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Lossless Image Compression Technique for Multiview Image Using Arithmetic Encoding

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Abstract— Image compression is a process that reduces the image size and removing the unreasonable information. Shorter data size is suitable because it simply reduces cost. There are number of different data compression methodologies, which are applied to compress most of the formats. Widely used in modern image and video compression algorithm such as JPEG, JPEG-2000, H-263, CALIC. This report deals with the image compression with arithmetic encoding. Arithmetic encoding is common algorithm used in both lossy and lossless data-compression. It is an entropy technique, in which the frequently encountered seen symbols are encoded with fewer bits than lesser seen symbols. By using arithmetic encoding high degree of adaptation and redundancy reduction is achieved. To display high bit resolution images on low bit resolution displays, bit resolution needs to be reduced. Towards achieving a reduced bit rates and high compression gain, an enhanced method for compression of various color images are presented, which is based on hierarchical prediction and adaptive coding. An RGB image is first transformed to YCbCr by a reversible color transform and a various conventional lossless grayscale image compression techniques which encodes Y component. A hierarchical decomposition that enables the use of upper pixels, left pixels, and lower pixels for the pixel prediction to encode the chrominance channel. The prediction error is measured based on context model and the adaptive coding is applied to the error signal. Parameters such as peak signal to noise ratio, encoding, decoding time and bit rate have been evaluated and it is exposed that the proposed method further reduces the bit rates compared with JPEG2000 and CALIC.
Keywords-Context adaptive arithmetic coding, Hierarchical decomposition, Lossless RGB image compression, Pixel prediction, Reversible color transform

I. INTRODUCTION

Multiview images are obtained by recording a scene from different viewpoints using an array of cameras. These datasets have become an important component in a wide range of signal processing applications. In the computer graphics community, multiview images are used to create photorealistic results with a low computational complexity. The reason for using real datasets, as opposed to an accurate 3D representation of a scene, stems from the fact that natural images contain many subtle properties which are difficult to model and reproduce. Yet these properties are necessary to create a 'realistic' perception in the rendered scene. The process of creating virtual views from images is known as image-based rendering (IBR). In particular, IBR has been extensively researched due to its applications in free viewpoint TV (FTV) and 3D TV. The latter creates a perception of depth, whereas FTV allows the user to perceive an immersive experience by interactively choosing their viewpoint. In FTV, IBR plays an important role; it is used to synthesize novel viewpoints where no camera exists. Other examples of applications where multiview images are commonly used include: object and feature recognition, security surveillance, teleconferencing and remote education. These applications have to process significantly more data than the traditional single view setup. For example, in IBR a popular approach known as light field rendering can consist of 1000 images with an uncompressed data size of ~1GB. Therefore, in order to make these applications practical, it is important to develop methods which efficiently compress this type of data. Multiview images are highly redundant in that they contain very similar content in each view. This property is due to the fact that in a multiview image array the cameras are commonly very closely spaced. As a consequence, a given object in one of the images will also appear shifted in each of the neighbouring images. Moreover, the shift can often be predicted and partially depends on the geometry of the array. These properties can be taken into account when developing coding methods to achieve a high compression. When developing a multiview compression method, it is important to consider the type of application the algorithm is designed for. If the data is encoded offline and stored on a hard disk, we can design a complex encoding method with a high compression efficiency. However, in an interactive communication system, we must consider other aspects in addition to this property. An interactive communication setup consists of a server and remote clients. The remote clients connect to the server and request certain images from the dataset. An advantage of this method is that only the requested views are transmitted as opposed to the complete dataset. In this setup, the ability to transmit certain images without decoding the dataset is significantly more important than compression efficiency. This property is known as random access. In addition, other factors such as decoding complexity and scalability should be taken into account. Scalability is a general term which defines whether a single bit stream can be decoded multiple times according to different distortion or resolution levels (spatial or temporal). In compression, we must also carefully consider how the coding parameters are chosen to optimize the method. Typically, the parameters are selected using a rate distortion (RD) formulation where the goal is to minimize the distortion for a given bit budget (complexity and other factors can also be taken into account). For example in sub band coding the goal is to select a set of quantizes which minimize the distortion for a given rate constraint. The number of free parameters in a coding setup is typically large and optimization techniques must be employed to solve these problems. A popular framework applied in image and video coding is Lagrangian minimization. Here, the constrained optimization problem is transformed into an unconstrained one by jointly minimizing the rate and distortion. This framework can be applied in an operational sense by encoding the data points or by modelling the RD using a certain class of signals, such as a Gaussian random process or piecewise polynomial signals.

