Hierarchical Prediction & Context Modeling Approach for Image Compression Based on Multi Level Image

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ABSTRACT

This paper present a new lossless color image compression Algorithm, based on the hierarchical prediction & context modeling arithmetic coding. For the lossless image compression of an RGB image, it is first decor related by a reversible color transform & then Y component is encoded by a conventional lossless grayscale image compression method. For encoding the chrominance images, we develop a hierarchical scheme that enables the used of upper, left and lower pixels for the pixels prediction, whereas the conventional raster scan prediction method use upper & left pixels. An appropriate context model for the prediction error is also define and the arithmetic coding is applied to the error signal corresponding to each context. It is shown that the proposed method further reduces the bit rates compared with JPEG-2000 & JPEG-XR.

Keywords: Lossless image compression, Hierarchical prediction, Context modeling, Over-complete dictionary.

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INTRODUCTION:

Digital images are usually encoded by lossy compression methods due to this large memory or bandwidth requirements. The lossy compression method achieve high compression ratio at the cost of image quality degradation. However, there are many cases whrer the lossy information or artifacts due to compression needs to be avoided such as medical, prepress, scientific and artistic images. As cameras and display systems are high quality and as the cost of memory is lowered. We many also wish to keep our precious and artistic photos free from compare artifacts. Hence efficient lossless compression will become more and more important, although the lossy compressed iage are usually satisfactory in many cases.

Multimedia data compression is a challenging job for compression technique, due to the possibility of loss of data and required large amount of storage place. The minimization of storage place and proper transmission of these data needed compression. Now in these days various image compression techniques are used. Some compression technique is lossless and some compression technique is loss. The process of lossless compression technique is slow and takes more time for compression. In the series of compression technique one method are available such method is called DWT image compression technique?

The DWT image compression technique is very efficient image compression technique due to the property of symmetry. The property of symmetry reduces the selection time of block. But the process produces lossy image compression. Some authors used some other technique along with DWT transform function and produces lossless image compression technique.

In this dissertation proposed a block based DWT image compression technique using genetic algorithm and HCC code matrix. The HCC code matrix compressed into two different set redundant and non-redundant here generate similar pattern of block coefficient. The similar block coefficient generated by particle of swarm optimization. The process of particle of swarm optimization is select the optimal block of DWT transform function.

The proposed algorithm implemented in MATLAB software. This software is well known application for image processing. The process of implementation also used two different algorithms such as PCRT and JPEG. The experimental result shows that our proposed algorithm produces better result in compression of PCRT and JPEG.

For the experimental purpose used some standard image such as Lena, Barbara and cameraman image. The size of resolution of this image is 256*256. The source of image is Google.

HIERARCHICAL DECOMPOSITION & PIXEL PREDICTION

In this section discuss the hierarchical decomposition and pixel prediction. The chrominance channels Cg and Cv resulting form the RCT usually have different statistics from Y, and also different from the original color planes R, G, B. In the chrominance channels, the overall signals variation is suppressed by the color transform, but the variation is still large near the object boundaries. Hence, the prediction errors in the chrominance channel are much reduced in a smooth region, but remain relatively large near the edge or within a texture region.

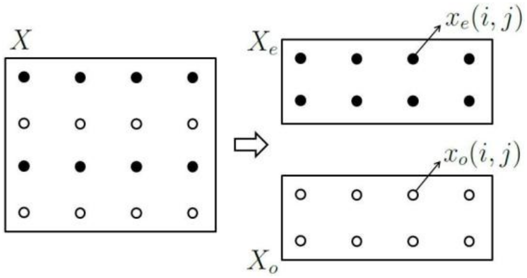
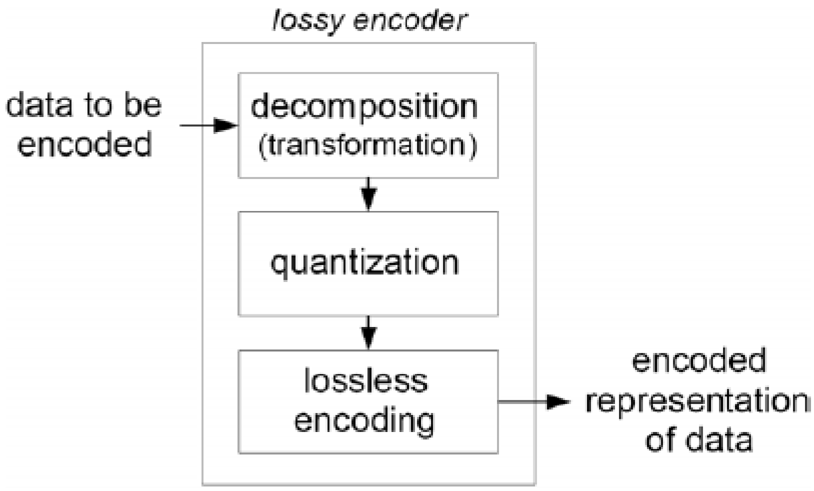


