Optimize the use of Power Line Communication OFDM System with Intelligent Network using Channel Coding

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Abstract:

In this paper, the optimization can be used in conjunction with coding have been investigated. The thesis is to improve the power line communication OFDM modulation parameters have been used. So the first introductory speech communication power line communication systems, parameters and characteristics of the systems we have examined. Then we paid the OFDM modulation and OFDM modulation structure for this purpose together with the corresponding relationship given. The modulation using OFDM, we have shown that the resulting line parameters can be improved. Finally, we provide simulation results show the validity of the method.

Keyword: Power line, noise, modulation, OFDM, error rates

1. Introduction

Expansion of high voltage transmission lines, along with the relative ease of its use as a transmission medium for communication purposes and is independent of the network communication links with other organizations, Many applications in power line communication devices as a reliable and inexpensive communication medium in the transmission and distribution networks are accounted for.

In order to make better use of available bandwidth and high-capacity data transmission, Designing a special modem using advanced modulation techniques, proper coding, and digital signal processing techniques in regards to noise and also feature high-voltage transmission channel, will pave the way for achieving such a product. It is noteworthy that provide a variety of voice and data services using single multiplexer side of the modem is possible.

Modulation and Demodulation implement a digital strategy optimization requires some method to overcome the common problems in the area of telecommunications. Some of these problems can limit the signal to noise rate, non-uniformity of the channel characteristics in the frequency range used and cited a lack of synchronization of transmitter and receiver.

Power line carrier communication technology refers to the context through which the power transmission lines to send and receive digital signals.

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Power lines, power lines and telecommunications technology used to transfer information. Powerful companies have used this technology to send and receive information. For example, an electric company in London for a remote control high voltage networking equipment like switches, this technology was used.

In recent applications in home automation and machining techniques such as X10 or Lonwork low speed communication lines are used.

For this that we must examine the structure of a PLC network should be aware of this, we find that both PLC data transmission rate can be The PLC also in terms of data transfer speed that can be and both are of different applications. PLC with a little more speed in low voltage distribution lines are used and its use for measuring energy consumption in more remote or home automation system equipment is PLC technology for the benefit of the advantages such as high costs and lack of time to build a new communication channel among the best known methods in terms of geographical coverage.

The technology of wireless data speed is greater and can be appropriately chosen market broadband services.

Contacts a strong competitor in the telecommunications broadband network in power lines the inside of the building is excellent.

However, as power lines and other telecommunications technologies with technical challenges and obstacles facing its own.

The use of power distribution networks is to achieve broad band has attracted a lot of attention and has been the subject of many investigations. The grid line is not designed for data transmission, thus undesirable features a frequency range for communication purposes should be specified. To achieve high transmission rates for multimedia applications, consider the frequency bands suitable for digital transmission systems should be considered.

One of the best techniques to achieve these goals, the technique of orthogonal frequency division (OFDM) is [1] which can be considered modulation schemes. Using OFDM, frequency selectivity characteristics of the power line and is easily maintained. In addition, OFDM is very efficient for bandwidth allocation desired [2].

The OFDM spectrum consists of a number of sinc function as the Nyquist condition, summing them flat spectrum will have the same output frequency is complete [1]. Furthermore, the efficiency of OFDM positive thing to deal with ISI and full frequency, the digital processor is easily implemented, since this can easily be done by IDF

2. OFDM modulation

Special case of multi-carrier OFDM systems in high bit rate data to a parallel array is separated into lower bit rates and by each of these carriers are modulated. The main motivation of using OFDM, resistance to multipath channels is in the system [2, 1].

In wireless communications, especially at high frequencies, multipath propagation phenomena with high bit rate is a major obstacle, since the symbol ISI is causing interference. If the delay spread of the channel is to be a T_m symbol of the period and Become a symbol period T, Single-carrier system, each received symbol is influenced $\frac{T_m}{T}$ by the previous symbol, for high bit rate data corresponding to each symbol

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period due to the small ratio $\frac{T_m}{T}$ will be of great value. We will send you information via several sub-carriers, String of input symbols T to N the symbol period ranges, each with a longer period of time are divided. The symbols in a multipath channel causes each symbol is influenced by the previous symbol. Thus can be seen the error of multi-carrier ISI in single-carrier systems is far less.

