Review on sparsely based adaptive channel estimation

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ABSTRACT— Work threshold of noise is not adaptive so it will not able to channel estimation in different scenario with same static threshold. Sparsity concept but it will not use for those channel which are not used sparsity based channel or less sparsity based channel channel estimation are used by iterative prediction but not converse with minimum error optimization. Reduce the channel noise by estimation or prediction of the noise distribution at receiver side but channel behavior is also varying, for example high sparsity to low sparsity. So used this type of method of frame work which select the adaptive threshold with optimized nature and also depend the behavior of noise in channel. In this proposed approach Reduce the probability error estimation and Reduce the mean square error on different threshold and channel sparsity.

KEYWORDS— FDM, MIMO;Sparsity; channel optimization

I. INTRODUCTION

Channel estimation is an important technique especially in mobile wireless network systems where the wireless channel changes over time, usually caused by transmitter and/or receiver being in motion at vehicular speed. Mobile wireless communication is adversely affected by the multipath interference resulting from reflections from surroundings, such as hills, buildings and other obstacles. In order to provide reliability and high data rates at the receiver, the system needs an accurate estimate of the time-varying channel. Furthermore, mobile wireless systems are one of the main technologies which used to provide services such as data communication, voice, and video with quality of service (QoS) for both mobile users and nomadic. The knowledge of the impulse response of mobile wireless propagation channels in the estimator is an aid in acquiring important information for testing, designing or planning wireless communication systems. The channel estimator gives the knowledge on the channel impulse response (CIR) to the detector and it estimates separately the CIR for each burst by exploiting transmitted bits and corresponding received bits. Signal detectors must have knowledge concerning the channel impulse response (CIR) of the radio link with known transmitted sequences, which can be done by a separate channel estimator. Transmission of a pilot channel together with the traffic channel is very valuable for estimating fading-channel parameters (including amplitude and phase). It is beneficial for detecting multipath rays so that rake fingers are efficiently assigned to the strongest multipath and making possible coherent reception and weighted combining of multipath components for a direct-sequence (DS) code division multiple access (CDMA) system. It is also valuable for initial acquisition, time-tracking, and handoff. A pilot signal for determining multipath component characteristics is well-justified for one-to-many transmission channels, such as the IS-95 forward link [1]. Multicarrier modulation (MCM) is now considered an effective technique for high rate data communications in both wire and wireless environments. MCM partitions the channel bandwidth into several parallel independent subchannels. It has a relatively longer symbol duration which produces greater immunity to impulse noise and fast fading, and moreover, the independence of the subchannels provides a simple equalization scheme and a natural way to optimize the channel capacity usage. Correct channel estimation is very important to the implementation of the MCM system. Although some techniques such as differential PSK modulation can be used to eliminate the need for channel estimation, they cause some performance loss. In most systems, a known training sequence is sent by the transmitter and a training algorithm is performed by the receiver on the observed channel output and the known input to estimate the channel [2]. The most challenging task in a MIMO communication system is channel estimation. Because each received signal contains independent data from all the transmitters, multiple channels have to be estimated simultaneously. Research on wireless radio

