Performance Evaluation of Rake Receiver for Wavelet Video with UEP Codes in W-CDMA System and Fading Channels

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Abstract: - The Rake receiver for wavelet video compression with four levels of unequal error protection (UEP) codes in wide-band code division multiple access (W-CDMA) system over additive white Gaussian noise (AWGN) and Rayleigh fading channels are performed and evaluated. The deployment of Wavelets has approached a powerful technique for compressing video sequence. The wavelet transform compression technique has shown to be more appropriate to high quality video applications, producing better quality output for the compressed frames of video. A spatially scalable video coding framework of MPEG2 in which motion correspondences between successive video frames are exploited in the wavelet transform domain. The basic motivation for our coder is that motion fields are typically smooth and, therefore, can be efficiently captured through a multiresolutional framework. Wavelet decomposition is applied to video frames and the coefficients at each level are predicted from the coarser level through backward motion compensation. The proposed algorithms of the embedded zero-tree wavelet (EZW) coder and the two-dimensional wavelet packet transform (2-D WPT) are analysed. The presented scheme of the Rake receiver is used for multipath problems and each Rake receiver is provided for each level of UEP codes. The implementation of a W-CDMA and Rake receiver, one of the most challenging tasks in third generation receivers, demonstrates that the architecture can support very high data rates while retaining flexibility for multi-user radio communication.

Key-Words: - Rake Receiver, Unequal Error Protection Codes, Embedded Zero-Tree Wavelet Transform, Two Dimensional Wavelet Packet Transform, Wide-Band Code Division Multiple Access, Additive White Gaussian Noise, Rayleigh Fading Channel.

1. Introduction
The wavelet functions are developed for harmonic analysis, signal representation, speech and video bandwidth compression, multiresolution signal processing, and signal design in various coding and communication applications. The wavelets in commercial applications were mainly with efficient compression techniques on signals such as voice and video. This was due to the logarithmic-scale decomposition in frequency, which fits naturally in many of the sound and video sequence reconstruction studies. Wavelet theory covers quite a large area. It treats both the continuous and discrete time cases [1]. The introduction of the embedded zero-tree concept for wavelet-based video compression has generated a significant improvement in performance compared to previous video coding methods. A refinement of the EZW approach, called set partitioning into hierarchical trees (SPIHT) by Said and Pearlman, is the most well known EZW derivative. While SPIHT enjoys a good rate-distortion performance for video sequences with comparatively low complexity, it is quite fragile against bit errors in noisy communication channels. Direct sequence signal acquisition in W-CDMA environment is estimated. A digital matched filter is presented and investigated for direct sequence spread-spectrum systems [2].

The coding scheme presents four levels of error protection and four levels of Rake receivers for different sets of bits in a transmitted symbol using W-CDMA system over AWGN and Rayleigh fading channels. The proposed scheme accomplishes unequal error protection by encoding the data according to the significance of the information and switching between four codes and four Rake receivers. The scheme uses the different pseudo-noise codes of digital matched filter synchronizer to make up four levels of unequal error protection codes and four levels of Rake receivers. The unequal error protection with bits of different significance for data transmission is accomplished in this scheme. It was shown that four levels of different error protections were easily accomplished with the digital matched
filter pseudo-noise code synchronizer schemes in W-CDMA system over AWGN and Rayleigh fading channels by providing the coded detection at the Rake receivers. The scheme provides the capability of multi-level error protection without complexity as compared to regular digital matched filter pseudo-noise code schemes.

2. The Rake Receiver for Wavelet Video with Unequal Error Protection Codes in W-CDMA System and Fading Channels

The four levels of unequal error protection codes and Rake receivers with wavelet video transmission in W-CDMA system over AWGN and Rayleigh fading channels are analyzed. Figure 1 illustrates the block diagram of UEP codes for wavelet video transmission with Rake receiver in W-CDMA system over AWGN and Rayleigh fading channels Encoder. Figure 2 shows the block diagram of UEP codes for wavelet video transmission with Rake receiver in W-CDMA system over AWGN and Rayleigh fading channels Decoder.

