

Semi-Blind Equalization for OFDM System Based On Modified Newton Method

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Abstract

Recent wireless broadband communication system like Multiple Input Multiple output(MIMO) joint with Orthogonal Frequency Division Multiplexing(OFDM).It works High data rate, better spectral effectiveness and high throughput quadrature amplitude modulation(QAM).This communication system provides unflinching communication & wide coverage. The main challenge to MIMO-OFDM system is to rescue of the Channel State Information (CSI) perfectly and coordinated between transmitter & receiver. Channel estimation technique based on semi-blind equalizer for Multiple Inputs Multiple Output (MIMO) for Rayleigh fading channel is proposed in this paper. A Modified Newton Method (MNM)for minimizing the conventional cost function and it has much low computational complexity than Newton method. MIMO-OFDM is popular because of its good quality data transmission rate and its robustness against multipath fading. The performance evaluation of channel estimation for semi-blind equalizer is carried out with Modified Newton Method (MNM) through Matlab simulation. The performance of channel estimation techniques MNM is evaluated and results are demonstrated,it has better performance than Gradient-Newton (GN)-based concurrent Constant Modulus Algorithm(CMA) with SDD scheme (GNCMA+SDD). It is also compared with pilot based Minimum Mean Square Error (MMSE) algorithm.

Keywords:MIMO-OFDM, QAM, MNM, CMA.

Introduction

1.1 OFDM (Orthogonal Frequency Division Multiplexing)

Orthogonal frequency division multiplexing (OFDM) is based on the multicarrier communications technique. The proposal of multicarrier communications is to divide the total signal bandwidth into number of subcarriers and information is transmitted on each of the subcarriers. Unlike the conventional multicarrier communication scheme in which spectrum of each subcarrier is non-overlapping and band pass filtering is used to extract the frequency of interest. In OFDM the frequency spacing between subcarriers is selected such that the subcarriers are mathematically orthogonal to each other. The spectra of subcarriers overlap each other but individual subcarrier can be extracted by baseband processing. This overlapping property makes OFDM more spectral efficient than the conventional multicarrier communication scheme.

The OFDM symbol is generated as follows:

Firstly, N data complex symbols are cushioned with zeros to get NS symbols that are used to compute the IFFT. The computation of IFFT is the critical OFDM symbol focused around the deferment spread of the multi-way channel; a particular janitor time must be chosen (say TG). A variety of specimens comparing to this janitor time must be taken from the beginning of the OFDM symbol and added at the end of the symbol. Also, the same number of specimens must be chosen from the end of the OFDM symbol and must be embedded in the starting.

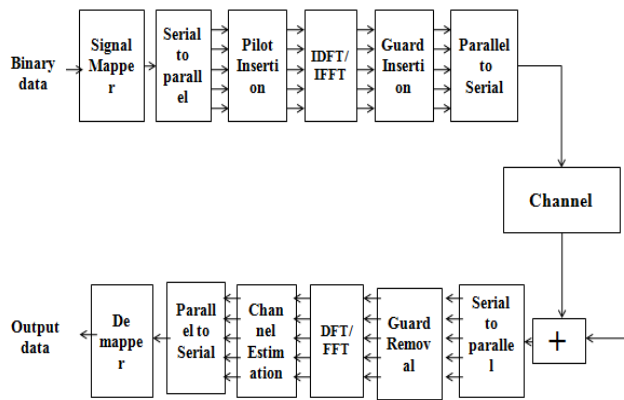


Figure 1 :Block diagram of OFDM System

1.2 MIMO-OFDM System:

In a MIMO-OFDM system with N subcarriers the individual data streams passed through OFDM modulators which perform an IFFT on blocks of length N followed by a parallel to serial conversion[1].

Wireless communication related to multiple transmit and receive antennas, which is called multiple-input multiple-output (MIMO) communication, can significantly increase data throughput and link range, efficiently combat fading, and greatly improve service quality, system capacity and reliability by only exploiting the same band-width as a single-input single-output (SISO) system. More importantly, it was shown in and that in a Rayleigh flat-fading environment, if all the propagation coefficients from transmitters to receivers are statistically independent and known in advance, a MIMO system has a very large capacity that increases linearly with the smaller of the number of transmitters and the number of receivers. On the other hand, to make better use of the frequency spectrum resources, quadrature amplitude modulation (QAM) schemes have become popular in numerous wireless network standards, because QAM signals have high availability of spectrum, good performance of transmission, and relative simplicity in modulation and demodulation. Owing to the aforementioned advantages, MIMO communication systems employing high throughput QAM signals have found widespread applications.

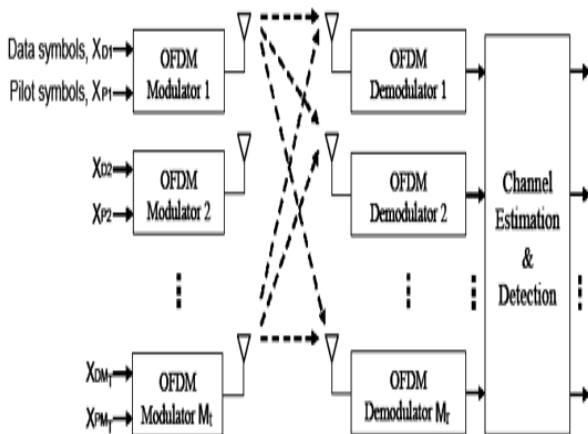


Figure 2:MIMO-OFDM System

1.3 Modified Newton Method

The idea for the ModifiedNewton method is similar to that for the Newton-Raphson method. The difference is that the tangent at the initial guess is used in the iterations, instead of the current tangent. To ensure that the tap weights rapidly converge to the optimum value, we propose a novel MNM. The advantage of this method over the regular Newton method, is that the system Jacobian is formed only once at the start of the step and factored only once if a direct solver is used. The drawback of this method is that it requires more iterations than Newton's method.

