LS codes can be obtained, the sequence of Code 1 is

{1, 1, 1, -1, 1, 1, -1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1 , -1, 1, 1, 1, -1, -1, -1},



And the sequence of Code 2 is

{1, 1, 1, -1, -1, -1, 1, -1, 0, 0, 0, 0, 0, 0, 0, 0, 1, -1, 1, 1, -1, 1, 1, 1}

Simulation diagrams of the autocorrelation function and cross-correlation function are as shown :

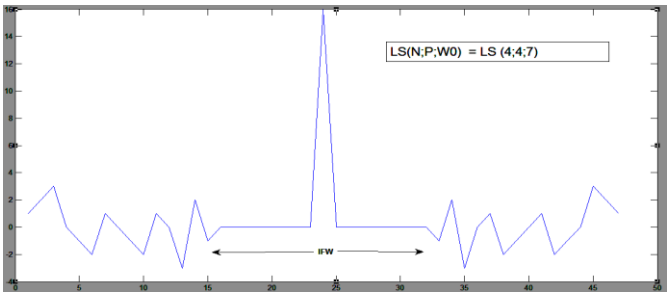


Fig. 2.3:Autocorrelation of LS Code

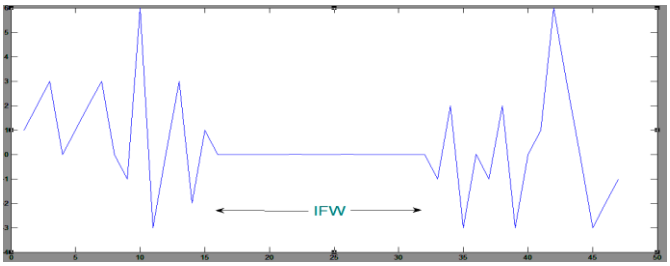


Fig. 2.4: Cross Correlation of LS Code

From Figure above, it is revealed that LS code has the same "Zero Interference Windows" as that of LA code. In the window the auto-correlation value is an impulse and the cross correlation value is zero, and the width of this window is in relation with numbers W0 among c sequence and s sequence.

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2.3 THE DESIGN OF LAS CODE AND THE SIMULATION OF CORRELATION CHARACTERISTIC

LAS code is made up of LA code and LS code, and LA code takes action of spread numbers of access Sequence,
and LS code is basic multiple that subscribes access code. In order to design LAS code, LS code is inserted into LA code, so it enhances the duty ratio of LA code, and optimizes the feature of "Zero Interference Window",

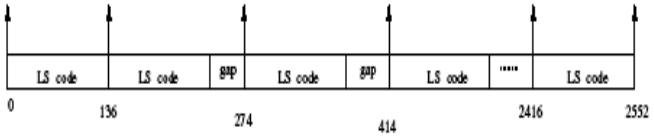

Fig.2.5: LS code representation

Thus it has quite favorable auto-correlation and cross correlation characteristics. Apply above designed LA Code and LS code to design two LAS codes, and make simulation as follows:
From figure 2.6 & 2.7, we predict that LAS code has small cross-correlation and has zero cross-correlation in the "Zero Interference Window", and it can reach to ideal effect when it transmits voice and data in the same radio frequency and the same network channel.

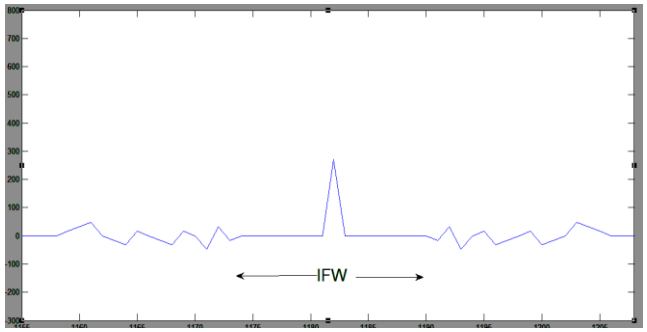

Fig. 2.6 Auto correlation of LAS code

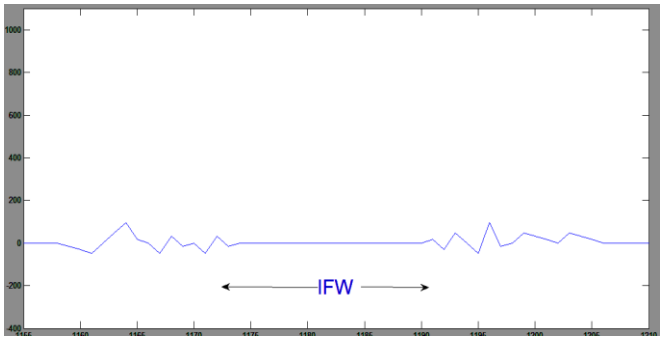

Fig. 2.6 Cross Correlation of LAS Code.