The discrete wavelet transform is described with the generic signal \( g(t) \) that can be represented in terms of translates and dilates typically bandpass of a single prototype wavelet \( \beta(t) \).

\[
g(t) = \sum_{i,j} \alpha(i,j) 2^{-i/2} \beta(2^{-i} t - j) \tag{1}
\]

or similarly for some \( W>0 \)

\[
g(t) = \sum_j \eta(j) 2^{-j/2} \theta(2^{-j} t - j) + \sum_{i,j} \alpha(i,j) 2^{-i/2} \beta(2^{-i} t - j) \tag{2}
\]

where

\[
\alpha(i,j) = \int_{-\infty}^{\infty} g(t) 2^{-i/2} \beta(2^{-i} t - j) dt
\]

are detail coefficients of wavelet.

\[
\eta(j) = \int_{-\infty}^{\infty} g(t) 2^{-j/2} \theta(2^{-j} t - j) dt
\]

are approximation coefficients or scaling coefficients, and \( \theta(t) \) is a low-pass scaling function. The significance is the interpretation of equation (2) as a multiresolution analysis of \( g(t) \): \( i \) indexes the scale or resolution, the smaller \( i \) the higher the resolution, while \( j \) indexes the spatial location of analysis. If the mother wavelet is centred at time 0 and frequency \( f_c \), \( \alpha(i,j) \) measures the content of around time \( 2^j \) and frequency \( 2^j f_c \), while \( \eta(j) \) represents the local mean around time \( 2^j \). In this framework, we can think of \( g(t) \) as the finest scale \( (W=0) \) representation of \( g(t) \) itself. The function \( \beta(t) \) has to satisfy some critical conditions to ensure that equation (2) holds for any square integrable function \( g(t) \). In particular, \( \beta(t) \) has to satisfy the two scale equations:

\[
\theta(t) = \sqrt{2} \sum_n c_n(t) \theta(2t - n) \tag{3}
\]

\[
\beta(t) = \sqrt{2} \sum_n c_n(t) \theta(2t - n) \tag{4}
\]

where the coefficients \( c(n) \) can be nonzero only over a finite number of consecutive values of \( n \). Hence,

\[
\beta_{i,j}(t) = 2^{-j/2} \beta(2^{-i} t - j)
\]

\[
\theta_{i,j}(t) = 2^{-j/2} \theta(2^{-i} t - j)
\]

The three orthogonality constraints require

\[
\int \beta_{i,j}(t) \theta_{i,j}(t)^* dt = \delta(j - j')
\]

\[
\int \beta_{i,j}(t) \beta_{i,j}(t)^* dt = \delta(j - j') = \delta(i - i')
\]

\[
\int \beta_{i,j}(t) \theta_{i,j}(t)^* dt = \delta(j - j') = 0
\]

The three orthogonalties are satisfied by coefficients \( c(n) \) those have the following properties:

\[
\sum_n c_n(n)c_n(n + 2k) = \delta(k)
\]

\[
c_i(n) = (-1)^n c_i(n)
\]

where \( c(n) \) are the coefficients of a perfect reconstruction two-band or dyadic filter bank with the quadrature mirror reconstruction property. Therefore, the design of wavelets is equivalent to the design of filter banks. Observe that the conditions imposed up until now are not sufficient to construct in practice useful wavelets. Certainly, they can lead to decompositions with not enough regularity. Regularity is imposed requiring a large number of vanishing moments. In practice, \( \eta(j) \) and \( \alpha(i,j) \) can be computed recursively from \( \alpha(i+1,j) \) using the efficient pyramid algorithm proposed by Mallat [3]. It is not necessary to explicitly compute the shape of \( \theta(t) \) and \( \beta(t) \). The basic applications of wavelets in this paper stems from a multiresolution decomposition of a time-varying multipath response of the form \( h(t, \tau) \) at any \( \tau \) with respect to \( t \) are:

\[
h(t, \tau) = \sum_j \eta(j, \tau) 2^{-j/2} \theta(2^{-j} t - j) + \sum_{i,j} \alpha(i,j, \tau) 2^{-i/2} \beta(2^{-i} t - j)
\]
with resolvable multipath components of the form

\[ h(t, \tau) = \sum_{i=1}^{Q} g_i(t) \delta(\tau - \tau_i) \] [3].