OFDM systems include methods that compute the channel impulse response (L coefficients in the time domain) instead of the transfer function (K coefficients in the frequency domain). A similar method has been pursued for acoustic channels. By doing so, the number of channel parameters is reduced when $L< K$, which is often the case, but this solution may still require inversion of large matrices, whose size is proportional to N_tL , where N_t is the number of transmit elements [3]. In the mobile communication systems employing pilot tone as a phase and amplitude reference for demodulation on fading channels, the pilot filter is used to extract the reference. For example, a bank of low-pass filters is employed in DS-CDMA system to estimate the channel response for each finger prior to rake combining. The receiver extracts the pilot using pilot filters with fizedbandwidth. In the forward link, some computationally efficient pilot filters like a moving average filter and a first-order IIR filter are preferred for simple implementation [4]. For coherent detection, high accurate channel estimation is required under the multi-path-fading environment. Propagation channel in mobile communication environment is characterized as multi-path fading channel model. The rate of fading variation increases with the vehicular speed and transmitted carrier frequency. If 2GHz frequency band is used and vehicular speed is 100km/h, the maximum Doppler frequency reaches to 185Hz. And if such vehicular accelerates to 200km/h like a bullet train, the maximum Doppler frequency rises up to 370Hz. The pilot channel assisted channel estimation can provide good estimation performance for fast fading channel. Then two types of pilot channel structure are being concerned. One is time multiplexed pilot structure that carries known periodical pilot symbols on each slot. A couple of channel estimation filters are already studied. Low-order Gaussian approximate interpolation and linear interpolation can provide good performance in high vehicular speed range, however they have SNR degradation in low vehicular speed range. Simple several slots averaging can improve SNR performance than linear interpolation [5]. In OFDM system, time- and frequency-domain two dimensional minimum mean square error (2D-MMSE) channel estimation is optimum. However, to realize 2D-MMSE channel estimation, accurate channel statistics are required, which are often time-varying and unavailable in practice. In robust channel estimation has been derived to make full use of the time- and frequency-domain correlations of the frequency response of time-varying wireless channels, and is insensitive to channel statistics. However, robust channel estimation still needs some prior channel information: the maximum Doppler shift, the maximum multi-path delay and the noise power, whose accurate values are time-varying and difficult to obtain. In order to accommodate channel conditions as more as possible, these three parameters must be assumed to take large values. This inevitably results in performance degradation. On the other hand, time-domain one-dimensional recursive least square (1D-RLS) adaptive channel estimation has been presented, where statistical prior knowledge of wireless channel is not required. But it can only capture the time-domain correlation of time-varying wireless channel, and its performance is sensitive to the variation of each path delay, which is common in practice. In addition to its very slow convergence speed, 1D-RLS adaptive channel estimation is actually useless in practice [6].

II. LITERATURE REVIEW

Zhen Gao et. al [1] this paper proposes a spatially common sparsity based adaptive channel estimation and feedback scheme for frequency division duplex based massive multi-input multi-output (MIMO) systems, which adapts training overhead and pilot design to reliably estimate and feedback the downlink channel state information (CSI) with significantly reduced overhead. Specifically, a non-orthogonal downlink pilot design is first proposed, which is very different from standard orthogonal pilots. By exploiting the spatially common sparsity of massive MIMO channels, a compressive sensing (CS) based adaptive CSI acquisition scheme is proposed, where the consumed time slot overhead only adaptively depends on the sparsity level of the channels. Additionally, a distributed sparsity adaptive matching pursuit algorithm is proposed to jointly estimate the channels of multiple subcarriers. Furthermore, by exploiting the temporal channel correlation, a closed-loop channel tracking scheme is provided, which adaptively designs the non-orthogonal pilot according to the previous channel estimation to achieve an enhanced CSI acquisition. Finally, generalize the results of the multiple-measurement-vectors case in CS and derive the Cramer-Rao lower bound of the proposed scheme, which enlightens us to design the non-orthogonal pilot signals for the improved performance.

Xudong Zhu et.al [2]in this paper, a signal-to-noise ratio-based sparsity estimation method is proposed to detect the sparsity level of the channel. Then we propose the priori aided subspace pursuit algorithm if the channel sparsity meets the theoretical CS model, otherwise we use an improved iterative channel estimation method with the help of the channel sparsity. Simulation results demonstrate that the proposed scheme could improve the robustness and performance of TDS-OFDM systems compared with the conventional iterative methods or recently proposed CS based methods.

Patricia Ceballos Carrascosaet.al [3]in this paper, frequency and time correlation of the underwater channel are exploited to obtain a low-complexity adaptive channel estimation algorithm for multiple-input–multiple- output (MIMO) spatial multiplexing of independent data streams. The algorithm is coupled with nonuniform Doppler prediction and tracking, which enable decision-directed operation and reduces the overhead. Performance is demonstrated on experimental data recorded in several shallow-water channels over distances on the order of 1 km. Nearly error-free performance is observed for two and four transmitters with BCH(64,10) encoded quadrature phase-shift keying (QPSK) signals. With a 24-kHz bandwidth, overall data rates of up to 23 kb/s after coding were achieved with 2048 carriers. Good results have also been observed in two other experiments with varying MIMO–OFDM (orthogonal frequency-division multiplexing) configurations.

