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Competent Communication of JPEG2012 over Wireless Groove

S.M.KrishnaGanesh[1]
Computer Science and Engineering
St. Joseph College of Engg & Technology
Tanzania, East Africa

Dr.S.Venkatesan Jeyakumar[2]
General Engineering
St. Joseph College of Engg & Technology
Tanzania, East Africa

***Abstract*— Compression plays an important role in Image processing. The JPEG2000 image is transmitted over wireless channels. In our new model of JPEG 2012 we applied quantum chemical calculation for quantization and statistical thermodynamic entropy coding, the transmission of image over wireless channel is examined using reorganization of compressed images into error resilient and the product code. The product code consist of Turbo code and Reed-Solomon codes which are used earlier in JPEG 2000. The error can be reduced by increasing the PSNR value. The resulting scheme is tested for transmission of compressed JPEG2012 images over wireless channels.**

***Keywords*—** JPEG2000, JPEG 2012, ECC, PSNR, UEP

I. Introduction

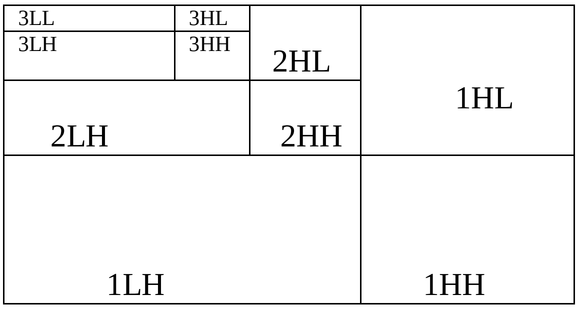
Compressing an image is significantly different than compressing raw binary data. Of course, general purpose compression programs can be used to compress images, but the result is less than optimal. This is because images have certain statistical properties which can be exploited by encoders specifically designed for them. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. Image compression is the application of data compression on digital images. In effect, the objective is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. One of the error metrics used to compare the various image compression techniques is the Peak Signal to Noise Ratio (PSNR).Where PSNR is a measure of the peak error.

Variety of error-resilient techniques for image transmission has been recently proposed. JPEG2012 was designed to overcome the limitations of the original JPEG standard and provide high-quality images at low bit-rates. In addition, JPEG2012 includes new features and functionalities for client/server imaging applications and resource constrained wireless devices. The system proposed in the present paper is based on the JPEG2000 coder, which is able to generate error-resilient streams. The considered transmission scenarios are over wireless channels producing bit errors according to the Rayleigh distribution. The JPEG2000 coder is used in conjunction with the application of a product code consisting of Turbo codes and Reed–Solomon codes. Due to the systematic form of Turbo codes, the immediate extraction and decoding of source information from the channel-coded stream is possible, if the stream is not corrupted. Whenever the stream is corrupted, the product codes will correct several errors. Uncorrectable errors are localized and the corrupted portion of the stream is discarded. The optimal allocation of Reed–Solomon symbols is also examined in the present paper and an algorithm for efficient UEP is proposed. The UEP algorithm is based on the formulation of channel packets of constant size, i.e., packets in which the source bytes vary but the sum of source and channel bytes is fixed. This approach admits a fast dynamic programming solution. The resulting robust transmission system is evaluated and is shown to outperform the best-performing known schemes for the transmission of images over wireless channels.

II. JPEG 2012

The wavelet transform is first applied on the source image data. The transform coefficients are then quantized and entropy coded, before forming the output. Fig 1 shows the block diagram of JPEG 2012. The decoder is just the reverse of the encoder. Unlike other coding schemes, JPEG 2012 can be both lossy and lossless. This depends on the wavelet transform and the quantization applied. Each tile component is then decomposed using the DWT into a series of decomposition levels which each contain a number of subbands. These subbands contain coefficients that

describe the horizontal and vertical characteristics of the original tile component. Applying one-dimensional transforms in the horizontal and vertical directions forms two-dimensional transforms. This results in four smaller image blocks; one with low resolution, one with high vertical resolution and low horizontal resolution, one with low vertical resolution and high horizontal resolution, and one with all high resolution, which is
shown in figure shown below



