An Efficient Block Based Compression Technique using Interpolated Down Conversion and Graph Based Smoothness Prior

G.Karthika, Mrs.K.Muthulakshmi
PG Scholar, M.E. PhD.,HOD ECE
S.Veerasamy Chettiar College of Engineering and Technology.

Abstract

Image compression process reduces the total number of bits required for representing original image in storage or transmission purpose. we focus on the design of a new Bicubic interpolated TDDC(Transform domain downward conversion) -based coding method by using our proposed interpolation-compression directed filtering (ICDF) and error-compensated scalar quantization (ECSQ), leading to the compression-dependent TDDC (CDTDDC) based coding. ICDF is first used to convert each 16 16macroblock into an 88 coefficient block. Then, this coefficient block is compressed with ECSQ, resulting in a smaller compression distortion for those pixels that locate at some specific positions of a macro-block.The proposed CDTDDC-based coding can be applied to compressboth grayscale and color images

I. INTRODUCTION

With the development of the imaging technology, more and more images with high qualities and large spatial resolutions are provided for satisfying people's visual experiences. However, it issues a great challenge to image transmission and storage. Therefore, a more efficient image compression scheme is highly demanded, which can ensure a higher image quality with a smaller quantity of bits for the image representation.

Based on that most images can be obtained via interpolation from sparse pixel data yielded by a signal-sensor camera [9], and natural images exhibit high spatial correlations between neighboring pixels [2], many interpolation-based image coding methods [3]-[7] have been proposed. In [5], 2×2 average operator is employed for decimation before JPEG compression. A replication filter and a Gaussian filter are used for restoring the image from the decimated one. The theoretical down-sampling model is studied and compared in [6]. Tsaig et al. [7] propose to code the filter parameters as the side information for better reconstruction at the decoder side. In [3] [4], the authors suggest coding the down-sampled low-resolution image during encoding and recovering the high frequency components during decoding by interpolating the compact image representation generated by sparse sampling in the spatial domain. Although the predominated smooth regions of an image can be satisfactorily recovered by interpolation, the reconstruction of high frequency components of the edge and texture regions still remains a great challenge. In order to overcome the problem, Wu et al. [1] employ the piecewise autoregressive model to handle the large phase errors during the interpolation of the image edges. However, there is a heavy computation burden at the decoder side due to the optimal block estimation problem driven by the autoregressive model. Moreover, Lin et al. [2] propose a new image coding method based on the adaptive decision of appropriate downsampling directions/ratios and quantization steps to achieve higher coding quality. The method tries to avoid downsampling a macroblock along the direction of high spatial variations, which signals the existence of edges and other image features with great impact on the perceptual visual quality. In [2], the down-sampled pixels are obtained by averaging the neighboring pixels of the original resolution image. Although it can somewhat reduce the aliasing artifacts introduced by direct sampling, the blurring artifacts will be introduced. Also as the down-sampling process is independent of the following super-resolution process, the reconstruction errors between the original and the restored macroblock cannot be ensured to be the smallest. More recently, the JPEG2000 [15] and H.264/AVC [16] have been developed for achieving higher compression performances for images.

II. RELATED WORK

Jonathan Taquet et al propose a new hierarchical approach to resolution scalable lossless and near-lossless (NLS) compression. It combines the adaptability of DPCM schemes with new hierarchical oriented predictors to provide resolution scalability with better compression performances than the usual hierarchical interpolation predictor or the wavelet transform.

IoanTabus et al introduces an efficient method for lossless compression of depth map images, using the representation of a depth image in terms of three entities: 1) the crack-edges; 2) the constant depth regions enclosed by them; and 3) the depth value over each region.

Changhan Yoon et al propose an efficient pulse compression method of chirp-coded excitation, in which the pulse compression is conducted with complex baseband data after downsampling, to lower the computational complexity

Seyun Kim et al presents a new lossless color image compression algorithm, based on the hierarchical prediction and context-adaptive arithmetic coding

Luís F. R. Lucas et al describes a highly efficient method for lossless compression of volumetric sets of medical images, such as CTs or MRIs. The proposed method, referred to as 3-D-MRP, is based on the principle of minimum rate predictors (MRPs), which is one of the state-of-the-art lossless compression technologies presented in the data compression literature.