### 2.1. The Rake Receiver for W-CDMA

A signal propagates from transmitter to receiver over multiple paths with multiple different time delays can be resolved into separately fading signals by cross-correlating the received signal with multiple time shifted versions of the pseudorandom sequence. The Rake receiver was developed in the 1950’s as a diversity receiver designed expressly to equalize the effect of multipath. The Rake receiver derives its name from the parallel correlators obtain an alike appearance to the fingers of a garden rake. The implementation of a W-CDMA and Rake receiver is the most challenging exercises in third generation receivers and its structural design can maintain very high data rates while remaining flexibility for multi-user communication systems [4].

The structure of the Rake receiver is illustrated in figure 3 below. It consists of a bank of Rake fingers, each correlating to a different delay of the received signal. The finger outputs are combined to form a decision statistic. Each Rake receiver is supplied with different level of digital matched filter (DMF) pseudo noise (PN) code for dissimilar level of UEP code. Each correlator consists of two inputs: a delay of the received signal and a DMF PN sequence used as the spreading code to generate the spread spectrum modulated signal at the transmitter. The DMF PN sequence performs as the reference signal. The bandwidth of the PN sequence is denoted as \( W = 1/T_c \), where \( T_c \) is the chip duration. The autocorrelation function of a PN sequence has a single peak of width \( 1/W \), and it disappears toward zero elsewhere inside one period of the PN sequence. The bandwidth \( W \) of the PN sequence is completed sufficiently large to identify the significant echoes in the received signal.

The phase (\( \omega \)) and gain (\( \beta \)) regulators are functioned in the receiver for all correlator outputs join constructively. An appropriate delay is introduced into each correlator output so that the phase angles of the correlator outputs are in agreement with each other. The correlator outputs are weighted so that the correlators responding to strong paths in the multipath environment have their contributions accentuated, while the correlators not synchronizing with any significant path are correspondingly suppressed. The weighting coefficients \( \omega_n \) are computed in accordance with the maximal ratio. The signal to noise ratio of a weighted sum, where each element of the sum includes of a signal plus additive noise of fixed power, is maximized when the amplitude weighting is performed in proportion to the relevant signal strength.

The linear combiner output is:

\[ r(t) = \sum_{n=1}^{L} \omega_n \phi_n(t) \]

Where \( \phi_n(t) \) is the phase compensated output of the \( n^{th} \) correlator, and \( L \) is the number of correlators in the receiver. Provided we use enough correlators in the receiver to span a region of delays sufficiently wide to encompass all the significant echoes that are
likely to occur in the multipath environment, the output \( r(t) \) behaves essentially as though there was a single propagation path between the transmitter and receiver rather than a series of multiple paths spread in time. The Rake receiver operates with the binary phase shift keying (BPSK) in performing spread spectrum modulation at the transmitter. Hence, the final performance in the Rake receiver is integrating the linear combiner output \( r(t) \) over the bit interval \( T_b \) and then determining whether binary symbol 1 or 0 was transmitted in that bit interval [4].