Figure1 shows an OFDM modulator. The $\frac{N}{T_s}$ transmitted data symbol rate are divided into N categories. Each category contains N complex symbol which simultaneously carries on during N frame period equal to T_s the period of the symbols are sent. Signal sent within the n th time frame called. Thus, by the symbol $C_{n,k}$ on my carrier in my frame is sent.

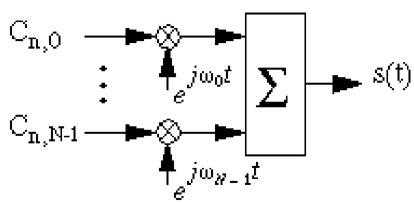

Fig. 1. OFDM modulator

OFDM modulator output signal can be expressed by the following relationships:

$$S(t) = \sum_{n=-\infty}^{+\infty} \left[\sum_{k=0}^{N-1} C_{n,k} . g_k (t - nT_s) \right] \quad (1)$$

Where the parameters are defined as follows:

$$g_k(t) = \begin{cases} e^{j2\pi f_k t} & 0 \le t < T_s \\ 0 & t < 0 \text{ or } t > Ts \end{cases}$$

$$f_k = f_0 + \frac{k}{T_s} \qquad k = 0,1,....,N-1 \quad (2)$$

$C_{n,k}$: Submitted by sub-carrier symbol k in frame n th time

N: number of sub-carrier OFDM

f_k : Sub-carrier frequency k

f_0 :the first sub-carrier frequency

OFDM demodulator is shown in Figure 2. The required filters are not shown for simplicity. As can be seen the carrier signal in the transmitter are calculated by multiplying the conjugate sub carrier is. Then integrated over time intervals and sampling the integrator output, transmitted symbols are retrieved. Orthogonality of sub-carriers of OFDM signal means that the product integral symbol to be sent and $g_k(t)$ received was in k branch.

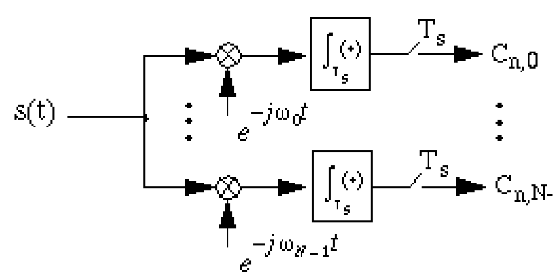

Fig2. OFDM demodulator

Not coded OFDM system increases the delay range is greater than the guard interval can increase the risk of system failure. Why ISI and ICI error increases. But the use of coded OFDM channel delay spread is affected items within the code diversity plays an important role in the system error probability. Diversity of the channel delay spread is a function code. Delay spread of the channel code can be improved by increasing diversity. Why the delay range is shorter than the corresponding coherent bandwidth [6].

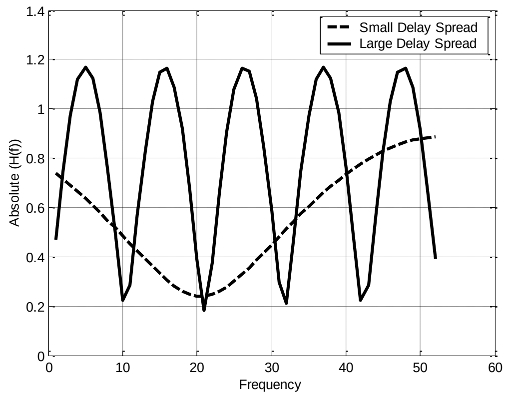

Fig. 3. Channel frequency response for the two-mode range with low latency and high

3. Implementation of OFDM modulation parameters to improve power line communication

Due to the power line networks with high impedance discontinuities, a signal with a certain amount of delay and weaken the cell receptors, which leads to reflection on the receiver is.

Thus, multipath signal propagation model to describe the characteristics of the sender channel seems to be appropriate.