Pascal Peter et al address this missing link with two contributions. First, we show the relation between the discrete colorization of Levin et al. and continuous diffusion-based inpainting in the YCbCr color space.

Wei Hu et al introduce two techniques to reduce computation complexity. First, at the encoder, we low-pass filter and downsample a high-resolution (HR) pixel block to obtain a low-resolution (LR) one, so that a LR-GFT can be employed.

Chuan Qin et al propose a novel joint data-hiding and compression scheme for digital images using side match vector quantization (SMVQ) and image inpainting. The two functions of data hiding and image compression can be integrated into one single module seamlessly.

III. PROPOSED SYSTEM

In this project, we focus on the design of a new TDDC-based coding method by using our proposed interpolation compression directed filtering (ICDF) and error-compensated scalar quantization (ECSQ), leading to the compression dependent TDDC (CDTDDC)-based coding. More specifically, ICDF is first used to convert each 16 × 16 macro-block into an 8 × 8 coefficient block. Then, this coefficient block is compressed with ECSQ, resulting in a smaller compression distortion for those pixels that locate at some specific positions of a macroblock. We select these positions according to the 4:1 uniform sub-sampling lattice and use the pixels locating at them to reconstruct the whole macro-block through an interpolation. The proposed CDTDDC-based coding can be applied to compress both grayscale and color images. More importantly, when it is used in the color image compression, it offers not only a new solution to reduce the data-size of chrominance components but also higher compression efficiency.

In this work, we propose a new TDDC-based coding to compress each 16_16 macro-block. In general, the transform domain downward conversion is implemented by using an advanced pre-filtering and the reconstruction of a compressed macro-block is achieved based on the image interpolation. The pre-filtering used in our work not only facilitates an efficient interpolation at the decoder side but also produces a specific transformed macro-block at the encoder side, which leads to the transform domain downward conversion. To this end, an interpolation-compression directed filtering (ICDF) is proposed and performed on each macroblock before compression. Then, an error-compensated scalar quantization (ECSQ) is designed to reduce the distortion occurring on some specific pixels of the compressed macroblock, where these pixels will be collected to implement the interpolation for the reconstruction of a macro-block.

Interpolation-compression directed filtering

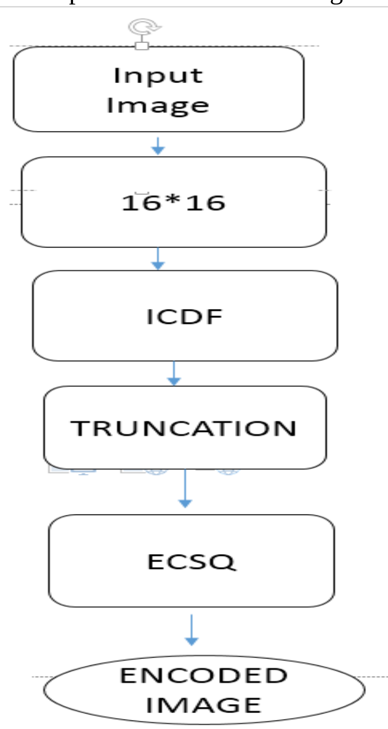

Figure proposed work flow

We present our analysis with the 1-D representation for the corresponding 2-D image block in this subsection. Firstly, we compose a transform matrix ψ by performing the Kronecker product, denoted as , on the DCT matrix C as ψ=C℗C. Then, we concatenate all columns of B to form a coefficient vector X. Based on ψ and x, X may be obtained by X =ψ x, which implies that the 2-D transform has been achieved via the 1-D operation. Finally, the inverse transform will be implemented as

$x = \psi^{-1} X$

In this work, the compressed pixels locating at some predetermined positions (denoted as Ω) of an N x N macro-block will be used to reconstruct a decompressed macro-block via image interpolation. Specifically, these positions are defined according to the 4:1 uniform sub-sampling lattice. Regardless of the compression, let x Ω be composed by K = N2=4 pixels locating at Ω in b. Typically, these pixels are picked out from b along the vertical direction. If we compose a K x N2 matrix D by using K rows of ψ^{-1} corresponding to K selected
positions belonging to , we may get

