Iterative Channel Estimation for Block Transmission Systems without Cyclic Prefix

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1. Abstract

This paper proposes iterative channel estimation algorithms for block transmission systems without cyclic prefix (CP). Which utilize the feedback information in a form of Log-likelihood ratio (LLR) to estimate the channel, where Chained Turbo Equalization (CHATUE) algorithm is used to eliminate the CP. The computer results shown that the proposed iterative channel estimation algorithms can achieve good performance without CP.

2. Introduction

The next generation of cellular wireless requires much higher data rates or spectral efficiency. Block transmission using CP as a Guard Interval (GI) to avoid the inter-block-interference. With the CP-Transmission, the channel matrix has a circulant structure to reduce the complexity. However, CP-transmission systems decrease in power and spectral efficiencies. CHATUE [1] has been proposed to solve this problem. With the CHATUE algorithm, as shown in Fig. 1, which exchange the LLR between the equalizer and decoder in different blocks over the equalizer' chain, inference components can be cancelled without having to transmit CP. CHATUE utilizes permutation matrix J to convert the channel matrix from Toeplitz structure into circulant structure. Its performance improvement and superiority for Single Carrier Frequency Division Multiple Access (SC-FDMA) systems over the conventional CP-Transmission has been shown in [2].

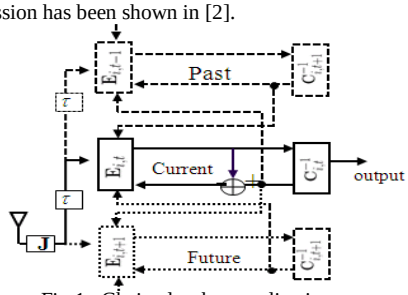

Fig.1 Chained turbo equalization

However, those papers consider only perfect channel estimation. This paper is to clarify this issue, and confirm that how much the sensitivity of CHATUE algorithm to the channel estimation errors. We proposed several new iterative channel estimation algorithms based on the conventional channel estimation algorithms. The interference (Fig. 2) between training sequence and data blocks can be eliminated by using the chained structure. After making significant modifications according to the CHATUE algorithm, three channel estimation techniques are verified in this paper: 1) Least Square (LS-H) channel estimation with hard decision. 2) LS channel estimation with soft decision. 3) Maximum Likelihood (ML) channel estimation with soft decision.

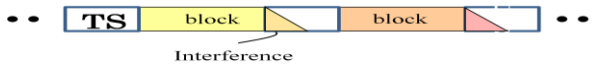

Fig.2 Frame structure

3. Simulations and Conclusion

A Single-Input-Single-output system without CP is considered. Each block consists of 512 Binary Phase Shift Keying (BPSK) symbols and training sequence (TS) is 35. The error-correcting code bits are generated using rate 1/2 memory 2 Nonsystematic Recursive Convolutional Code (NSRCC) encoder. Each channel path is generated using Jakes model, the overall channel of memory 32, the channel is assumed to be block fading, at Doppler spread (i.e., $f_d T_s = 10^{-5}$) , and 6 iterations are performed.

Fig. 3 shows the transmitter and iterative receiver structure without CP. Fig. 4 shows the ML/LS achieve good performance in terms of BER (i.e., 1.7 dB away from perfect channel estimation).

Simulation results demonstrate CHATUE algorithm can achieve good performance when considering the channel estimation errors.

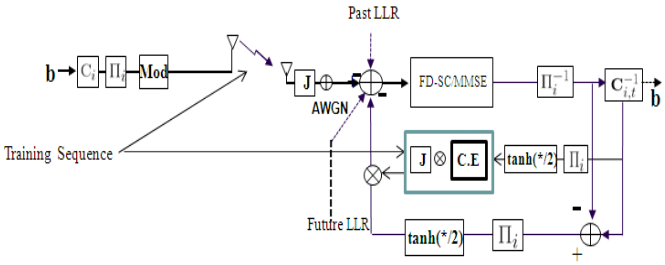

Fig.3 Block diagram

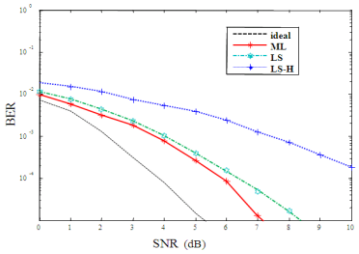

Fig. 4 BER Performance

References

[1] K. Anwar, H. Zhou, and T. Matsumoto, "Chained Turbo Equalization for Block Transmission without Guard Interval," in *IEEE VTC-spring 2010*, May 2010.
[2] H. Zhou, K. Anwar, and T. Matsumoto, "Chained Turbo Equalization for SC-FDMA Systems without Cyclic Prefix," in *IEEE Globecom workshop 2010*, Miami, USA.