In many cases, a stochastic model as a function of a random process H(n,f) is the kernel of random testing, where n is instead calculated H(f) is right.

Due to the increased signal attenuation and phase f, increases, H(n,f) stationary random process with respect to frequency. Examples of functions in this process are shown in Figure 4.

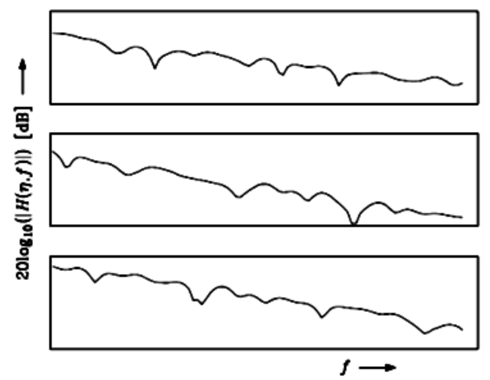

Fig. 4. Sample functions of stochastic processes non-fixed

For a given frequency f, H (n,f)dependent random variables with respect to the non-matching lines can be obtained on-line networks. Therefore, the central limit theorem can be good cause H (n,f) is a non-stationary Gaussian process with autocorrelation function is [7].

$$\varphi_{HH}(f1, f2) = \varepsilon\{H(n, f1) * H^*(n, f2)\} \qquad (3)$$

The second section describes the process we are. Average power transfer function is obtained as follows:

$$m(f) = \varepsilon\{H(n, f)\} \qquad (4)$$

By the power function can be approximated as follows:

$$P(f) = \varphi_{HH}(f, f) = \varepsilon\{|H(n, f)|^2\} \qquad (5)$$

In many cases, lead to a weakening of the parameters are different networks. Intermediate phase can be calculated as follows:

$$\varphi_0(\mathrm{f}) = \sum_i c_i f^{b_i} \qquad (6)$$

Where C_i is a normalization constant. For example, o2 = bi indicates that the phase transition is obtained by converting the field below. b_i = 0.5 and 1 = bi-phase skin effect describes the show as the average signal delay. Hence intermediate values are obtained easily.

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Normalized time random process are obtained as follows:

$$H(n,f) = \frac{H(n,f)}{\sqrt{P(f)}.e^{-j\varphi_0(f)}} \quad (7)$$

To prepare, the values of H(n,f) to consider a fixed frequency. In addition, the autocorrelation function for a random process typically normalized frequency is dependent differences [9].

Thus (f and n) H can easily be modeled using a stationary random process. An example of a normalized random process is shown in Figure 5.

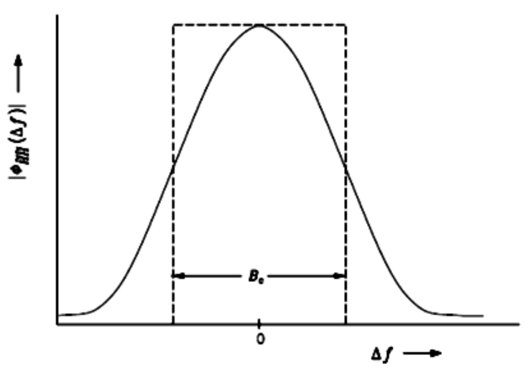

Fig. 5. An example of autocorrelated function

Thus, the bandwidth is always obtained as follows.

$$B_c = \frac{1}{\varphi_{HH}(0)} \int_{-\infty}^{+\infty} \varphi_{HH}(f) df \quad (8)$$

Was Hmantvrkhgfth distribution networks for energy transfer were made at a frequency of 50Hz. So use them as communication channels and creates problems such as high levels of noise.

Different types of noise in the PLC system and other methods of communication that can be modeled as AWGN.