In a word, in order to reduce the ISI to zero, the autocorrelation values of each address code should be an impulse, namely auto-correlation values should be all zero at any offsets except zero offset. In order to reduce the MAI to be zero, the cross-correlation among each address codes should also be zero at any offsets. The autocorrelation value of zero offset is called peak, and the auto-correlation and cross-correlation values of other offsets are called their sub-peaks. The ideal autocorrelation and cross-correlation functions should have no sub-peaks, so LAS code can make auto-correlation and cross-correlation functions reach to the ideal features, and it takes action to eliminate and suppress ACI, ISI and MAI more effectively which enhances system capacity, spectrum efficiency and transmission rate largely.

3 DIFFERENCE BETWEEN TRADITIONAL CDMA AND LAS-CDMA

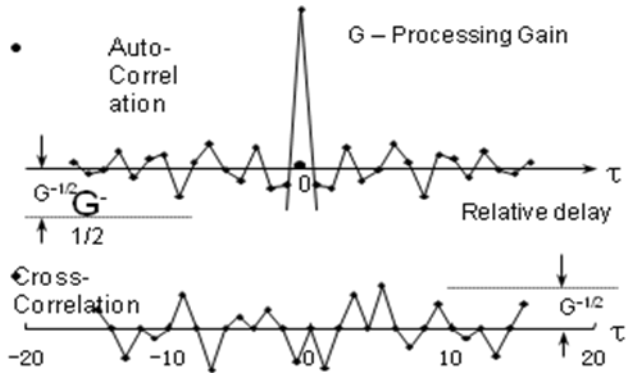

Fig. 3.1: Auto correlation and cross correlation of traditional CDMA codes

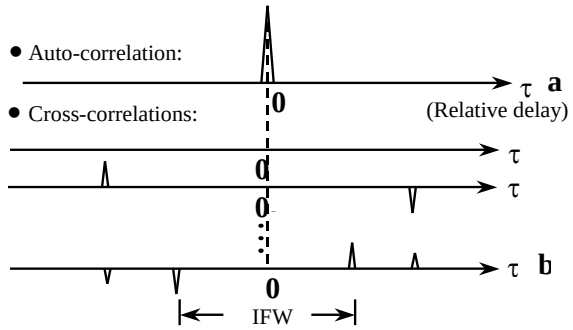

Fig. 3.2 Auto correlation and cross correlation of LAS codes

4. CONCLUSION

The paper illustrates the outstanding feature of LAS Code of having "Zero Interference Window", through simulation and analysis and in the Zero Interference window, auto-correlation and cross-correlation values can reach to an ideal effect, thus the excellent correlation feature enable it to be applied to many domains, such as TD-CDMA, FD-CDMA, Public Mobile Communication, Private Mobile Communication, Satellite communication Navigation exploration etc. When it is applied to different domains, it will bring different technology revolutions.

REFERENCES

i. *Daoben Li, "A High Spectrum Efficient Multiple Access Code" Fifth Asia Pacific Conference on Communication,1999 . pp.: 221-226 & 598-605.*

ii. *Chen-Yan Lai, Hsiao-Chiu "On LA code performance Analysis for LAS CDMA Communication" sixth IEEE Conference on Mobile and Wireless Communication June 2004.*

iii. *Yang Zhao,Wei Sun, "On the design and performance Analysis Of LAS spreading codes.*

iv. *Hua Wei " On the Uplink performance of LAS-CDMA" IEEE Transaction on wireless communication vol-5 May-2006.*

v. *Byoung-Jo Choi "On the design of LAS spreading codes" IEEE 56th 2002.*

vi. *Martin Haardt "Are LAS code a miracle" pp 589-591 Dec-2001.*

vii. *C.Y.Lai "On the construction of LA codes in LAS-CDMA Taiwan p.33 10-12 Dec-2003*

viii. *J.G.Proakis Digital Communication Mc-Graw Hill International edition 3rd pp.160-230,330-354,737-743,762-802.*

ix. *Li Daoben. "Some basic relations and comparisons Between Traditional CDMA and LAS-CDMA"[J]. Telecommunications Science. 2002, 10: pp. 16-19*

x. *S. Stanczak, H. Boche, and M. Haardt, "Are LAS codes a miracle?"[J]. In GLOBECOM'01, vol. 1, (San Antonio, Texas), pp.589-593, IEEE, Nov.2001.*