Fig. 1 Input Image & Its Decomposition

For the efficient lossless compression, it is important to accurately estimate the pdf of prediction error for better context modeling, along with the accurate prediction. For this, we propose a hierarchical decomposition scheme as depicted in fig 1, which show that pixels in an input image X is separated into two sub images: an even sub image Xe and an odd sub image Xo. Then, Xe is encoded first and is used to predict the pixels in Xo. In addition Xe is also used to estimate the statistics of prediction errors of Xo. In actual implementation, Xe is decomposition once more as will be explained later.

IMAGE COMPRESSION TECHNIQUE

In this section discuss the image compression technique. The video compression technique divide into two types one is lossy video compression and another is lossless image compression [9]. The lossy image compression technique is very efficient and compressed the image at very high compression rate. Instead of that the lossless image compression, the compression rate is very low. How to improve the compression ratio is major issue. For the improvement of compression ratio of image various encoders are used. Here we discuss three encoding technique lossless image compression and lossy compression.



Lossless Image Compression

Lossless data compression is used in many applications. For example, it is used in the ZIP file format and in the GNU tool gzip. It is also often used as a component within lossy data compression technologies (e.g. lossless mid/side joint stereo preprocessing by the LAME MP3 encoder and other lossy audio encoders).

Lossless compression is used in cases where it is important that the original and the decompressed data be identical, or where deviations from the original data could be deleterious. Typical examples are executable programs, text documents, and source code. Some image file formats, like PNG or GIF, use only lossless compression, while others like TIFF and MNG may use either lossless or lossy methods. Lossless audio formats are most often used for archiving or production purposes, while smaller lossy audio files are typically used on portable players and in other cases where storage space is limited or exact replication of the audio is unnecessary.

TIFF (Tagged Image File Format) (last review 1992) is a file format for mainly storing images, including photographs and line art. It is one of the most popular and flexible of the current public domain raster file formats. Originally created by the company Aldus, jointly with Microsoft, for use with PostScript printing, TIFF is a popular format for high color depth images, along with JPEG and PNG. TIFF format is widely supported by image-manipulation applications, and by scanning, faxing, word processing, optical character recognition, and other applications.

Lossy Compression

In lossy compression algorithms, two obligatory phases can be distinguished quantization and lossless compression. This means that the quantization is the key issue for lossy methods. Before the quantization, one more phase can be found decomposition, which is optional, but very frequently used because it allows one to create more effective quantization algorithms. The goal of the decomposition is to build a representation of the original data that will enable more effective quantization and encoding phases. Basic way to achieve this goal is to reduce the length of the representation comparing to the original data. Although the decomposition phase is optional, it exists in every practical implementation of lossy compression. Before the quantization will proceed, decomposition reduces the redundancy and correlation of symbols (pixel values) in the stream to be encoded. A combination of decomposition with simple quantization produces results in very good effectiveness with much lower complexity and encoding/decoding time.

The computer is becoming more and more powerful day by day. As a result, the use of digital images is increasing rapidly. Along with this increasing use of digital images comes the serious issue of storing and transferring the huge volume of data representing the images because the uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. Though there is a rapid progress in mass storage density, speed of the processor and the performance of the digital communication systems, the demand for data storage capacity and data transmission bandwidth continues to exceed the capabilities of on hand technologies. Besides, the latest growth of data intensive multimedia based web applications has put much pressure on the researchers to find the way of using the images in the web applications more effectively. Internet teleconferencing, High Definition Television (HDTV), satellite communications and digital storage of movies are not feasible without a high degree of compression. Compression-then-Encryption (CTE) paradigm meets the requirements in many secure transmission scenarios, the order of applying the compression and encryption needs to be reversed in some other situations.. To limit the effects of data loss that may occur on the communications channel, the wavelet transformed image data are partitioned into segments, each loosely corresponding to a different region of the image.

PROPOSED CODING SCHEME

In this section, we explain the overall process of image compression, including the new encoding scheme. An input RGB color image is transformed into YCuCv color space by an Rct. The luminance image Y is encoded by any of lossless grayscale image colors, such as CALIC, JPEG2000 and JPEG-XR lossless. The chrominance image Cu and Cv are encoded using the method described in this section. To be specific, a chrominance image is decomposed row into an even image and odd image. The sub image can be further decomposed column by column into the even sub image and the odd sub image.