A. Lossless and Lossy Compression

The goal of image compression is to represent an image with the least amount of bits possible. There are "lossless" and "lossy" modes in image compression. In lossy compression, the image quality may be degraded in order to meet a given target data rate for storage and transmission. The applications for lossy coding are the transmission of the image and video through a band limited network and efficient storage. The issue in lossy compression is how much we can reduce the degradation of the image quality given the data rate. In lossy compression, most algorithms transform pixels into the transform domain using the DCT (Discrete Cosine Transform) or the DWT (Discrete Wavelet Transform). The source of the loss is either quantization of the transform coefficients or the termination of the encoding at a given data rate. In order to meet a data rate budget, the transform coefficients are explicitly quantized with a given step size as in ZTE, JPEG, H.263. Implicit quantization is used in algorithms such as EZW and SPIHT, which can be truncated at any point in the bit stream during encoding. In the lossless compression, the image after decompression is identical to that of the original. The issue in lossless coding is how much we can reduce the data rate. The main approach for lossless image compression is predictive coding or entropy encoding. For predictive coding, DPCM (Differential Pulse Code Modulation) is often used. Linear predictors are used where the prediction is obtained by the linear combination of previously decoded neighbors. For entropy coding, Run-length coding, Huffman coding, or arithmetic coding is used. Context modeling can be included in the entropy encoding, which is to estimate the probability distribution function of the symbols conditioned on the context, so as to increase the compression performance. The context consists of a combination of neighboring pixels already encountered. The structure of predictive coding is determined by the number of neighboring pixels used for the prediction, weighting for the linear combination of the neighbouring pixels and the method of context modeling. The JPEG lossless mode uses DPCM and Huffman coding or arithmetic coding. FELICS (Fast and Efficient Lossless Image Compression) developed by P. Howard is a simple and fast lossless encoder. CALIC (Context-based, Adaptive, Lossless Image Coding) by X. Wu and JPEG LS are other examples of lossless compression algorithms using predictive coding.

II. LITERATURE REVIEW

A. The Loco-I Lossless Image Compression Algorithm: Principles And Standardization Into Jpeg-Ls

Marcelo J et al proposed In JPEG-LS, the data in a multi-component scan can be interleaved either by lines (line- interleaved mode) or by samples (sample-interleaved mode). In line-interleaved mode, assuming an image that is not sub-sampled in the vertical direction, a full line of each component is encoded before starting the encoding of the next line (for images sub-sampled in the vertical direction, more than one line from a component are interleaved before starting with the next component). The index to the table used to adapt the elementary Golomb code in run mode is component-dependent. In sample-interleaved mode, one sample from each component is processed in turn, so that all components which belong to the same scan must have the same dimensions. The runs are common to all the components in the scan, with run mode selected only when the corresponding condition is satisfied for all the components. Likewise, a run is interrupted whenever so dictated by any of the components. Thus, a single run length, common to all components, is encoded. This approach is convenient for images in which runs tend to be synchronized between components (e.g., synthetic images), but should be avoided in cases where run statistics differ significantly across components, since a component may systematically cause run interruptions for another component with otherwise long runs. For example, in a CMYK representation, the runs in the K plane tend to be longer than in the other planes, so it is best to encode the K plane in a different scan. The performance of JPEG-LS, run in line-interleaved mode on the images of Table 2, is very similar to that of the component-by-component mode shown in the table. We observed a maximum compression ratio deterioration of 1% on "gold" and "hotel," and a maximum improvement of 1% on "compound1." In sample-interleaved mode, however, the deterioration is generally more significant (3 to 5% in many cases), but with a 3 to 4% improvement on compound documents. Palletized images. The JPEG-LS data format also provides tools for encoding palletized

