BER simulation analysis of PRS - OFDM systems with MLSD

Ilia Iliev[1], Stanio Kolev[2] and Stoicho Manev [3]

Abstract – **In the presented paper investigations, concerning the correlation of one of the main parameters in the communication systems: BER from the SNR by fixed carrier frequency offset ε, have been carried out. Systems without PRS and systems with PRS have been studied. The using of MLSD is a way to improve BER performance by PRS signals detection.**

Keywords – ICI, PRS, OFDM, BER, Correlative coding, MLSD

I. INTRODUCTION

OFDM systems have been widely used in the digital communication systems. Due to the **frequency offset ε** the inter subcarriers interference (ICI) increases. This leads to negative effect to the BER performance. In this work comparison between the simulation manner obtained values for BER, concerning different polynomials for PRS coding, has been made.

II. SYSTEM MODEL

The block diagram of the investigated communication system is presented bellow [3]:

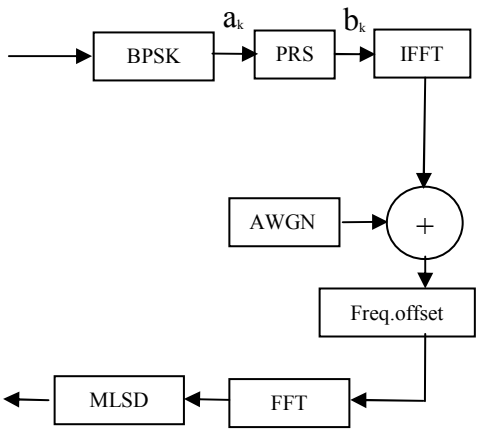

Fig.1. Block diagram of the communication system with 1- D coding block and MLS Decoder

Here the following abbreviations have been used:

BPSK: binary phase shift keying;
PRS: partial response signalling;
IFFT: inverse fast Fourier transform;
FFT : fast Fourier transform;
AWGN: additive white Gauss noise.

MLSD - Maximum Likelihood Sequence Detector.

The information has been coded by means of BPSK. After this operation PRS coding has been done. The following polynomials:[1], [4,-3,-1], [-3,2,1] and [3,2,-1] have been investigated. The first polynomial with coefficient [1] is equivalent to the case, when system without PRS coding is used.

The next operation in the system model is IFFT. The signal, obtained after the IFFT, is transmitted in base band through channel with additive white Gauss noise. Frequency offset ε has been considered.

The receiver includes FFT. The detection has been carried out by means of MLSD decoder. Vitterby algorithm has been used and the received sequence has been detected. In the detector channel estimate impulse response has been used. Traceback depth for equalizer is equal to 12.

III. EXPERIMENTAL RESULTS

Results are obtained by means of number of simulations. On the figures bellow the experimental results are shown.

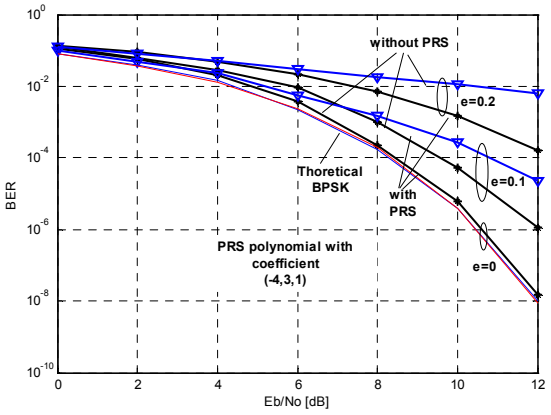

Fig. 2. Study of BER of PRS-OFDM system using a polynomial with coefficients (-4 3 1)

The simulation environment is Matlab .

The simulation results are obtained under the following conditions: the parameter ε has been changed BER has been measured.

[1] Ilia Iliev, Assoc.prof. in the Faculty of Telecommunications at Technical University of Sofia, 8 Kl. Ohridski Blvd, Sofia 1000, Bulgaria, E-mail: igiliev@tu-sofia.bg

[2] Stanio Kolev Assis. with the Faculty of Telecommunications at Technical University of Sofia, 8 Kl. Ohridski Blvd, Sofia 1000, Bulgaria, E-mail: skolev@tu-sofia.bg

[3] Stoicho Manev Assis. with the Faculty of Telecommunications at Technical University of Sofia, 8 Kl. Ohridski Blvd, Sofia 1000, Bulgaria

The comparison between the obtained and the well known in the scientific literature results allows general estimation to be made and can be used as methodology for choice of appropriate coefficients for PRS polynomials, where the ICI has been minimized without decreasing the BER.

For Fig.2 when ε = 0,1 and SNR is greater than 7 dB there is an improvement of BER, if PRS coding is used. This is evident on the chart (the 4-th line from the bottom up (the blue line) refers to OFDM system without PRS) and the 3-th line from the bottom up (the black line) refers to OFDM system, using a PRS polynomial (4,-3,-1).