2.2. The Embedded Zero-Tree Wavelet Coding
Discrete wavelet transform (DWT) is becoming popular in many video applications due to the unique feature of multi-resolution representation. After the embedded zero-tree wavelet transform (EZWT) of a video sequence, the important data is concentrated in the upper left corner that corresponds to the low frequency range of the wavelet coefficients. The remaining data in the high frequency domain is not as significant. The embedded zero-tree wavelet algorithm exploits the important hypothesis that if a wavelet coefficient at a coarse scale is insignificant with respect to a threshold, then all the wavelet coefficients of the same orientation in the spatial location at finer scales are likely to be insignificant with respect to the same threshold. Because wavelet decompositions offer space frequency representations of frames of video sequences, i.e., low frequency coefficients have large spatial support, whereas high frequency coefficients have small spatial support, the wavelet representation calls for new quantization strategies that go beyond traditional subband coding techniques to exploit this underlying space frequency video sequence characterization.

Shapiro made a breakthrough in 1993 with his embedded zero tree wavelet-coding algorithm [5]. Since then a new class of algorithms has been developed that achieve significantly improved performance over the EZW coder. In particular, Said and Pearlman’s work on set partitioning in hierarchical trees [6], which improves the EZW coder, has established zero tree techniques as the current state of the art of wavelet video coding since the SPIHT algorithm proves to be very successful for both lossy and lossless compression. A wavelet coefficient tree is defined as the set of coefficients from different bands that represent the same spatial region in the video sequence. A wavelet video sequence representation can be thought of as a tree structured spatial set of coefficients. Figure 4 illustrates three levels wavelet decomposition of the video sequence. The lowest frequency band of the decomposition is represented by the root nodes (top left) of the tree (LL), the highest frequency bands by the leaf nodes (bottom right) of the tree, and each parent node represents a lower frequency component than its children. Except for a root node, which has only three children nodes, each parent node has four children nodes, the 2x2 region of the same spatial location in the immediately higher frequency band.

2.3. The 2-Dimensional Wavelet Packet Transform
Discrete wavelet transform is applied to video sequence; it is advantage of the fact that video sequence is composed of low frequency components and high frequency components. Low frequency components give a video sequence its foundation, or character, while high frequency components give a video sequence it is fine details or nuances. Figure 5 illustrates the wavelet decomposition of the two-dimensional wavelet packet transform for the video sequence. The output from the low pass filter produces and approximation of the signal based on the low frequency detail coefficients. The output from the high pass filter produces the fine details of the video sequence, that when put together will form the original video sequence. However, these values are down-sampled. This means that the output of either filter has every second coefficient dropped. This effectively halves the number of coefficients from each filter. Nevertheless, at the reconstruction side, this can produce some distortion, but if the filters are chosen carefully then perfect reconstruction can occur.

One of the aspects that make wavelets so suited to video coding is that the filtering process can be iterated repeatedly, allowing us to break up a video sequence into various lower resolution versions or multilevel decomposition. This is especially useful when video sequence compression is being considered, because we can make trade-off between useful video sequence information and plain noise. Typically, the way in which this is conducted is by filtering the output of the Low Frequency Decomposing Filter with the same wavelet function.
The low frequency coefficients of this output may again be filtered, extracting more information and so on. Now, because there is a down sampling routine done after each filtering process, the theoretical limit that stops us from iterating is until we reach one DWT coefficient. In general, the more levels of decomposition we have, the better the compression, although loss of quality [2].

Masnick and Wolf [7] first introduced the concept of unequal error protection codes in 1967. Their approach influenced different techniques of protection of codeword symbols, restricting the known facts to systematic codes. Dunning and Robbins [8] presented a more general approach in 1978. Their accomplishment pointed out that encoding is crucial for the unequal error protection properties of a code. Consequently, the two different encodings of the same code are not similar regarding their unequal error protection properties. The structure of codes with unequal error protection differs fairly from the ordinary code. The ordinary codes are designed to obtain uniform distance distribution to provide a large minimum distance. The unequal error protection codes have the codewords joined in clusters.