X Ω = DX

Moreover, if the positions of X's elements are changed, some necessary column-swaps must be performed on D to guarantee the correct output for x. More specifically, let us use X_R to represent a column-vector composed by K coefficients locating at R in B and use $X_{R'}$ to denote another column-vector composed by the other (N2 - K) coefficients locating at R' . Then, we combine X_R and $X_{R'}$ together to construct X as X = $[X_R^T < X_{R'}^T]^T$. Meanwhile, we use K corresponding columns of D to compose a matrix D_R and use the other (N2 -K) columns of it to compose another matrix $D_{R'}$. Coupling D_R and $D_{R'}$ together, we get D = $[D_R\ D_{R'}]$ which makes

$$\mathbf{x}_\Omega = [\mathbf{D}_\Re\ \mathbf{D}_{\bar{\Re}}] \begin{bmatrix} \mathbf{X}_\Re \\ \mathbf{X}_{\bar{\Re}} \end{bmatrix}$$

The interpolation by using x may be represented by the coefficient vector as

xI = HDX

According to the IDID-based solution, an interpolation optimized X may be determined as

$$\tilde{\mathbf{X}} = \arg\min_{\mathbf{X}} \|\mathbf{x} - \mathbf{HDX}\|_2^2.$$

Therefore, the optimal X is calculated as

$$\tilde{\mathbf{X}} = \left((\mathbf{HD})^T(\mathbf{HD})\right)^{-1}\left((\mathbf{HD})^T\mathbf{x}\right)$$

In our work, we aim at an optimal X which not only produces an efficient interpolation for a better reconstruction, but also effectively controls the compression cost, i.e., the bit rate, for practical coding. However, the IDID-based solution only targets an optimal interpolation, but ignores the cost for the compression.

