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Effect of Adaptive LMS Algorithm on Fast fading Channels in OFDM System

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Abstract:

Aim:

To implement Analysis of the Bidirectional LMS Algorithm overFast-Fading Channels and improve it by Adoptive LMS.

I INTRODUCTION:

WITH the advent of space diversity systems, decoupling users through channel aware signal processing techniques in the presence of multiple access interference (MAI)and noise has become an integral part of the system design .There are various processing techniques now widely adopting research and standards . Among them, linear combining methods are popular for their simplicity despite the fact that they are not optimum in a maximum likelihood sense. Two key linear combiners are zero forcing (ZF) and minimum mean squared-error (MMSE). Although they are not optimal ,the MMSE receiver satisfies an alternative criterion, i.e., it minimizes the mean squared error (MSE) and ZF is known to eliminate MAI completely.

The performance analysis of such linear receivers is of great interest in wireless communication as it provides abase line link level performance metric for the system. Today ,performance results for MMSE/ZF receivers are well known for micro diversity systems where co-located diversity antenna sat the base station communicate with distributed users . Macro-scale diversity combining has recently become more common from a variety of perspectives. Any system where both transmit and receive antennas are widely separated can be interpreted as a macro diversity multiple input multiple output (MIMO) system. They occur naturally in network MIMO systems and collaborative MIMO concepts and The performance of macro diversity systems has been investigated via simulation , but very few analytical results appear to be available. The reason for the lack of results is the complexity of the channel matrix that arises in macro diversity systems. When the receive antennas are collocated ,classical models and Kronecker correlation matrix has a Wishart form. Here, extensive results in multi variety statistics can be leveraged and performance analysis is now well advanced. In contrast, the macro diversity case violates the Wishart assumptions and there is no such distribution in the literature for macro diversity channel matrices for finite size systems. This makes most of the analytical work extremely difficult. The analytical complexity is clearly evident even in the simplest case of a dual source scenario .Despite this complexity, some analytical results are available for the dual user case in for macro diversity MMSE and ZF receivers.

In , they consider the statistical properties of the output signal to interference plus noise ratio(SINR)/signal to noise ratio (SNR) of MMSE and ZF receivers respectively and obtain high SNR approximations of the symbol error rate (SER). In the SER performance of macro diversity maximal ratio combining (MRC) has been exactly derived for arbitrary numbers of users and antenna configurations. The erotic sum capacity of the macro diversity MIMO multiple access channel is considered in where tight approximations of erotic sum capacity are derived in a compact form. Rayleigh fading is assumed for finite system sizes in and One of the analytical techniques used is also used here. sum capacity in logarithmic form is expressed as an exponential and argotic sum capacity is then written as the mean of a ratio of quadratic forms.

In this work, we have a very different starting point and consider the characteristic function (CF) of the SNR/SINR. The exponential in the CF also leads to a mean of a ratio of quadratic forms. Hence, the two studies produce similar ratios at this point in the analysis and the same technique ,namely a Laplace type approximation is employed both here and to simplify the result. Note that the analysis leading up to the ratio of quadratic forms and following the Laplace approximation is quite specific to the individual problems considered. As a result, gives approximate results for argotic capacity and here, approximate SER results and SNR/SINR distributions are obtained. Note that some of the quadratic forms encountered here are of a different form to those .On an another front, an asymptotic large random matrix approach is employed to derive a deterministic equivalent to the argotic sum capacity in. Similarly, an asymptotic approach is used to study cellular systems with multiple correlated base station (BS) and user antennas .In this paper, we extend the results in to more general user and antenna configurations. In particular, the contributions made are as follows:

1. We derive the approximate probability distribution function(PDF) and cumulative distribution function (CDF)of the output SINR/SNR of MMSE/ZF receivers. The approximate cumulative distribution functions are shown to have a remarkably simple form as a generalized mixture of exponentials.

2. High SNR approximations for the SER of MMSE/ZF receivers are derived for a range of modulations and these results are used to derive diversity order and array gain results. The high SNR results are simple, have a compact form and can be used to gain further insights into the effects of channel distribution information (CDI) on the performance of macro diversity MIMO systems.

