

OFDM-BASED POWER LINE COMMUNICATION ENHANCEMENT USING RSC CODING WITH ADAPTIVE NOISE COMPENSATOR

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ABSTRACT: IN this paper ,we propose a RSC coding combined with adaptive noise compensation to minimize the interference and path effects with better performance than the turbo codes at very low bit error rate and high coding rate. RSC encoder/decoder, mapper/DE mapper are inserted and pilot insertion block for enhancing the preliminary estimation of OFDM. Compensator is based on impulse bursts estimation using a new clipping and blanking function, estimation of SNR and PAPR. Compare to the existing system, The proposed system gives better performance at high coding rate.

KEYWORDS:

Power-line communication(PLC),Orthogonal frequency division multiplexing modulation(OFDM),Recursive systematic convolutional code (RSC), adaptive impulsive noise compensator.

INTRODUCTION: Present days, the PLC systems are more interest because they can be used for transmitting data over the industrial area or residential area. PLC offers high speed data, video, image and voice services to the customers. Low cost implementation is the main advantage of PLC technology with several challenges. PLC also receive much attenuation due to the connectivity over wider area and availability of power lines. To overcome noisy environment the compensator is used. PLC system requires robust, efficient modulation and coding schemes. Two impairments to the PLC system are i)multipath propagation

which is characterized by slow fading or Ricean fading scenarios and ii)impulsive noise which is characterized by asynchronous scenarios. OFDM is widely used modulation scheme in PLC channels against noise and multipath effects. Number of channel models found in literature with the number of topologies, network locations, frequency bands, etc.

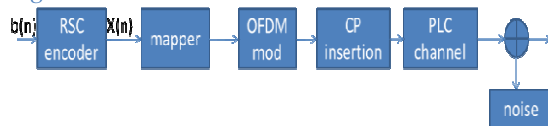
Yassine Himeur proposed turbo coding combined with adaptive noise compensator to reduce the burst errors & multipath effects. Turbo encoder/decoder is used for coding in this system. Zimmermann's top-down (0.5kHz-20MHz) model is used which is based on physical signal propagation effects in PLC networks with impedance mismatching and different branches. Wada hosny investigates the BER performance of 16-QAM constellation with OFDM with the presence of impulsive noise and background noise over multipath PLC channel. Impulsive noise modeled as Middleton class A, background noise modeled as AWGN. Jing Lin proposed impulsive noise as a sparse vector in the time domain with no assumptions and applied sparse Bayesian learning method for the estimation and mitigation with no training. Mario Bogdanovie proposed least square estimation algorithm to increase the error correction on the receiver side and decrease the data transmission errors issued by amplitude and phase distortions. Algorithm is based on the synergy of block and comb type pilot arrangement in LS channel estimation. P.Amirshahi's system overcome multipath fading and frequency selectivity along with manmade noise and investigates indoor power line channel with burst impulsive noise. Wu Dan's system reduces the loss due to effects in the channel. OFDM multicarrier

transmissions technique decreases ISI and Selective fading. M.Nandakumar proposed a system that “estimate BER and computational complexity for OFDM using modulation schemes” to decrease the computational complexity versions of low cost OFDM system for the implementation of clustered OFDM system for the data transmission in pass band frequency .Raju Hormis’s system is PAM based coded modulation scheme that combines LDPC and maximum distance separable block codes to achieve high spectral efficiency, low decoding complexity and better the performance in the presence of ISI. rest of this paper is about RSC coding, PLC channel characteristics, Impulsive noise model and OFDM transmission technique.

SYSTEM DESCRIPTION:

RSC ENCODER:RSC encoder constructed from the standard convolutional encoder by feeding back one of the outputs. It consists channel encoder and interleaver. interleaver randomizing the code maintaining enough structure to permit decoding. Encoder produces codes with low weights with fairly low probability but same input may still cause low weight output. RSC codes have an infinite impulsive response. If a data sequence is consisting of a 1 that is followed by series of 0’s enters the RSC encoder, code sequence will be generated containing both ones and zeros for long as the subsequent data bits remain zero, that is RSC encoders will tend to generate high weight code sequences for groups of data bits spread far apart in the input sequence.

Fig1:RSCencoder



CHANNEL MODEL OF PLC: This PLC channel is based on the top-down model and it considers black box and set of measurements are gathered by exciting the channel with reference

signal in either Time domain or Frequency domain. PLC channel has bandwidth of 500kHz to 20 MHz and frequency response expressed in terms of transmission.

$$H(f) = \sum_{i=1}^N g_i \exp(-(a_0 + a_1 f^k) d_i) \exp(-2\pi f d_i / v_p)$$

g_i =weighting factor, a_0, a_1 =attenuation factor, k =exponent, $v_p=c_0/2$.