First, we consider a single one of the OFDM Symbol. Sgnyalyng along the axis of the discrete frequencies over a non frequency selective fading channel is a discrete time. In describing the low-pass channel fading in the field of complex information channel mode, the following factors Kryrv a function is dependent channels [11].

$$s[k] = \lambda_k = H(\Delta f.k) \ , \ \ k = 0,1,\dots,D-1 \quad (9)$$

x [K] and y [k] represents the input and output channels have disappeared. Communication inputs and outputs are as follows:

$$y[k] = s[k].e^{j\varphi_c}.x[k] + n[k] \quad (10)$$

Where the carrier phase shift φ between the transmitter and receiver that can be assumed to be constant during one OFDM Symbol; N [k] represents Gaussian white noise.

By applying the stochastic model can be exploited Fade g [k] = s [k], where k is a constant. Risian distribution with probability density function (0) I can be expressed as follows [12].

$$PG(g|v) = \frac{2g}{\sigma_v^2}.\exp\left(-\left(\frac{g^2}{\sigma_v^2} + K_v\right)\right) I(2g\sqrt{\frac{K_v}{\sigma_v^2}}) \quad (11)$$

Where

$$\sigma_v^2 = \frac{P(\Delta f.v)}{K_v + 1} \quad (12)$$

$$K_v = \frac{m^2(\Delta f.v)}{P(\Delta f.v) - m^2(\Delta f.v)} \quad (13)$$

Normalized mode channel is as follows:

$$s[k] = \frac{s[k]}{\sqrt{P(\Delta f.v)}.e^{-j\varphi_0(\Delta f.k)}} = \frac{s[k]}{\sqrt{(1+K_k)\sigma_k^2 e^{-j\varphi_0(\Delta f.k)}}} \quad (14)$$

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B. neighboring nuclei are Kryrhay OFDM bandwidth. Therefore, the time-varying fading channel and the channel state can be considered constant for at least two consecutive Symbol.

Symbol of sending over a series of OFDM, as a discrete time stochastic process s [g, k] we consider. Each sample function will lead to a power line. Next, the characteristics of time-varying channels are considered.

Given the improved model to describe the time change yet. A reasonable choice of s [g, k] contains the random variables of a sample function H (μ, f) for fixed values of frequency, f = Δf-9 is. However, because we're looking results that the average power of the transmitter is correct, further sought to identify a sample function s [g, k] with regard to the frequency of discrete random process H (π, ΔF.0) we are.

On the other hand, to obtain a blur Mdlkanal appropriate, a functional analysis of the channel can be considered as a line network. Figure 6 Histogram H (Δf, μ) || for 1 <(Δfu) /MHZ<y and assuming average power function p (f) is to consider. Carrier space small enough to be considered an appropriate number of samples H (f) is located in the histogram [5].

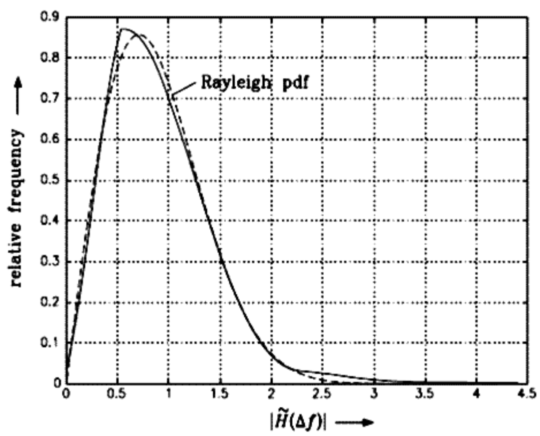

Fig. 6. Histogram of the normalized transfer function

4. Results and discussion

In this section, the capacity of the average rate during the signal to noise ratio is calculated using numerical integrals. Results are independent of the number of OFDM sub-carrier.

Figure 7 correlated to the results of a 8PSK and 16QAM and 32QAN and 4Q YPSK and, as expected, for a fixed data rate, OFDM channel fades over power lines require a rate greater than SNK is AWGN.

Figure 8 shows the effect of the parameter a on the channel capacity. As can be seen, the capacity of a specific SNK, decreases with aincreasing.