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images in an appropriate index space (i.e., as an array of indices to a palette table), rather than in the original color space. To this end, the decoding process may be followed by a so-called sample- mapping procedure, which maps each decoded sample value (e.g., and 8-bit index) to a reconstructed sample value (e.g., an RGB triplet) by means of mapping tables. Appropriate syntax is defined to allow embedding of these tables in the JPEG-LS bit stream. Many of the assumptions for the JPEG-LS model, targeted at continuous-tone images, do not hold when compressing an array of indices. However, an appropriate reordering of the palette table can sometimes alleviate this deficiency. Some heuristics are known that produce good results at low complexity, without using image statistics. For example, [54] proposes to arrange the palette colors in increasing order of luminance value, so that samples that are close in space in a smooth image will tend to be close in color and in luminance. Using this reordering, JPEG-LS outperforms PNG by about 6% on palletized versions of the images “lena” and “gold”. On the other hand, PNG may be advantageous for dithered, halftoned, and some graphic images for which LZ-type methods are better suited. JPEG-LS does not specify a particular heuristic for palette ordering.

B. Reversible Inter Frame Compression Of Medical Images: A Comparison Of Decorrelation Methods

P. Roos et al proposed Interpolated temporal decorrelation is generally better than extrapolated temporal decorrelation for the medical image sequences considered. Wiener-based percussive motion estimation is the most efficient method for motion compensation. However, Wiener-based decorrelation is hardly (if at all) more efficient than non-motion compensated inter frame decor-relation. For the medical image sequences, none of the inter frame decorrelation methods performs significantly better than straightforward intra frame hint. This is ascribed to the temporal noise present in the medical image sequence. Both spatial down sampling and temporal smoothing of the series reverse the above conclusion. Unregistered interpolation approximates the performance of intra frame HINT within a few percent. The lower complexity makes the method an interesting alternative to intra frame HINT. Unregistered extrapolation has a significantly lower complexity still, but the decorrelation results are not as good as for the interpolation scheme. The requirements concerning compression ratio and computational speed will determine which method is most appropriate.

C. Lifting-Based Reversible Color Transformations For Image Compression

J. Sullivan et al proposed in more detail the main ideas behind the development of the YCoCg and YCoCg-R color space transforms for RGB image data. We showed that their coding gain is higher than that of the traditional YCrCb transform, and close to that of the optimal KLT. Thus, it is unlikely that a linear color transform with simpler computational structures and better coding gains can be derived. Versions of these transforms are used in modem standards such as the draft JPEG XR image coding standard and the H.264/MPEG-4 AVC video coding standard. We also presented two constructions for 4- channel transforms, which can provide significant coding gains (5 to 7 dB) for input data in 4-channel CMYK format. A version of the YCoCgK is also used in the draft JPEG XR standard.

III.SYSTEM DEVELOPMENT

A. Lossless Image Compression

Following figure shows the Lossless Image Compression System

1) Color Transform: In this proposal to develop a hierarchical prediction methods in lossless compression are based on the raster scan prediction which is sometimes inefficient in the high frequency region? In this proposal we design an edge directed predictor and context adaptive model for this hierarchical scheme. For the compression of color images RGB is first transformed to YCuCv by an RCT.

2) Reverse Color Transform: Reversible color transform for 16-bit-color (hicolor) picture coding. The work is motivated by the increasing needs of multimedia applications on low-end devices such as mobile phones and PDAs. They have limited resources and up to 16-bit displays. Current image/video coding systems can hardly manage this case effectively. To enhance coding efficiency on this condition, a reversible color transform customized for hicolor systems is derived from Y'CrCb and JPEG2000 Reversible Component Transformation (RCT). The transform proves simple but highly-decorrelating, and able to reduce the computation time of decoding. Comparison experiment demonstrates the effectiveness of this transform with equal or even higher coding efficiency on low-end devices with 16-bit display mode.