Md. Masud Rana et.al[4] In this paper, normalized least mean (NLMS) square and recursive least squares (RLS) adaptive channel estimator are described for multiple input multiple output (MIMO) orthogonal frequency division multiplexing (OFDM) systems. These CE methods uses adaptive estimator which are able to update parameters of the estimator continuously, so that the knowledge of channel and noise statistics are not necessary. This NLMS/RLS CE algorithm requires knowledge of the received signal only. Simulation results demonstrated that the RLS CE method has better performances compared NLMS CE method for MIMO OFDM systems. In addition, the utilizing of more multiple antennas at the transmitter and/or receiver provides a much higher performance compared with fewer antennas. Furthermore, the RLS CE algorithm provides faster convergence rate compared to NLMS CE method. Therefore, in order to combat the more channel dynamics, the RLS CE algorithm is better to use for MIMO OFDM systems.

Rafael Boloix-Tortosaet.al [5] in this paper, face the problem of blind channel estimation in zero padding OFDM systems. Based on the assumption that the transmitted symbols are independent and identically distributed, propose a blind adaptive estimation algorithm for minimum phase channels, based on Independent Component Analysis that exploits the particular structure of the ZPOFDM system model. Some included simulations show that this novel algorithm can yield comparable performance as the SVD methods with a reduced computational complexity.

Rocco Claudio Cannizzaroet.al [6] in this paper, proposed adaptive channel estimation for Orthogonal Frequency Division Multiplexing (OFDM) in fast time-varying (TV) channels. A Basis Expansion Model (BEM) approach is used to capture the time variation of the channel within each OFDM block, and to reduce the estimator dimensionality. Capitalizing on the BEM structure and on a frequency domain training, two adaptive approaches are proposed, based on Kalman filtering and Recursive Least Squares (LS) methods, which exploit the time correlation of the channel between successive blocks and do not require any a-priori knowledge of the channel statistics. Simulation results show that, compared to classical Least Squares and statistically-aided Linear Minimum Mean Squared Error (LMMSE) approaches, the two proposed techniques effectively estimate the channel, adapt fast to its non-stationary changes, thus enabling efficient TV channel equalization of the inter-carrier interference (ICI) induced in
OFDM systems by high Doppler spreads.

XiaolinHouet.al [7] in this paper propose two-dimensional recursive least square (2D-RLS) adaptive channel estimation for OFDM system. 2DRLS adaptive channel estimation does not require accurate channel statistics, and at the same time can make full use of time and frequency-domain correlations of the frequency response of time-varying wireless channels. With properly chosen parameters, 2D-RLS adaptive channel estimation can converge into the steady state in only several OFDM symbols' time. Computer simulations demonstrate that 2D-RLS adaptive channel estimation is very effective and suitable for a broad range of channel conditions. Furthermore, with proper training sequences design on transmitter antennas, 2D-RLS adaptive channel estimation can be applied to multiple inputs multiple outputs (MIMO) OFDM system.

Guoan Chen et. al[8]In this paper, adaptive channel estimation (ACE) anddedicated pilot power adjustment based on the fading-rate measurementis investigated for the pilot-aided direct-sequence (DS)code division multiple access (CDMA) system. A novel adaptivechannel estimator is presented, which makes use of an optimumintegral duration or selects the optimum finite-impulse response(FIR) filter coefficients based on the fading-rate measurement. Dynamicadjustment of the dedicated pilot power is further proposedfor the purpose of increasing the system capacity, based on thefact that the power of the dedicated pilot channel (DPCH) can bereduced when the mobile station moves slowly. Theoretical analysisand computer simulation results show that significant performanceimprovement can be achieved by using the proposed adaptivechannel estimator and the dynamic pilot power adjustmentmethod.

Henrik Schoberet.al [9] inthis paper investigates adaptive two-dimensional (2D) Wiener filtering for channel estimation in OFDM based communication systems. The estimation technique should work for a wide range of users' velocity (0-360 km/h) and different mobile environments, i.e. different multipath spreads. Therefore, an adaptive filter scheme, based on a 2D-Wiener filter, is proposed. The main idea is to prestore sets of filter coefficients for different environments and velocity ranges. Extensive simulations have been performed to investigate the effects of mismatch to the channel state and to determine the best choice of filter sets. To estimate the channel conditions for selecting one of the prestored Wiener filters, a new velocity estimation technique is proposed based on the time correlation function of the time variant multipath channel. This estimation technique allows an efficient implementation of the channel estimation algorithm. Only few filter sets are necessary to cover a wide range of channel types.