When ε = 0,2 and SNR is greater than 4 dB improvement is observed if PRS coding is used. This is evident on the chart - the third pair of curves (blue and black) from the bottom up.

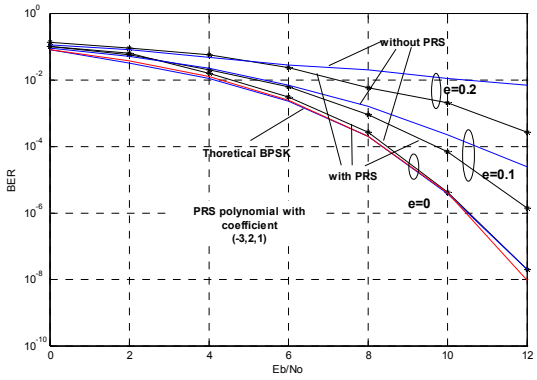

Fig. 3. Study of BER of PRS -OFDM system using a polynomial with coefficients (-3 2 1)

For Fig.3 when ε = 0,1 and SNR is greater than 6 dB there is an improvement of BER, if PRS coding is used. This is evident on the chart (the 4-th line from the bottom up (the blue line) refers to OFDM system without PRS) and the 3-th line from the bottom up (the black line) refers to OFDM system, using a PRS polynomial(-3,2,1).

When ε = 0,2 and SNR is greater than 5 dB improvement is observed if PRS coding is used. This is evident on the chart - the third pair of curves (blue and black) from the bottom up.

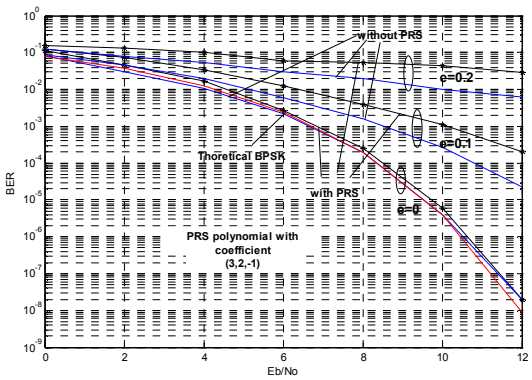

Fig. 4. Study of BER of PRS - OFDM system using a polynomial with coefficients (3 2 -1)

For Fig.4 when ε = 0,1 and SNR is greater than 7 dB there is an improvement of BER, if PRS coding is used. This is evident on the chart (the 4-th line from the bottom up (the blue line) refers to OFDM system without PRS) and the 3-th line from the bottom up (the black line) refers to OFDM system, using a PRS polynomial (4, -3, -1)

When ε = 0,2 and SNR is greater than 4 dB improvement is observed if PRS coding is used. This is evident on the chart - the third pair of curves (blue and black) from the bottom up

IV. Conclusion

The using of MLSD is a way to improve BER performance by PRS signals detection. After number of experiments, selection of polynomials set, used in OFDM systems with PRS is possible. A significant improvement in CIR, compared to conventional systems has been carried out. The results of simulation experiments have shown that PRS-OFDM system, using polynomials with coefficients (4, -3, -1), (-3, 2, 1), (3, 2, -1) in the PRS simulation model, give an improvement of CIR compared with the OFDM system without PRS.

References

[1] P. Kabal and S. Pasupathy, "Partial response signaling," IEEE Trans. Commun., vol. COM-23, pp, 921-925, Sept. 1975

[2] Proakis, J.G, "Digital Communications", 2"d Edition, McGraw-Hill, l989.

[3] Zhao Y.,Jean-Damien L., and Sven-Gustav H.,"Intercarrier Interference Compression in OFDM Comminication Systems by using Correlative Coding",IEE Commun. Lett.,vol 2,pp.1089-7798,August 1998

[4] M. Russell and G. J. Stuber, "Interchannel interference analysis of OFDM in a mobile environment," in Proc. IEEE Vehicular Technology Conf., 1995, pp. 820–824.

[5] Hua Zhang and Ye (Geoffrey) Li "Optimum Frequency-Domain Partial Response Encoding in OFDM System" IEEE TRANSACTIONS ON COMMUNICATIONS, VOL. 51, NO. 7, JULY 2003

[6] EE 379B - Digital Communication II: Coding; John M. Cioffi , http://www.stanford.edu/group/cioffi/

[7] Kyoung-Young Song, Jae-Dong Yang, Xianglan Jin, and Jong-Seon No "Quadrature Partial Response Signaling Based on Alamouti Code " ISIT 2009 Seoul Korea,June 28-Juli 3,2009

[8] Kolev St. "A New Wireless PRS-OFDM Simulation Model" CEMA'10, Athens, 2010