II SYSTEM ANALAISI:

Existing System:

This project addresses the problem of channel tracking and equalization for multi-input multi-output(MIMO) time-varying frequency-selective channels. These channels model the effects of inter-symbol interference (ISI), co-channel interference (CCI), and noise. A low-order autoregressive model approximates the MIMO channel variation and facilitates tracking via a Kalman filter. Hard decisions to aid Kalman tracking come from a MIMO finite-length minimum-mean-squared-error decision-feedback equalizer (MMSE-DFE), which performs the equalization task. Since the optimum DFE for a wide range of channels produces decisions with a delay $\Delta > 0$, the Kalman filter tracks the channel with a delay. Achannel prediction module bridges the time gap between the channel estimates produced by the Kalman filter and those needed for the DFE adaptation. The proposed algorithm offers good trackingbehavior for multiuser fading ISI channels at the expense of higher complexity than conventional adaptive algorithms. Applications include synchronous multiuser detection of independent transmitters, as well as coordinated transmission through many transmitter/receiver antennas, for increased data rate.

Proposed System:

A bidirectional LMS algorithm is considered for estimation of fast frequency-selective time-varying channels with a promise of near optimal tracking performance and robustnessto parameter imperfections under various scenarios at a practical level of complexity. The performance of the algorithm is verified by the theoretical steady-state MSE analysis and experimental bit error rate (BER) results.

Extension System:

An exact algorithm is provided for finding the Least Median of Squares (LMS) line for a bivariate regression with no intercept term. It is shown that the popular PROGRESS routine will not, in general, find the LMS slope when the intercept is suppressed.Unlike conventional least squares (LS), there is no closed-form solution with which to easily calculate the LMS line since the median is an order or rank statistic. A general non-linear optimization algorithm performs poorly because the median of squared residuals surface is so bumpy that merely local minima are often incorrectly reported as the solution.

III LITERATURE REVIEW:

J. H. Winters,etal, (1984),This paper studies optimum signal combining for space diversity reception in cellular mobile radio systems. With optimum combining, the signals received by the antennas are weighted and combined to maximize the output signal-to-interference-plus-noise ratio. Thus, with co channel interference, space diversity is used not only to combat Rayleigh fading of the desired signal (as with maximal ratio combining) but also to reduce the power of interfering signals at the receiver. We use analytical and computer simulation techniques to determine die performance of optimum combining when the received desired and interfering signals are subject to Rayleigh fading. Results show that optimum combining is significantly better than maximal ratio combining even when the number of interferers is greater than the number of antennas. Results for typical cellular mobile radio systems show flat optimum combining increases the output signal-to-interference ratio at the receiver by several decibels. Thus, systems can require fewer base station antennas and/or achieve increased channel capacity through greater frequency reuse. We also describe techniques for implementing optimum combining with least mean square (LMS) adaptive arrays

H. Gao, P. J. Smith, and M. V. Clark, et al, (1998), We derive an exact closed-form solution for the reliability of an ideal M-branch MMSE (minimum mean-squared error) diversity combiner operating in a Rayleigh-fading channel with N interferers, each having some specified average power. The reliability is defined as the probability, taken over fading of the desired and interfering signals, that the combiner's output signal-to-interference ratio (SINR) is greater than some specified threshold. This kind of metric is important in evaluating the potential capacity improvements of using diversity combining and adaptive array processing in interference-limited wireless systems. Our result is remarkably simple, fast, straightforward to compute, and numerically stable. We show a set of special cases, which relate to standard results and reveal valuable insights into how this type of array processing operates in interference-limited environments.

J. H. Winters, J. Salz, and R. D. Gitlin, et al, (1994),For a broad class of interference-dominated wireless systems including mobile, personal communications, and wireless PBX/LAN networks, the authors show that a significant increase in system capacity can be achieved by the use of spatial diversity (multiple antennas), and optimum combining. This is explained by the following observation: for independent flat-Rayleigh fading wireless systems with N mutually interfering users, they demonstrate that with K+N antennas, N-1 interferers can be null out and K+1 path diversity improvement can be achieved by each of the N users. Monte Carlo evaluations show that these results also hold with frequency-selective fading when optimum equalization is used at the receiver. Thus an N-fold increase in user capacity can be achieved, allowing for modular growth and improved performance by increasing the number of antennas. The interferers can also be users in other cells, users in other radio systems, or even other types of radiating devices, and thus interference cancellation also allows radio systems to operate in high interference environments.

IV MATERIAL AND METHODS MIMO:

The radio communications, multiple-input and multiple-output, or MIMO ,the use of multiple antennas at both the transmitter end and receiver end to improve communication performance. It is one of several forms of smart antenna technology.MIMO is a technology that has attracted attention in wireless communications, because it offers significant increases in data through put and link range without additional bandwidth or increased transmit power. It achieves this aim by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency ie, more bits per second per hertz of bandwidth and to achieve a diversity gain that improves the reduced fading. Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n {Wi-Fi}, 4G, 3GPP Long Term Evolution, Wi MAX and HSPA+.