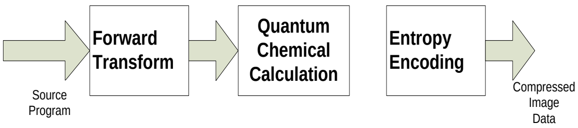


Fig 1: JPEG 2012 Block Diagram

This process of applying the one-dimensional filters in both directions is then repeated a number of times on the low-resolution image block. This procedure is called dyadic decomposition.

III. Transformation

The source image is partitioned into rectangular non-overlapping blocks in a process called tiling. These tiles are compressed independently as though they were entirely independent images. All operations, including component mixing, wavelet transform, quantization, and entropy coding, are performed independently on each different tile. The nominal tile dimensions are powers of two, except for those on the boundaries of the image. Tiling is done to reduce memory requirements, and since each tile is reconstructed independently, they can be used to decode specific parts of the image, rather than the whole image. Each tile can be thought of as an array of integers in sign-magnitude representation. This array is then described in a number of bit planes. These bit planes are a sequence of binary arrays with one bit from each coefficient of the integer array. The first bit plane contains the most significant bit (MSB) of all the magnitudes. The second array contains the next MSB of all the magnitudes, continuing in the fashion until the final array, which consists of the least significant bits of all the magnitudes

To perform the forward DWT, a one-dimensional is decomposed into a set of low-pass samples and a set of high-pass samples. An example for Dyadic decomposition is shown in fig 3. Low-pass samples represent a smaller low-resolution version of the original. The high-pass samples represent a smaller residual version of the original; this is needed for a perfect reconstruction of the original set from the low-pass set. Convolution-based filtering is done by performing a series of dot products between the high-pass and low- pass filter coefficients and the extended one-dimensional signal. Lifting-based filtering is done by updating odd sample values with a weighted sum even sample values, and updating even sample with a weighted sum of odd sample values. For the lossless case the results are rounded to integer values.

Fig 2: One of the tested images – “collie”

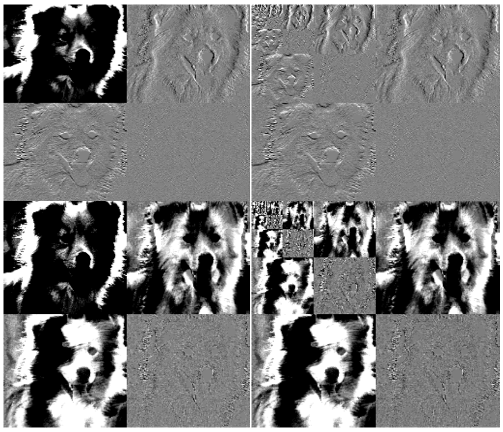


Fig 3: Decomposed image:

a) Wavelet – first level; b) wavelet – last (8-th) level;

c) Median – first level; d) median – last (8-th) level

Wavelet coefficient 0.48296291

0.83651630 0.22414387 -0.12940952

-0.12940952 -0.22414387 0.83651630

-0.48296291

IV. Quantum Chemical Calculation

After transformation, all coefficients are quantized. This is the process by which the coefficients are reduced in precision. Dividing the magnitude of each coefficient by a quantization step size and rounding down accomplishes this. These step sizes can be chosen in a way to achieve a given level of quality. This operation is lossy, unless the coefficients are integers as produced by the reversible integer 5/3 wavelet, in which case the quantization step size is essentially set to 1.0. In this case, no quantization is done and all of the coefficients remain unchanged.

In our Implementation of quantum chemical approach, the calculation was done by dividing the magnitude of each coefficient by a quantization step size and rounding down accomplishes this which results in reduction of coefficients in such a way the clarity of image is improved, In this case, quantization was done and all of the coefficients remain increasing.