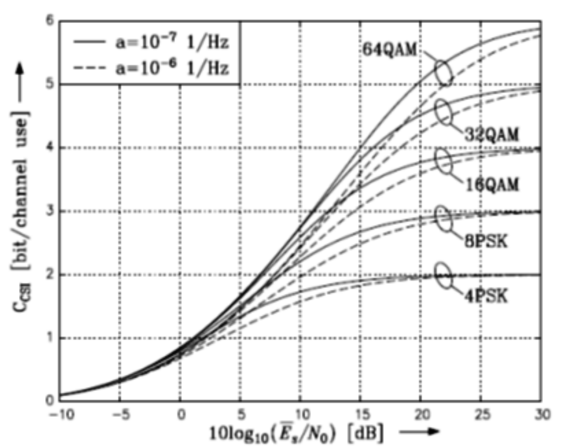

Fig. 7. Channel capacity for different modes

In relation to the average capacity SNK, use a larger bandwidth is equivalent to increasing the value of a. Figure 8 channel capacity curves for 2MHZ and Bt and Bt = ΣMHZ shows.

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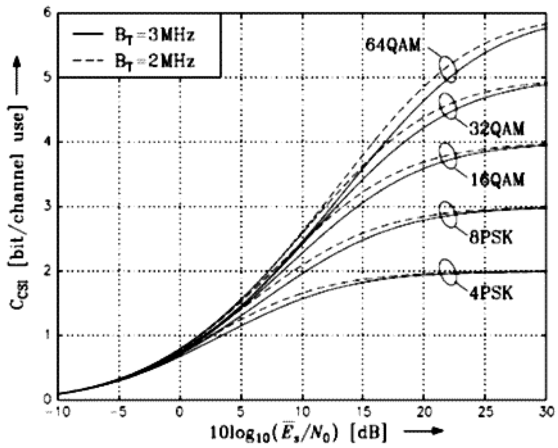

Fig. 8. Channel capacity for different conditions

Estimate the power spectral density:

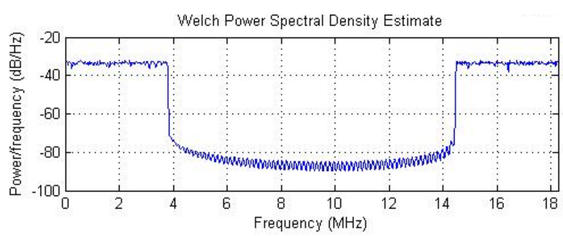

Fig. 9. Estimate the power spectral density

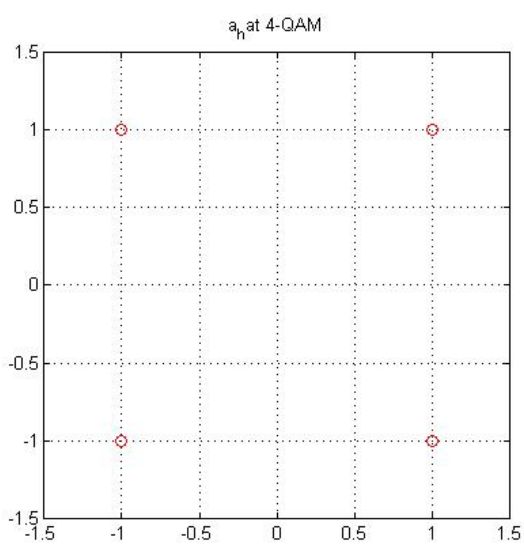

Fig. 10. 4-DAM modulation

5. Conclusion

PLC channel variable impedance in relation to major problems such as power lines, substantial noise attenuation and high attenuation lines, interference and multi-way channels have the effect of causing far worse behavior PLC channel channels show related to mobile communication nothing.

Channel modeling is generally based on the transfer function, and noise. Received signal as the sum of a filtered version of the signal and interference and reflections. It also depends on the channel characteristics of the frequency, time, and location of the transmitter and receiver.

Using OFDM, frequency selectivity characteristics of the power line and is easily maintained. In addition, OFDM is very efficient for bandwidth allocation desired. OFDM is a modulation technique that is widely used for advanced channel coding techniques are used.

In addition to channel coding, the coding is similar to other systems of interest and reduces the probability of bit error. Due to the use of frequency diversity coding offers higher profit.

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