V Rayleigh fading:

Rayleigh fading is a statistical model for the effect of a propagation environment on a radio signal, such as that used by wireless devices .Rayleigh fading models assume that the magnitude of a signal that has passed through such a transmission medium will vary randomly, or fade, according to a Rayleigh distribution the radial component of the sum of two uncorrelated Gaussian random variables.Rayleigh fading is viewed as a reasonable model for troposphere and ionosphere signal propagation as well as the effect of heavily built-up urban environments on radio signals. Rayleigh fading is most applicable when there is no dominant propagation along a line of sight between the transmitter and receiver. If there is a dominant line of sight, Rician fading may be more applicable .Rayleigh fading is a reasonable model when there are many objects in the environment that scatter the radio signal before it arrives at the receiver. The central limit theorem holds that, if there is sufficiently much scatter, the channel impulse response will be well-modeled as a Gaussian process irrespective of the distribution of the individual components. If there is no dominant component to the scatter, then such a process will have zero mean and phase evenly distributed between 0 and 2π radians. The envelope of the channel response will therefore be Rayleigh distributed.

Calling this random variable R, it will have a probability density function:

$$p_{R(r)} = \frac{2r \; e^{-r2/\Omega}}{\Omega} \qquad ,r \geq 0$$

Where

$\Omega = E(R^2)$

The requirement that there be many scatterers present means that Rayleigh fading can be a useful model in heavily built-up city centers where there is no line of sight between the transmitter and receiver and many buildings and other objects attenuate, reflect, refract, and diffract the signal. Experimental work in Manhattan has found near-Rayleigh fading there. In troposphere and ionosphere signal propagation the many particles in the atmospheric layers act as scatterers and this kind of environment may also approximate Rayleigh fading. If the environment is such that, in addition to the scattering, there is a strongly dominant signal seen at the receiver, usually caused by a line of sight, then the mean of the random process will no longer be zero, varying instead around the power-level of the dominant path. Such a situation may be better modelled as Rician fading.

Consider that Rayleigh fading is a small-scale effect. There will be bulk properties of the environment such as path loss and shadowing upon which the fading is superimposed.How rapidly the channel fades will be affected by how fast the receiver and/or transmitter are moving. Motion causes Doppler shift in the received signal components. The figures show the power variation over 1 second of a constant signal after passing through a single-path Rayleigh fading channel with a maximum Doppler shift of 10 Hz and 100 Hz.These Doppler shifts correspond to velocities of about 6 km/h (4 mph) and 60 km/h (40 mph) respectively at 1800 MHz, one of the operating frequencies for GSM mobile phones. This is the classic shape of Rayleigh fading. Note in particular the 'deep fades' where signal strength can drop by a factor of several thousand, or 30–40 dB.

VI SYSTEM MODEL AND THE BIDIRECTIONAL LMS ALGORITHM:

We consider an unknown time-varying frequency-selective communication channel represented by anLc-tap fading vector fk = [fk,0 . . . fk,Lc−1]T with uncorrelated entries and assume the following discretetimecomplex baseband model at an epoch k given as

$$y_k = \sum_{l=0}^{L_c-1} f_{k,l}\, a_{k-l} + n_k = \mathbf{f}_k^T \mathbf{a}_k + n_k \qquad (1)$$

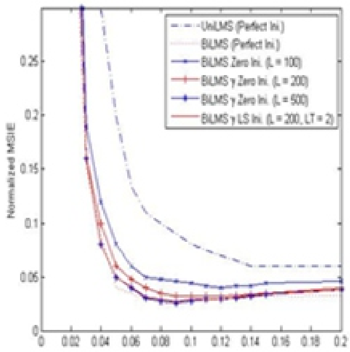
where yk is the observation symbol, ak = [ak . . . ak−Lc+1] T is the vector of data symbols chosen from a finite alphabet A in an independent and identical fashion, and nk is a circularly symmetric complex white Gaussian noise with zero-mean and variance N0.The bidirectional LMS algorithm is basically an extension of the conventional unidirectional LMS thatoperates both in the forward and the backward directions along an observation block. Defining ˆff k andˆfbk to be the channel estimates in the forward and the backward directions, respectively, the algorithm isgiven as