The four levels of unequal error protection codes with four different levels of unequal error protection codes are designed for the digital matched filter pseudo-noise code synchronizer scheme. The first level is the lowest error protection level with easiest level of digital matched filter pseudo-noise code synchronizer. The second level is the lower level with easier level of digital matched filter pseudo-noise code synchronizer. The third level is the higher level with harder level of digital matched filter pseudo-noise code synchronizer. The fourth level is the highest level with hardest level of digital matched filter pseudo-noise code synchronizer. Each level of UEP code is combined with a different Rake receiver. The unequal error protection with information of different significance for data transmission is achieved in this system. The four levels of different error protections are accomplished with the digital matched filter pseudo-noise code synchronizer systems and Rake receivers for detecting codes at the receiver [7].

2.5. Wide-Band Code Division Multiple Access System

The W-CDMA is technique in which users share the channel by employing different spreading codes. In W-CDMA systems, all the users occupy the same frequency band at the same time. This is in contrast to frequency division multiple access (FDMA) and time division multiple access (TDMA) schemes in which the signals occupy the channel at disjoint frequencies or times, respectively. In W-CDMA systems, each transmitter has a different spreading code that is known by the intended receiver. For effective operation, the cross correlation between code used by different users should be minimized so that the despreading process will reject most of the multi-user interference. W-CDMA systems can be implemented using either frequency hopping (FH) or direct sequence (DS) spread spectrum (SS) techniques, although DS is by far the most popular choice. One
reason for this is that when multiple approaches is generally more computationally intensive than the synchronous approach. The basis function to be used as the spreading waveform is determined by a PN sequence and is allowed to change with each incoming data bit. Since both the transmitter and receiver are assumed to know which spreading function is used, and these codes are known to be orthogonal. Each user is assigned a different spreading code, i.e., transform basis function, and allowed to transmit over the same channel. If all users transmit synchronously, the orthogonality of the spreading waveforms ensures that there is no interference between users. The direct sequence spread spectrum (DSSS) communications systems nominate coherent binary phase shift keying (BPSK) for both the data modulation and the spreading modulation. The encoded DSSS with BPSK signal is provided:

\[ y(t) = x(t)x(t) = s(t)b(t)\sqrt{2S}\cos w_c t \]  

where \( x(t) = b(t)\sqrt{2S}\cos w_c t \), \( b(t) \) is the baseband signal at the transmitter input and receiver output, \( s(t) \) is the spreading signal, \( S \) is the signal power, \( w_c \) is the carrier frequency.

Equation (6) represents the modulo-2 addition of \( s(t) \) and \( b(t) \) as a multiplication because the binary signals, 0 and 1, represent values of 1 and -1 into the modulator. The signal \( x(t) \) has a \( [(\sin x)/x]^2 \) spectrum of bandwidth roughly \( 1/T \) (where \( T \) is the periodicity at baseband), while the SS of signal \( y(t) \) has a similar spectrum but with a bandwidth of approximately \( 1/T_c \), where \( T_c \) is the periodicity of the spreading signal. The processing gain of the system is \( G_p = (B_p/R) = T/T_c \). \( B_p \) is the bandwidth in Hertz and \( R \) is the information rate. If the interfering signal is represented by \( I(t) \), then in the absence of noise, assuming that the interferer limits the system performance. Also, the interferer’s power level exceeds the thermal noise power, the signal at the receiver is given as \( r(t) = y(t) + I(t) \). The receiver multiplies this by the PN waveform to obtain the signal:

\[ r(t) = s(t)[y(t) + I(t)] = s(t)[s(t)x(t)] + s(t)I(t) = x(t) + s(t)I(t) \]  

(7)

From \( s(t)^2 = 1 \), \( s(t)I(t) \) is the effective noise waveform due to interference. The conventional BPSK detector output is given as: \( r = m\sqrt{E_b} + n \), where \( m \) is the data bit for the \( T \) second interval, \( E_b \) is the bit energy, \( n \) is the equivalent noise component. The spreading-despreading functions do not affect the signal and do not affect the spectral and probability density function of the noise. For this reason, the bit error probability \( P_b \) associated with the coherent BPSK SS signal is the same as with the BPSK signal and is given as [9]:

\[ P_b = (1/2)\text{erfc}\left(\frac{E_b}{\sqrt{N_o}}\right) \]  

