Optimal Power Allocation Schemes using DWT in OFDM Based Cognitive Radio Systems

Deepa.k
PG Scholar (CS), Department of ECE
Sri Shakthi Institute of Engineering and Technology
Coimbatore, Tamilnadu, India,

Ms. M. Raj Kumari, M.E
Asst. Prof(S)/Department of ECE
Sri Shakthi Institute of Engineering and Technology
Coimbatore, Tamilnadu, India

Abstract— **In communication it is necessary to have a qualitative video transmission with reduced distortion. The optimal power allocation scheme minimizes the overall video distortion while restricting secondary user interference. For this purpose, the two level Daubechies wavelet D2 is employed to encode the video as a layered scalable stream comprising of one Base layer and several intensification layers. The coded video layers are assigned to the secondary OFDM subcarriers of the CR user. Video transmission in such CR scenarios is challenging due to the stringent interference constraints imposed on the secondary users. This is an end to end system to minimize the average video distortion under certain bounded video packet delay constraint. Optimal power allocation algorithm is employed to transmit an picture, audio and video over a cognitive radio in a prioritized manner, taking into account the processing time and bandwidth utilization. The performances of the proposed optimal schemes are compared in terms of the Peak Signal to Noise Ratio (PSNR) of the received image in the OFDM CR wireless system. Presented numerical results demonstrate that the proposed optimal scheme results in a significantly enhanced PSNR of video transmission compared to the competing scalable and non-scalable schemes. Besides the above advantages, the proposed scheme is found to have increased efficiency, ensures energy saving at the low fading margin.**

Keywords- Optimal power allocation, Cognitive radio, DWT, OFDM.

I. INTRODUCTION (HEADING 1)

Recently video transmission is used in various applications like communication, military and space etc. In such applications, for simplicity, videos are converted into various frames and then transferred to the destination. The major problem in video transmission is the interference of noise. Hence it is necessary to identify the noise in the frame and measures are to be taken inorder to reduce it. This can be reliably achieved by means of employing optimal power allocation based cognitive radio, and betterment in PSNR is also obtained.

Cognitive Radios are a technology that may be used to implement opportunistic sharing, Cognitive Radios are able to sense the spectrum to see whether it is being used by the Primary User. However this sensing operation may be rendered difficult due to a degraded wireless channel, which has prompted concerns from Primary users of the spectrum. In order to facilitate the deployment of Cognitive Radio technologies for the secondary usage of spectrum it is crucial to prove the reliable detection of Primary Users.[1] During an ongoing communication using temporarily available licensed spectrum, the involved Cognitive Radios have to continuously monitor the used spectrum for reappearing Primary Users. The Cognitive Radios can exchange sensing and setup information in a timely manner.

Orthogonal Frequency Division Multiplexing (OFDM) employs closely spaced narrowband orthogonal subcarriers for data transference, thus avoiding the problem of inter symbol interference associated with wideband frequency selective channels. OFDM an appropriate modulation scheme for CR systems, the downlink transmission capacity of the CR user is thereby maximized, while the disturbance introduced to the primary user (PU) remains within a tolerable range. The optimal scheme allows CR base station (BS) to transmit more power in order to achieve a higher transmission rate than the classical loading algorithms. This loading scheme maximizes the downlink transmission capacity of the CR user while keeping the interference induced to the PUs below a specified threshold. OFDMA systems give it additional flexibility towards dynamic radio resource allocation for multiple users with a low interference between adjacent subcarriers.

wavelet transform can be seen as a decomposition of a signal in the time-scale plane. There are different types of wavelet transforms depending on the nature of the signal (continuous or discrete), and the nature of the time and scale parameters.[2] In this paper, we focus on the two-dimensional discrete wavelet transforms (2D-DWT), where the signals, as well as the time and scale parameters, are discrete. We consider the implementation of 2D-DWT-based analysis and synthesis filters in a video encoder–decoder system. We refer to the analysis filter as 'encoder' and the synthesis filter as 'decoder'. Furthermore, we assume that the image is sized at $N \times N$ pixels in grayscale, and that the high-pass and low-pass filters (in the bank implementation) are each of size L. The peak signal-to-noise ratio (PSNR) is the ratio between a signal's maximum power and the power of the signal's noise. Engineers commonly use the PSNR to calculate the quality of reconstructed images that have been compressed. Each picture element (pixel) has a color value that can change when an image is compressed and then decompressed. Signals can have a wide dynamic range, so PSNR is usually expressed in decibels, which is a logarithmic scale. The PSNR is most commonly used as a measure of quality of reconstruction of lossy compression codecs (e.g., for image compression).The proposed scheme is used to achieve high accurate output with less noise and to save energy.