Following quantization, each subband is subjected to a packet partition. Each packet contains a successively improved resolution level on one tile. This way, the image is divided into first a low quality approximation of the original, and sequentially improves until it reaches its maximum quality level. Finally, code-blocks are obtained by dividing each packet partition location into regular non-overlapping rectangles. Thus the code blocks can be obtained.. These code-blocks

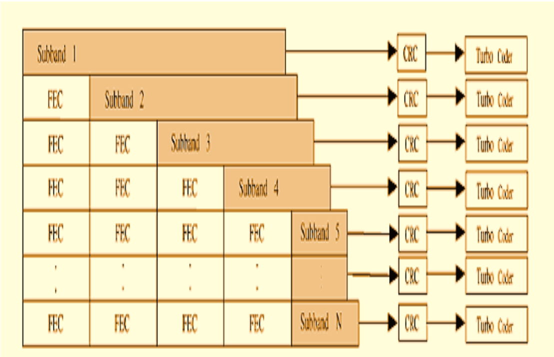


Fig 4: Product code based on Turbo codes and Reed-Solomon codes

V. ENTROPY CODING

In information theory an entropy encoding is a lossless data compression scheme that is independent of the specific characteristics of the medium. One of the main types of entropy coding assigns codes to symbols so as to match code lengths with the probabilities of the symbols. Typically, these entropy encoders are used to compress data by replacing symbols represented by equal-length codes with symbols represented by codes where the length of each code word is proportional to the negative logarithm of the probability. Therefore, the most common symbols use the shortest codes. In our technique, we employ the statistical thermodynamic concept and the entropy value is minimized which yields a high resolution of image.

VI. CODER

Error control coding (ECC), or channel coding, is a method of adding redundancy to information so that it can be transmitted over a noisy channel to another party, and subsequently be checked and corrected for errors that occurred in transmission. Channel coding is especially beneficial for wireless and multimedia applications.JPEG2012 coder is able to generate error-resilient streams. The considered transmission scenarios are over wireless channels producing bit errors according to the Raleigh distribution. The JPEG2012 coder is used in conjunction with the application of product code consisting of turbo codes and Reed Solomon codes. Due to the systematic form of turbo codes, the immediate extraction and decoding of source information from channel –coded stream is possible. Whenever the stream is corrupted, the product codes will correct several errors. Uncorrectable errors are localized and corrupted portion of the stream is discarded.A Different amount of protection, provided by Reed–Solomon codes, is allocated to each layer. Some overhead information is added to the stream to describe the Reed–Solomon policy and the size of the layers in bytes. The product code used for the protection of source symbols is depicted in Fig. 4. All rows are protected using systematic Turbo codes. During the Turbo decoding of a received packet, the CRC indicates if the packet is corrupted. On the occurrence of a corrupted packet, the Turbo codes are used to recover the information. If, however, the packet is not corrupted, due to the systematic form of the Turbo codes, the source information can be directly extracted without the need for channel decoding.JPEG2000 is based on independent block coding of wavelet coefficients. The JPEG2000 bit stream is composed by a succession of layers corresponding to code blocks which are independent in their decoding does not require prior decoding of their code blocks .we propose the division of the wavelet coefficient to be transmitted into N disjoints set in the wavelet domain. The disjoint set of coefficient are channel coded appropriately into channel packets, then, the erasure of a packet during transmission will not prevent the uncorrupted information from being decoded.

VII. CONCLUSIONS

In the previous work a novel image transmission scheme was proposed for the communication of JPEG2000 images over wireless channels. The proposed JPEG 2012 system reorganizes the compressed JPEG2000 stream in a product-code scheme consisting of Turbo codes and Reed–Solomon codes, in addition to that the quantum chemical method and statistical thermodynamic method of entropy coding are used. The resulting schemes were tested for the transmission of images over wireless channels.

As the PSNR value increases the errors can be reduced. In the future, it can be developed for the transmission of colored images where as here it is concentrated on gray images. Experimental evaluation showed the superiority of the proposed scheme in comparison to other transmission schemes.

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