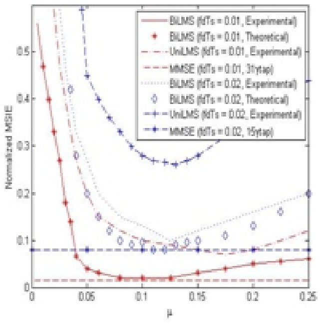
$$\hat{\mathbf{f}}^{f}_{k+1} = \hat{\mathbf{f}}^{f}_{k} + 2\,\mu\, e^{f}_{k}\, \mathbf{a}_k$$
$$\hat{\mathbf{f}}^{b}_{k-1} = \hat{\mathbf{f}}^{b}_{k} + 2\,\mu\, e^{b}_{k}\, \mathbf{a}_k$$

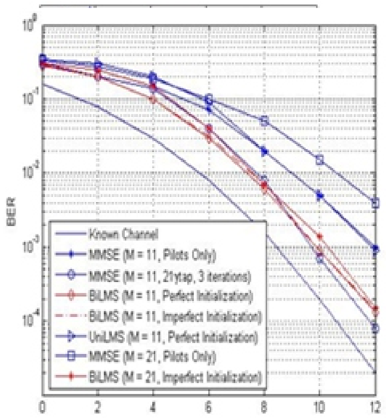
NLMS:

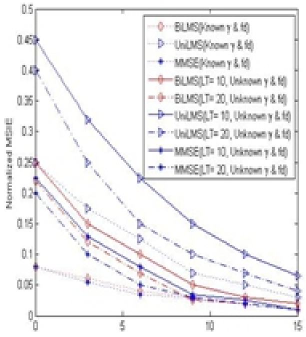
In wireless communication system and digital broadcast systems, the on-frequency RF (Radio Frequency) repeaters are installed to clear shadowing areas existing between base stations and mobiles [1-4]. However, on-frequency RF repeaters with high RF gain usually suffer from the oscillation problem caused by the unwanted feedback signal paths from the output of the RF repeater's transmit antenna to the receive antenna due to insufficient antenna separation.The so-called ICS (interference cancellation system) RF repeater synthesizes the feedback signal by estimating the feedback signal paths using an ADF (Adaptive Digital Filter) and then subtracts the unwanted feedback signal from the receive antenna signal. The ICS RF repeater can provide more antenna separation and thus can operate stably with higher RF gain than the conventional RF repeater. Various adaptive filtering algorithms have been reported to cancel the interference in ICS RF repeater.

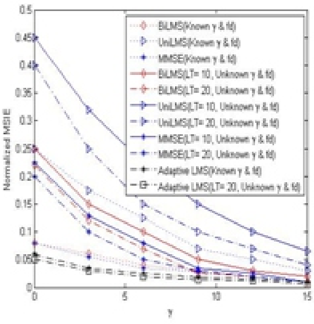
VII RESULT & DISCUSSION:

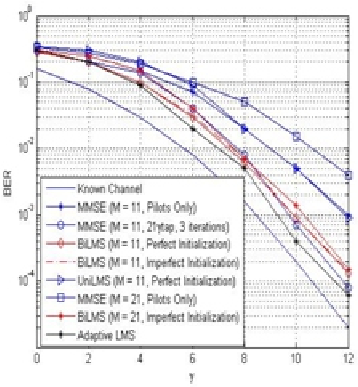












VIII CONCLUSION AND SCOPE OF WORK:

A bidirectional LMS algorithm is considered and analyzed over fast frequency-selective time-varying channels. The tracking performance of the bidirectional LMS is shown to be very close to that of the optimal MMSE filter in some settings of practical interest, and remarkably better than that of the conventional LMS algorithm. A step-size dependent steady state MSE together with the optimal step-size expressions are derived in order to provide a theoretical analysis, and the corresponding theoretical results show a good match to the experimental ones most of the time. The algorithm is also shown to be robust to imperfect initialization together with noisy Doppler and SNR information, and achieves BER results very close to that of the MMSE filter in various scenarios.When applying Least Median of Squares, coefficients are chosen so as to minimize the median of the squared residuals. Because the median is not sensitive to extreme values, it can outperform conventional least squares when data are contaminated. This paper makes two contributions to the LMS literature:

1)PROGRESS, the standard algorithm for fitting the LMS estimator, does not find the true LMS fit when the intercept is suppressed. Any computations based on the estimated slope (such as regression diagnostics and estimated standard errors) are also wrong.

2)For a bivariate regression with a zero-intercept, , an algorithmic method based on keeping track of the median squared residual is demonstrated.By applying Adaptive LMS we can decrease the normalized MSIE and improve BER performance.