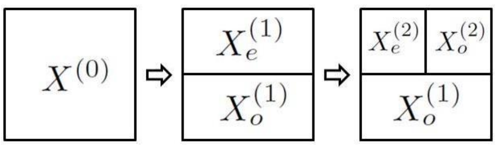
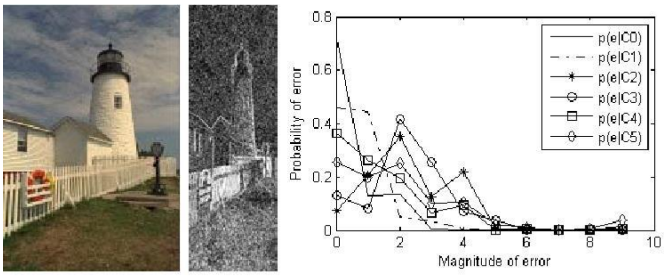


Fig. 2. Illustration of hierarchical decomposition.

TABLE I

Compression bit rate for medical image



(a) (b) (c)

	Size	JPEG2000	JPEG-XR	Proposed
Ceiling	4288 × 2848	7.5571	8.8331	**7.2080**
Locks	4288 × 2848	7.4574	8.8296	**7.1623**
Flamingo	4288 × 2848	7.0366	8.2698	**6.6371**
Berry	4288 × 2848	7.2468	8.6646	**6.8917**
Sunset	4288 × 2848	6.3586	7.9263	**5.9700**
Flower	4032 × 3024	6.4141	8.1298	**6.0655**
Park	4032 × 3024	5.8977	7.6534	**5.5622**
Fireworks	4032 × 3024	5.7797	7.4469	**5.2855**
Avg.		6.7185	8.2192	6.3478

Although the proposed prediction method usually generates small prediction errors owing to the RCT and the sophisticated prediction scheme, there are still relatively large errors near the edge ar texture region, which degrades the compression performance. For the efficient compression the statistics of symbols should well be described by an appropriate model and/or parameters. We model the prediction error as a random variable with pdf p(e|Cn), where Cn is the coding context that reflects the magnitude of edges and texture. Specifically, Cn is the level of quantization steps of pixel activity

$$\sigma(i, j) = |x_e(i, j) - x_e(i+1, j)|$$

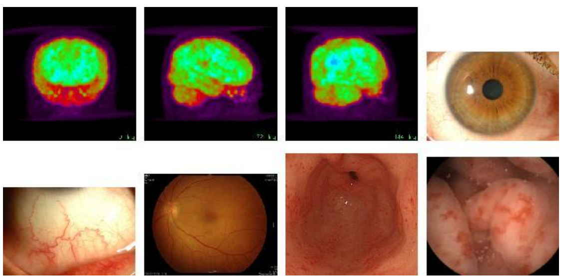
Note that the local activity and its quantization steps are calculated with the pixels in Xe, because all the pixels of Xe are available and its statistical property would be almost the same as that of Xo. The activity is quantized into k steps such that Cn represent the step

Qn-1<(i,j)<qn

For n= 1,2,3……………………..,K with q0= 0 and qk= infinite

The length of quantization step is determined such that each step includes the compression ratio lossless compression of color filter array image by multi level image. According to the world of image processing any named group of records is called a dataset. Dataset can be hold information such as medical records or insurance records.

The Medical images



The same number of elements. For such Context, a generic adaptive arithmetic coder is used to encode the prediction error. ribed the statistical property of prediction error very well, in that the error magnitude is large when the local activity is strong. Hence the proposed model can be effective for the compression with the arithmetic coding.

EXPERIMENTAL RESULTS

As stated in the introduction, the state of the art lossless compression method may be the CALIC [4], which shows higher coding gain than the JPEG-LS [2], [3] at the cost of higher computational complexity. For the compression the color image, the JPEG2000 and JPEG-XR [6] lossless provide better coding gain than the independent encoding of each channel by CALIC and also than the proposed method with JPEG2000 and JPEG-XR. The executables for our encoder /decoder and all the images used in the experiments are publicly available at our website [12].

The proposed method is also tested on the medical image in above figure and compared with JPEG2000 and JPEG-XR in the table. The test medical images are position emission tomography images for human brain, digital camera image for eye and eyeground, and the endscope image for human intestine. Which are generally smooth and hence less bits are generated when compared with the case of Kotak image.

CONCLUSION

We have proposed a lossless color image compression method based on the hierarchical prediction sheme and context modeling arithmetic coding. For the compression of an RGB images, It is first transformed into YCuCv color space using an RCT. After the color transformation, the luminance channel Y is compressed by a conventional lossless image coder. Pixels in chrominance channel are predicted by the hierarchical decomposition and directional prediction. Finally, an appropriate context modeling residuals is introduced and arithmetic coding is applied.

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