TRANSMISSION MODEL: Binary data stream block with length $N_C/2$. $b(n)=[b_0(n), b_1(n), \dots, b_{N_C/2-1}(n)]^T$ Coded data stream $C(n)=[c_0(n), c_1(n), \dots, c_{N_C-1}(n)]^T$ is permuted by random interleaver and mapped by QAM or BPSK mapper. CP insertion block is for reducing ISI and maintaining the orthogonality of OFDM –PLC in multipath PLC. Obtained signal is transmitted through the noisy PLC channel with frequency response $H(f)$.

OFDM MOD:OFDM with N_c sub carriers partitioned into N_p , N_d and null tones. received signal is described as $R_k(n)=H_k(n)S_k(n)+W_k(n)$ after DFT in the OFDM modulation. $R(n)$ is frequency domain output vector, $H(n)$ is frequency domain channel vector, $W(n)$ is frequency domain noise vector, $S_k(n)=P$ for all pilot tones. $S_k(n)=0$ for all null tones, $S_k(n)=X_k(n)$ for all data tones. $W(n)$ =frequency domain of AWGN $Z(n)$ +frequency domain of impulsive noise $I(n)$.

RECEPTION MODEL: Proposed receiver model can be considered as an iterative decoder structure that combines adaptive impulsive noise compensator algorithm and RSC decoding algorithm at every iteration, extrinsic information is fed into the channel estimation. Received signal is obtained after removing the CP and demodulates the N_c samples of every OFDM block and DE mapping data tones to the nearest position in constellation plot then received signal is passed through the compensator and gives estimated signal. Parity bits and a priori signal which is produced by SISO decoder are used in equalized symbol sequence.

RSC DECODING: Decoder should be SISO and it calculates LLR for received signal. The decoder

section consists of interleaver, channel estimator, MAP decoder and interleaver. MAP decoding includes the formation of a posteriori probabilities of each information bit followed by choosing the data bit value corresponding to MAP probability for that data bit. MAP algorithm is an optimal decoding than the ML algorithm. While decoding the decoder receives as input a SOFT value of the signal. Decoder provides the estimation of the same set of data bits but in a different order due to the presence of interleaver.

Fig2:RSCdecoder



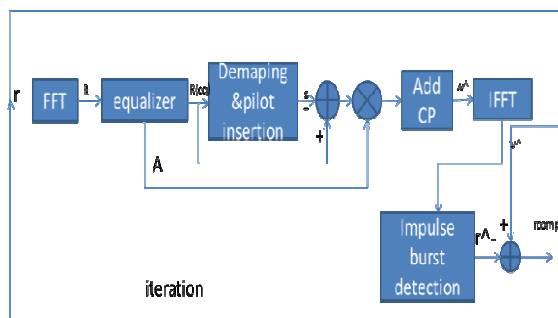
ALGORITHM FOR ADAPTIVE IMPULSIVE NOISE COMPENSATOR:

STEP1: $\hat{H}(n) \equiv H(n)$ where $\hat{H}(n)$ is the estimated value of the frequency domain channel vector of the OFDM symbol $H(n)$.

STEP2: Estimate the variance of total noise. $\sigma^2 = 1/N \sum_{k=0}^{N-1} |W_k(n)|^2$

STEP3: Estimate the impulsive noise samples by using a new clipping and blanking function.

Fig 3:Adaptive impulsive noise compensator



STEP4: Time domain response of the estimated received signal is derived by subtracting the estimate impulsive noise from the time domain response of received signal.

STEP5: Previous steps are repeated in order to get the best performance in terms of BER and MSE.

PLC NOISE MODEL: Interference is generated by the impulsive noise at the PLC receiver are

modeled by Middleton class A distribution is described by two factors i)impulsive index, ii)Gaussian to impulse noise power ratio $P_A(k) = \sum e^{-A} (A^m/m!) (1/\sqrt{2\pi}\sigma_m) \exp(-x^2/2\sigma_m^2)$ or Poisson noise model $P(t) = P_K(T=t) = (\lambda t)^k/k! \exp(-\lambda t)$, $k=0,1,\dots$

CONCLUSION: In this paper, we proposed a RSC-AINC receiver for an OFDM broadband PLC system. Proposed adaptive noise mitigation algorithm performs an iterative estimation and suppression of the impulsive noise generated over the PLC channel. By using this recursive systematic convolutional code the system gives better performance at high coding rate with less latency and complexity.

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