Instead of inverting the Jacobian $JF(x(p))$ on every iteration, it may only be inverted once per several iterations. In the context of systems, this approach may considerably reduce the computational cost. Its downside, though, is a slower convergence of the method, which is the case for both scalar equations and systems. Give an objective function $f(x)$, where x is a vector variable. Assume that the gradient of $f(x)$ can be decomposed into the following form

$$\nabla f(x) = A(x)x - b(x) \quad (1)$$

Where $A(x)$ and $b(x)$ are a positive definite matrix function and a vector function with respect to x , respectively. Let a search direction d_k be described by

$$d_k = X_{k'-1} - A^{-1}(X_{k'-1})b(X_{k'-1}) \quad (2)$$

Where k' is the iterative index.

By MNM+MMA+SDD, Here, the objective of adjusting the tap weights of the equalizer is to make $y_n(k) \approx S_n(k - k_n)$, where k_n is a delay time.

Performance Analysis

In the MIMO system, we are more apt to display the MSE and SER of all N users rather than the individual user's performance. The MSE and SER are respectively defined as,

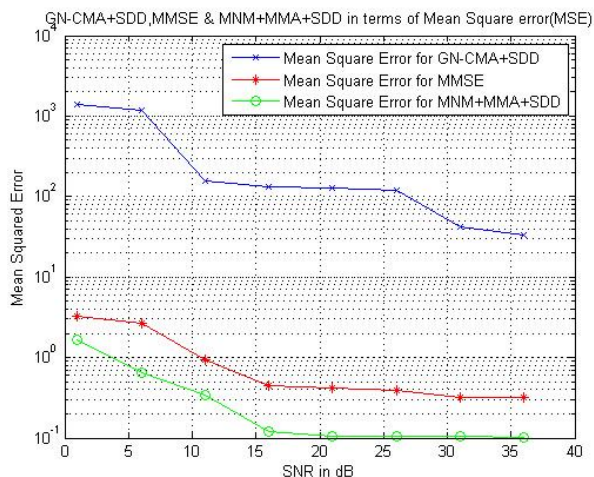
$$MSE = \frac{1}{N} \sum_{n=1}^N MSE_n \quad (3)$$

$$SER = \frac{1}{N} \sum_{n=1}^N SER_n \quad (4)$$

The modified Newton method presented here offers an increased rate of convergence over Newton's rule with no additional cost. In practice the modified method is found to offer greater efficiency in terms of total function evaluations than other so-called convergence methods. It is the re-use of previously computed values of the derivative that gives our modified method its numerical efficiency compared with the standard Newton method.

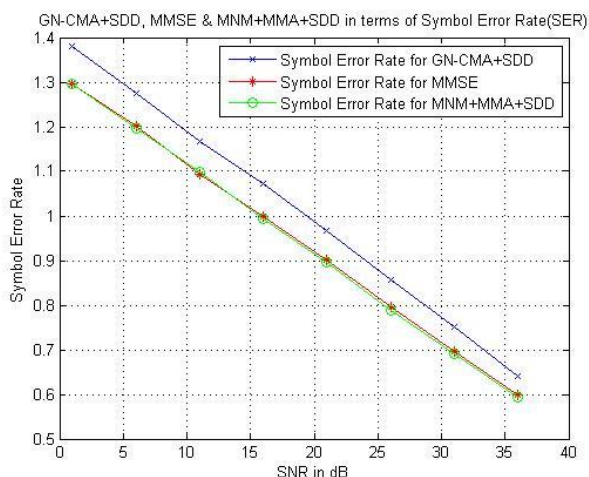
Simulation Results

1. MSE along with SNR



So by observing the above graphical results it is clear that, MSE is very less as compared with other method viz. GN+CMA+SDD & pilot based MMSE. So results are improved here.

2. SER along with SNR



In case of SER, it is observed that the values are less of MMSE & MNM+CMA+SDD than GN+CMA+SDD. But MMSE & MNM+CMA+SDD are almost same valued. Our modified Newton method is relatively simple and is robust; it is more likely to converge to a solution than are either the higher order schemes or Newton's method itself. A stopping criterion can be applied to our modified Newton method after each evaluation of either the function or its derivative. This feature is an additional advantage in terms of overall computational efficiency compared with methods that require several function or derivative evaluations in order to complete a full iteration.

Conclusion

Our modified Newton method is relatively simple and is robust; it is more likely to converge to a solution than are either the higher order schemes or Newton's method itself. This additional advantage in terms of overall computational efficiency compared with methods that require several function or derivative evaluations in order to complete a full

iteration.

The MNM is quadratically convergent. A novel MMA+SDD has been introduced for improving the performance symbol error rate. It has high computational precision. Combination with novel MNM the algorithmic complexity is reduced obviously. However, the computational complexity of the proposed method will increase with the increasing of the order of QAM signal, while that of the other methods remains nearly unchanged.

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