II. VIDEO TRANSMISSION SCHEME

We employ an interweave based OFDM CR model, in which the primary users occupy the L frequency bands of bandwidth B1,B2, ...,BL Hz. These bands are determined by the CR user through an appropriate spectrum sensing procedure.[3] The unoccupied spectral holes sensed by the CR base station for possible transmission are interspersed among the L PU bands as shown in the Fig.1. The bandwidth available for the CR transmission is divided into a sub band of bandwidth Δf per subcarrier for OFDM based transmission. EFMCRN algorithm is proposed in to transmit an image, audio and video over a cognitive radio in a compute manner, taking into account the processing time and bandwidth utilization.[4] We consider video data transmission by the CR base station to the CR users. A typical DPCM encoded digital video stream consists of Intra coded I frames and predictively encoded P frames. Such a motion prediction compensation based video coding scheme is ideally suited for video compression, especially for communication over band limited wireless channels.[5] The motion prediction for the P frames can be obtained through the Exhaustive Block Matching Algorithm described in (EBMA).

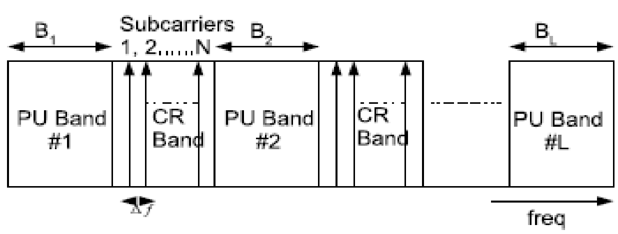

Fig. 1. Schematic of primary and secondary user spectral bands

III. OPTIMAL POWER ALLOCATION SCHEME

For a given video sequence V (x, y, t), the video distortion Dl (V) corresponding to the errors in the layer l∈ 1, 2, ...,N can be modeled as $D_1(V)=E\left\{\left\|\varphi^{-1}(\Delta S_1)\right\|^2\right\}$ where the video transform domain basis corresponds to the DB-wavelet employed for the spatial layering of the video stream and ΔSl is the error in the spatial layer Sl. The mean distortion D(V) for the video stream can then be expressed as,

$$D(V)=\sum_{l=1}^{N} D_1(V)\phi_e(P_l) \qquad (1)$$

The probability of bit error $\phi_e(P_l)$ for Binary Phase Shift Keying (BPSK) modulated data over an Additive White Gaussian Noise (AWGN) channel is given by[6] as,

$$\phi_e(P_l)=Q\left(\sqrt{\frac{P_l}{\sigma_v^{\,2}}}\right) \qquad (2)$$

where Q(·) denotes the Gaussian error function. Considering a Rayleigh flat-fading wireless channel across each of the OFDM CR user subcarriers, the average probability of biterror, averaged over the distribution of the fading gain of the Rayleigh fading wireless channel is given as,

$$\phi_e(P_l)=\int_0^{\infty} Q\left(\sqrt{\frac{a^2P_l}{\sigma_v^2}}\right) f_A(a)\,da \qquad (3)$$

where a denotes the envelope of the Rayleigh flat-fading coefficient, the probability density function (PDF) governing which is given as $f_A(a)=2ae^{-a^2}$. Hence, the net expression for the average bit-error in (3) can be simplified as,

$$\phi_e(P_l)=\int_0^{\infty} Q\left(\sqrt{\frac{a^2P_l}{\sigma_v^2}}\right) 2ae^{-a^2}da=\frac{\sigma_v^2}{P_l} \qquad (4)$$

Substituting the above probability of bit-error expression in (1) gives us the final simplified expression of overall video distortion as a function of the layer-subcarrier power P_l as,

$$D(V)=\sum_{l=1}^{N} D_l(V)\phi_e(P_l)=\sum_{l=1}^{N} D_l(V)\left(\frac{\sigma_v^2}{P_l}\right) \qquad (5)$$