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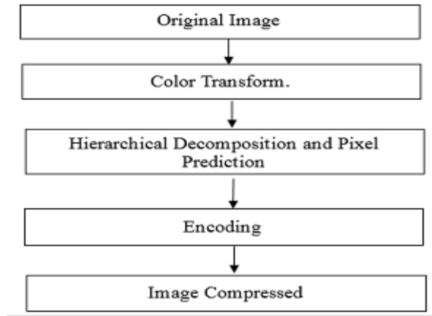

Figure Lossless Image Compression System.

3) Hierarchical Decomposition And Pixel Prediction: In this hierarchical decomposition, the chrominance channels Cu and Cv which results from the RCT usually have different figures from Y (luma), and also different from the original color planes R, G, and B. The overall signal variation is concealed by the color transform in the chrominance channels, but the variation is still large near the object boundaries. Consequently, the prediction errors in a chrominance channel are much reduced in a smooth region, but remain reasonably great near the edge or within a texture region. The pdf of prediction error for better context modeling, along with the accurate prediction is estimated for the efficient compression. Here, we propose a hierarchical decomposition scheme that is pixels in an input image X is splited into two sub images: an even sub image Xe and an odd sub image Xo. An even sub image is encoded first and is used to predict the pixels in odd sub image Xo In addition, Xe is also used to find the statistics of prediction errors of Xo.For the compression of Xo pixels using Xe, directional prediction is worked to avoid large prediction errors close to the edges. For each pixel, the horizontal predictor $\hat{x}h$(i, j) and vertical predictor $\hat{x}v$(i, j) are defined as

IV.PERFORMANCE ANALYSIS

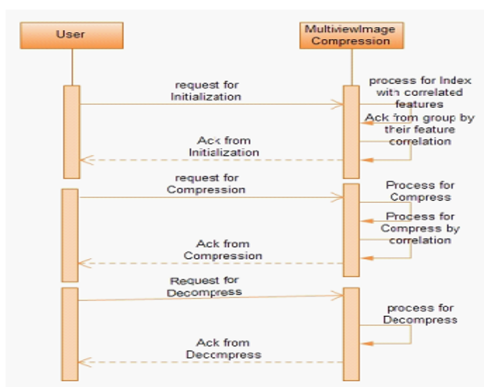

Fig. Sequence Diagram

Above Figure shows analytical model. This system consist of 3 phases name as color Transform, Hierarchical Decomposition and Pixel prediction, Encoding each phase in details. . Let us see each phase in details. Main part of the project is to collect multiview images to make it input. Multiview when same object is captured with different angles and dimensions, then that collection together called as multiview images. Now that images are provided as input to the system. Use request for Initialization, after that input images are process index with correlated features. As per features the images are classified into the number of group. And provide acknowledgement to the user. Now user ask for compression, this is not actual compression it only convert the all images set into the `.dat' file. After that user request the compression by co-relation this is the actual compression made into the `.dat' format. Now we got both `dat' file that is existing and proposed now we have to convert it into the image dataset, for this purpose user request the decompression. In this way lossless multiview compression is achieved.
INPUT IMAGE

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OUTPUT IMAGE

Table: Compression Data for 17 Groups

Image Name	Original Size	Size after compression	Compression ratio
Im0215.png	43.2	16.4	0.37
Im0296.png	36.2	13.1	0.36
Im0305.png	49.0	17.1	0.34
Im0387.png	34.0	14.2	0.41
Im0524.png	38.7	15.1	0.39
Im0542.png	36.2	13.7	0.37
Im0543.png	30.7	11.1	0.36
Im0560.png	28.8	11.5	0.39
Im0739.png	32.0	11.8	0.36

V. CONCLUSION

We presented an approach to obtain a sparse decomposition of multiview images. The underlying idea is that a multiview image array can be analysed as a set of layers, where each layer corresponds to an object located at a constant depth in the scene. We call this the layer-based representation. After extracting the layers, we obtain the sparse decomposition by using a multi-dimensional DWT. The DWT is applied in a separable approach. First, we use an inter-view DWT applied to the camera viewpoint dimensions. The DWT is implemented using the lifting implementation, and it is applied in the direction of the EPI lines to maximise sparsity. In addition, we modify the transform to take into account occluded regions. This is followed by a 2D DWT applied to the spatial coordinates. Our evaluation shows that the proposed decomposition is sparser than a conventional DWT with the same decomposition structure. An enhanced lossless RGB image compression based on hierarchical prediction and context adaptive coding has been proposed to reduce the bit rate and to achieve high compression gain.