Hyuk Jun Oh et.al [10] in this paper propose using decimation to estimate vehicle speed for adaptive channel estimation in pilot-aided transmission systems like DS-CDMA ones. It is shown that by passing the received pilot signal through band pass filter after decimation and computing its output energy, current velocity of mobile station can be accurately estimated. In addition, the proposed speed estimation unit is simple to implement. This allows us to use it accompanying computationally efficient pilot filter for forward link receive: a structure for adaptive channel estimation based on the proposed velocity estimation unit is addressed. The optimal coefficients of pilot filter are selected from a pre-calculated bank of coefficients based on the estimated mobile speed zone. Procedures for deriving the optimal coefficients and thresholds for the speed estimation unit are developed. The proposed method provides up to 0.75dB improvement compared to conventional non-adaptive ones.

Mitsuo Sakamoto et. al [11]Adaptive channel estimation with Velocity estimator is proposed for 3d generation cellular system called as IMT-2000. By using proposed Velocity estimator, it can select the 'best channel estimation mode depend on estimated vehicular speed. The comparison of several channel estimation schemes is studied analytically. Then each channel estimation's capability depend on vehicular speed is cleared. Velocity estimator for channel estimation control is studied. It evaluated the Velocity estimator and adaptive channel estimation with Velocity estimator under multi-speed environment. Proposed adaptive channel estimator can accomplish conflicting features, the wide vehicular speed range, low speed to 300km/h, good SNR performance, and the low power consumption for User Equipment.

Xiaowen Wang et. al [12] in this paper presented an adaptive channel estimation algorithm using the cyclic prefix in MCM systems. This algorithm can adaptively track variation of a moderately time-varying channel, which makes the MCM system more robust to channel variation. Moreover, the algorithm achieves this tracking property in an efficient way without adding any more overhead to the system since no additional training is needed.

Takeshi Onizawaet.al [13] this paper proposes a simple adaptive channel estimation scheme for orthogonal frequency division multiplexing (OmM) in order to realize high-rate wireless local area networks(LANs). The proposed estimator consists of simple frequency-domain FIR filters, which are adaptively selected according to the difference vector between adjacent subcarriers and channel amplitude of the subcarrier. Computer simulations show that the proposed scheme offers superior packet error rate (PER) performance to the least-squares scheme, by 1.1 dB in terms of required *E,IN,,* at

PER=O.l in AWGN channels. They also show, for the same criterion, a 0.7 dB improvement for a frequency selective fading channel with delay spread value of loons.

MilicaStojanovicet.al [14] an adaptive multipath decorrelating multiuser receiver is considered for application in Rayleigh fading multipath channels with significant Doppler spread. Coherent diversity combining is performed using adaptively obtained channel estimates in a manner that minimizes the impact of estimation errors on data detection. The bit-error rate of the receiver is evaluated analytically, showing dependence on the fading rate of the channel and tracking capabilities of adaptive least mean square and recursive least square algorithms, in addition to the order of multipath diversity and the number of active code division multiple-access users.

D.D. FALCONER et. al [15] in this paper propose a linear prefilter to force the overall impulse response of the channel/prefilter combination to approximate a desired truncated impulse response {DIR) of acceptably short duration. Given the duration of the DIR, the prefilter parameters and the DIR itself can be optimized adaptively to minimize the mean-square error between the output of prefilter and the desired prefilter output, while constraining the energy in the DIR to be fixed. In this work we show that the minimum mean-square error can be expressed as the minimum eigenvalue of a certain channel-dependent matrix, and that the corresponding eigenvector represents the optimum DIR. An adaptive algorithm is developed and successfully tested. The simulations also show that the prefiltering scheme, used together with the VA for two different channel models, compares favorably in performance with another recently proposed prefiltering scheme. Limiting results for the case where the prefilter is considered to be of infinite length are obtained; it is shown that the optimum DIR of length two must be one of two possible impulse responses related to the duo binary impulse response.

Author Name	Year	Technology Used	Description
Zhen Gao et. al	2015	common sparsity based adaptive channel estimation and feedback scheme.	this paper proposes a spatially common sparsity based adaptive channel estimation and feedback scheme for frequency division duplex based massive multi-input multi-output (MIMO) systems, which adapts training overhead and pilot design to reliably estimate and feedback the downlink channel state information (CSI) with significantly reduced overhead.
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