IV. PROPOSED SYSTEM

In proposed system, initially the input video stream is separated in to different frame format, from which a frame is selected and the noise presence in the frame is identified by this technique. The selected frame is subjected to 2D discrete wavelet transform that is used in JPEG. The actual image is high-pass filtered, yielding the three large images, each describing local changes in brightness in the original image. It is then low-pass filtered and downscaled, yielding an approximation image, this image is high-pass filtered to produce the three smaller detail images, and low-pass filtered to produce the final approximation image in the upper-left. The transformed image is converted in to bit format for better transmission. The converted bit format is applied to fading technique, Rayleigh fading technique is employed. All sub-bands are independently faded with Rayleigh-distributed envelope, which corresponds to the block fading approximation in frequency domain. The proposed mapping scheme generates a situation of subcarrier assignment for each data vector in a packet. This is provided to OFDM transceiver. From the received image the noise is identified using successive validation. The proposed block diagram is shown in fig 2.

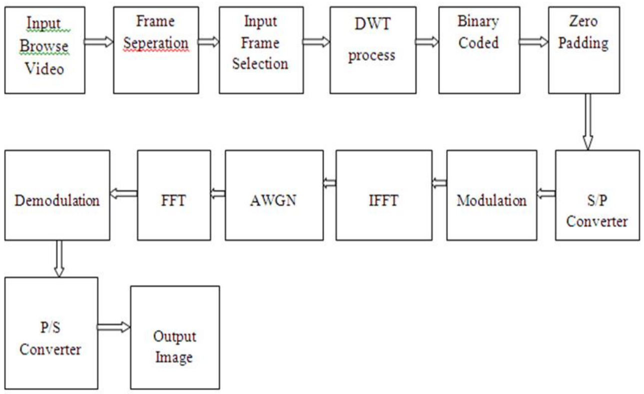

Fig.2. Block diagram of proposed scheme

A. Simulation result

The following are the simulation results of the proposed scheme. Fig 3 it shows that transformed DWT image. It produces the high resolution image. Different modulation schemes are used to identify the noise in the image. In the proposed scheme BPSK, QPSK, 8PSK, 16QAM are analyzed. Each modulation technique represents the SNR validation in db. Fig 4, Fig 5, Fig 6 shows that SNR validation using different modulation schemes. 16QAM modulation identifies maximum noise in the frame.

Fig.3. Transformed DWT image

Fig.4. SNR validation in BPSK modulation

Fig.5. SNR validation in QPSK modulation

Fig.6. SNR validation in 8PSK modulation

Fig.7. SNR validation in 16QAM modulation

V. CONCLUSION

An energy saving approach is proposed, where the compressed coefficients are arranged in descending order of priority and mapped over the channels starting with the best ones. The coefficients with lower importance level, which are likely mapped over the bad channels, are discarded at the transmitter to save power without significant loss of reception quality.

A novel scheme for wireless video transmission over OFDM subcarriers in a cognitive radio environment and derived a closed form solution for optimal subcarrier power allocation based on a convex optimization formulation is proposed and the noise is identified.

REFERENCES

[1] S. Mishra, D. Cabric, C. Chang, D. Willkomm, B. van Schewick, S. Wolisz, and B. Brodersen, "A real time cognitive radio testbed for physical and link layer experiments," in New Frontiers in Dynamic Spectrum Access Networks, 2005. DySPAN 2005. 2005 First IEEE International Symposium on, nov. 2005, pp. 562 –567.

[2] Ricardo Jose´ Colom-Palero*, Rafael Gadea-Girones, Francisco Jose, Ballester-Merelo, Marcos Mart?´nez-Peiro 'Flexible architecture for the implementation of the two dimensional discrete wavelet transform (2D-DWT) oriented to FPGA devices' 2004.

[3] G. Bansal, M. Hossain, and V. Bhargava, "Optimal and suboptimal power allocation schemes for ofdm-based cognitive radio systems," Wireless Communications, IEEE Transactions on, vol. 7, no. 11, pp. 4710 –4718, november 2008.

[4] S. Sana-e Zainab, "An efficient amp; flexible algorithm for multimedia transmission over cognitive radio network (efmcrn) based on bandwidth utilization and processing time," in Computer Networks and Information Technology (ICCNIT), 2011International Conference on, july 2011, pp. 229 –232.

[5] Y. Wang, J. Ostermann, and Y. Zhang, Video Processing and Communications, 1st ed. Prentice Hall, 2002.

[6] D. Tse and P. Viswanath., Fundamentals of Wireless Communication, 1st ed. Cambridge University Press, 2005.