(8)

The proposed DMF achieves a mean time to acquisition comparable to that obtained by the conventional matched filter allows an unlimited period of integration without complexity increase and some advantages in terms of probabilities of correct acquisition and false alarm. Since the nature of direct sequence spread spectrum signals is digital, digital matched filters provide a straightforward way of implementing correlation in noncoherent receivers for signals of that kind. Digital concepts provide most flexibility, which is required for easy adaptability to changing waveforms. This can be of paramount importance for the exploitation of the anti-interference and anti-eavesdropping capabilities of such systems. Digital matched filter is one of the most critical components incorporated in the VLSI transceiver in terms of power dissipation [10].

3. Experimental Results

The QCIF video sequences with compression rate of 0.312 bits/pixel are examined. The W-CDMA system obtains a bandwidth of 5MHz and will also be in many indoor achievements. The various sections of a compressed video sequence obtain different importance and error sensitivity. The W-CDMA system over AWGN and Rayleigh fading channels with Rake receivers of wavelet video for unequal error protection codes are considered with four levels of significance for operating with data stream of information. Each level of UEP code is matched with a different Rake receiver and a different level of DMF PN code. The proposed scheme accomplishes unequal error protection by encoding the data according to the significance of the information and dividing into four codes. The coding scheme introduces four levels of error protection and Rake receivers for different sets of bits in a transmitted symbol functioning W-CDMA system over AWGN, and Rayleigh fading channels. The proposed scheme applies the different pseudo-noise codes of digital matched filter pseudo-noise code synchronizer to construct four levels of unequal error protection codes and Rake receivers. The functioning estimation of four unequal error protection codes with Rake receivers in W-CDMA system over AWGN and Rayleigh fading channels are evaluated.

For the Embedded Zero-Tree Wavelet Coding, the four levels of unequal error protection codes with four significant levels of unequal error protection codes and four different Rake receivers are proposed for this digital matched filter pseudo-noise code synchronizer scheme. From figure 4, the first level or the LL3 is the lowest error protection level with no encoding. The second level or the HL2, LH2, HH2 is the lower error protection level with easiest level of digital matched filter pseudo-noise code synchronizer. The third level or the HL3, LH3, HH3 is the higher error protection level with easier level of digital
matched filter pseudo-noise code synchronizer. The fourth level or the HL1, LH1, HH1 is the highest error protection level with harder level of digital matched filter pseudo-noise code synchronizer.

For the 2-D Wavelet Packet Transform, the four levels of unequal error protection codes with four different levels of unequal error protection codes and four dissimilar Rake receivers are designed for this digital matched filter pseudo-noise code synchronizer scheme. Figure 5 illustrates the Wavelet Decomposition of the 2-D Wavelet Packet Transform for the video sequence. The first level or the average signal is the lowest error protection level with easiest level of digital matched filter pseudo-noise code synchronizer. The second level or the horizontal video sequence features is the lower error protection level with easier level of digital matched filter pseudo-noise code synchronizer. The third level or the vertical video sequence features is the higher error protection level with harder level of digital matched filter pseudo-noise code synchronizer. The fourth level or the diagonal video sequence features is the highest error protection level with hardest level of digital matched filter pseudo-noise code synchronizer.

Matlab programs are written to simulate the outcomes of the four levels of UEP codes with wavelet video compression and Rake receivers in W-CDMA system over AWGN and Rayleigh fading channels. The peak signal to noise ratio is calculated. The objective video sequence quality has been evaluated using peak signal to noise ratio, which is defined as follows:

$$\text{PSNR}=10 \times \log_{10} \left( \frac{\text{Peak Signal Value}}{\text{Mean Square Error}} \right)$$

where, Peak Signal Value=255 for an 8 bits/pixel video sequence.

$$\text{Mean Square Error}=\frac{1}{N \times N} \sum_{ij} (x_{ij} - y_{ij})^2$$

$x_{ij} - y_{ij}=$value of pixel $(i,j)$ in the original and reconstructed video sequences respectively.