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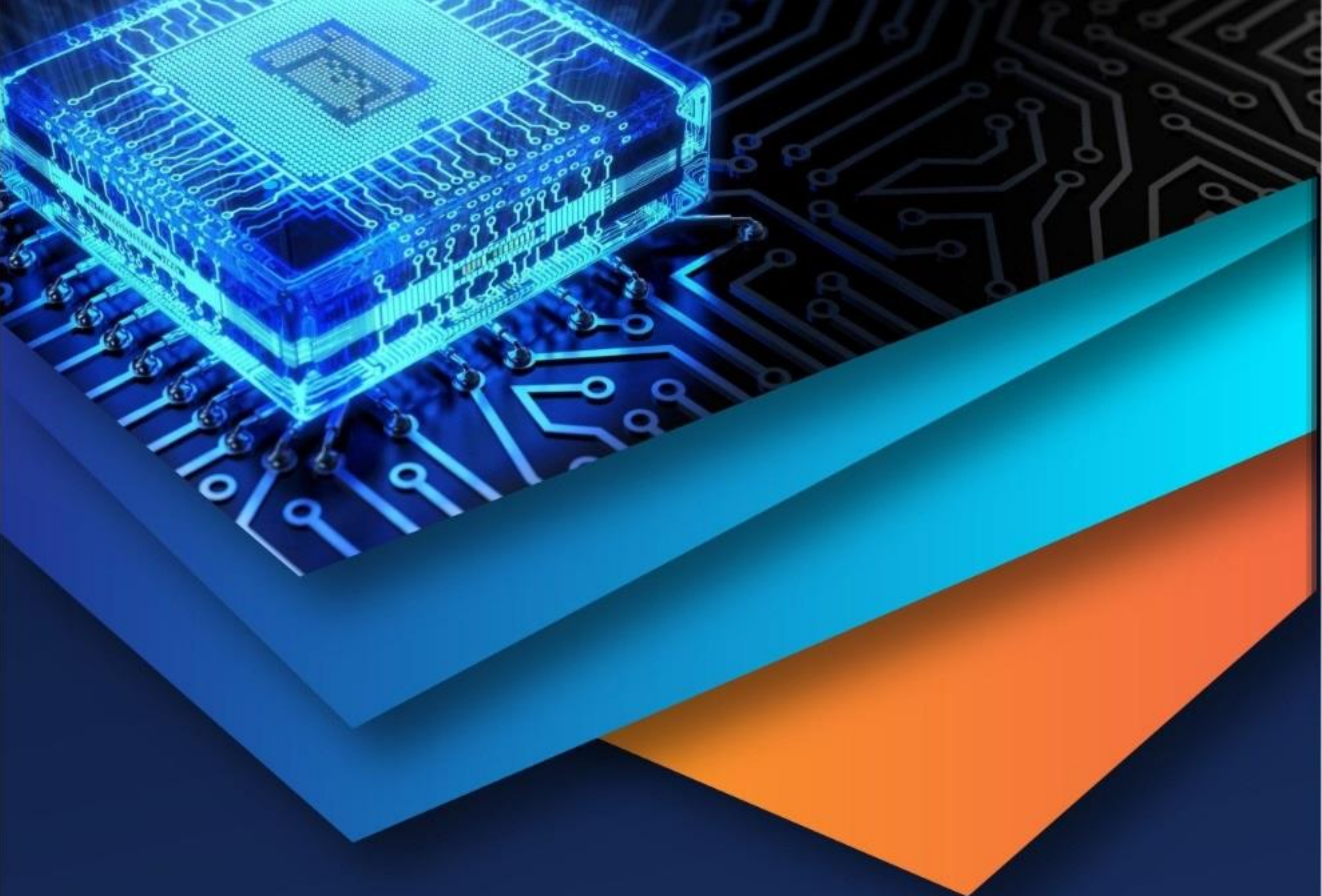

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