$N \times N=$number of pixels in the video sequence.

The table of outcomes of tested Miss America sequences is tabulated in the table 1.

The table of outcomes of tested Lab sequences is tabularized in the table 2.

<table>
<thead>
<tr>
<th>Miss America Sequences in QCIF with Compression rate of 0.312 (bits/pixel)</th>
<th>PSNR (dB) of Four levels UEP for EZWT</th>
<th>PSNR (dB) of Four levels UEP for 2-D WPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miss America Sequence with Rake Receivers, W-CDMA and AWGN Channel</td>
<td>12.24</td>
<td>12.02</td>
</tr>
<tr>
<td>Miss America Sequence with Rake Receivers, W-CDMA and Rayleigh Fading Channel</td>
<td>34.02</td>
<td>32.89</td>
</tr>
</tbody>
</table>

Table 1: The outcomes of tested Miss America sequences

<table>
<thead>
<tr>
<th>Lab Sequences in QCIF with Compression rate of 0.312 (bits/pixel)</th>
<th>PSNR (dB) of Four levels UEP for EZWT</th>
<th>PSNR (dB) of Four levels UEP for 2-D WPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Sequence with Rake Receivers, W-CDMA and AWGN Channel</td>
<td>9.29</td>
<td>9.04</td>
</tr>
<tr>
<td>Lab Sequence with Rake Receivers, W-CDMA and Rayleigh Fading Channel</td>
<td>31.05</td>
<td>29.72</td>
</tr>
</tbody>
</table>

Table 2: The outcomes of tested Lab sequences

The original tested Miss America sequence in QCIF (176x144) is illustrated in figure 6.
The original tested Lab sequence in QCIF (176x144) is illustrated in figure 11.

The outcomes of Lab sequences in QCIF (176x144) are illustrated in figures 12, 13, 14 and 15.
compared to the 2-D WPT coding with four levels of UEP codes and Rake receivers. The Rayleigh fading channels obtain higher peak signal to noise ratio than the AWGN channels. The qualities of QCIF video sequences improve with the progressive increase of the peak signal to noise ratio. The scheme also shows design flexibility so that it is easily modified to accommodate different needs for error protection in various data transmission systems. The detailed design procedure and the performance of four unequal error protection codes are presented.

Fig. 14 The reconstructed Lab sequence with Four levels of 2-D WPT and Rake receivers in W-CDMA system over AWGN channel; PSNR=9.04 dB (a) Frame number 20 (b) Frame number 40

Fig. 15 The reconstructed Lab sequence with Four levels of 2-D WPT and Rake receivers in W-CDMA system over Rayleigh fading channel; PSNR=29.72 dB (a) Frame number 20 (b) Frame number 40

4. Conclusion

Performance analysis of Rake receiver for wavelet video compression with four levels of UEP codes in W-CDMA system over AWGN and Rayleigh fading channels are investigated. The EZW algorithm and the 2-D wavelet packet transform are analysed with UEP codes and Rake receivers in W-CDMA system over AWGN and Rayleigh fading channels. The direct sequence signal acquisition in W-CDMA environment with the proposed digital matched filter synchronizer for fast code acquisition have been presented and analysed. The proposed scheme accomplishes unequal error protection by encoding the data according to the significance of the information and switching between four codes and four different Rake receivers. The scheme uses the different pseudo-noise codes of digital matched filter synchronizer to make up four levels of unequal error protection codes and four different Rake receivers. The Rake receivers for Wavelet video with UEP codes in W-CDMA system over AWGN and Rayleigh fading channels are operated to improve the video sequences superiority. The advantage of the video sequence quality enhances with four levels of UEP codes for the EZW coding and the 2-D WPT coding. The EZW transform coding with four levels of UEP codes and Rake receivers has advantages

References:


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