IV. EXPERIMENTAL RESULTS

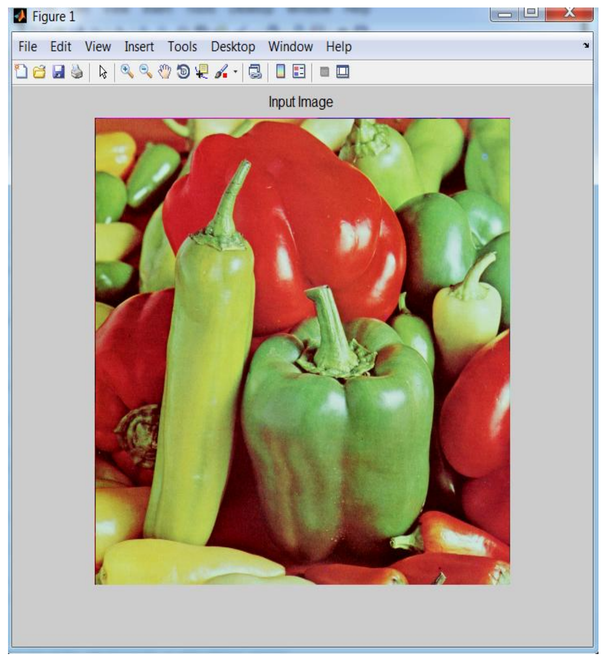

Figure input image

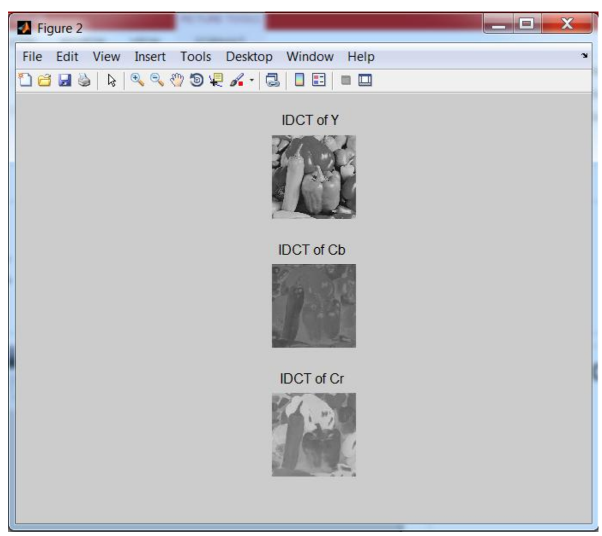

Figure IDCT Image

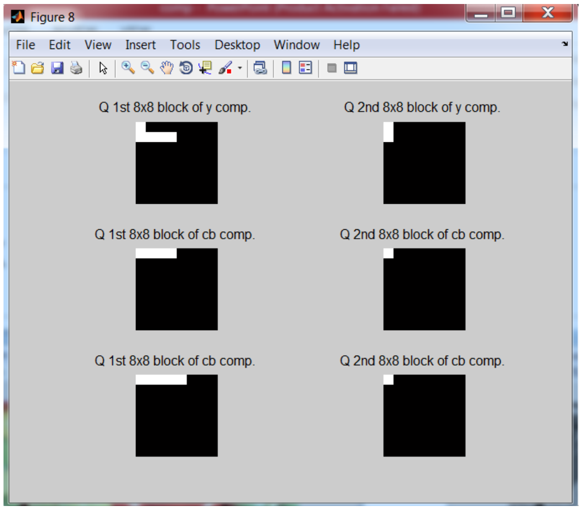

Figure output images

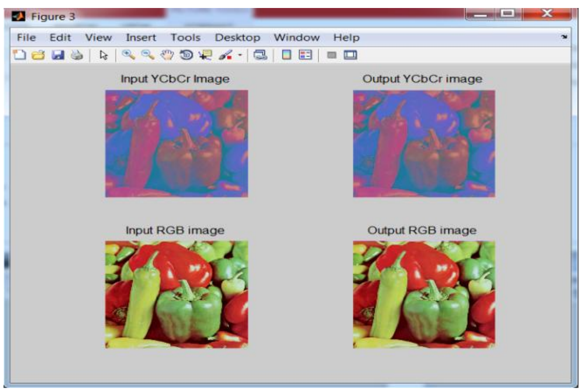

Figure decompressed image

V. CONCLUSION

In this project, we have proposed a TDDC-based coding method to compress image signals. In our way, each 16 x 16 macro-block is converted into an 8 x 8 small-sized coefficient block by using our proposed ICDF algorithm, which guarantees a better interpolation for the reconstruction of a compressed macro-block as well as a lower compression cost. After that, the small-sized coefficient block is compressed with our proposed ECSQ algorithm to reduce the compressiondistortion of some specific pixels collected to implement the interpolation for the whole macro-block. Based on the ICDF and ECSQ algorithms, we have proposed a CDTDDC based coding to compress both grayscale and color images. When our CDTDDC-based coding is used to compress color images, it not only offers a new way to reduce the data size of the chrominance components but also makes a high compression efficiency.

REFERENCES

[1] G.K.Wallace, “The JPEG still picture compression standard,” Commun. ACM, vol. 34, no. 4, pp. 30-44, 1991.

[2] Information Technology—JPEG 2000 Image Coding System: Core Coding System, ISO/IEC 15444-1 and ITU-T Rec. T.800, 2000.

[3] B.Zeng and J. J. Fu, “Directional discrete cosine transforms: a new framework for image coding,” IEEE Trans. Circuits Syst. Video Technol., vol. 18, no. 3, pp. 305-313, Mar. 2008.

[4] S.Muramatsu, D. D. Han, T. Kobayashi, and H. Kikuchi, “Directional lapped orthogonal transform: theory and design,” IEEE Trans. on Image Process., vol. 21, no. 5, pp. 2434-2448, May 2012.

[5] G.Fracastoro, S. M. Fosson, and Enrico Magli, “Steerable discrete cosine transform,” IEEE Trans. Image Process., vol. 26, no. 1, pp. 303- 314, Jan. 2017.

[6] E.H. Yang, C. Sun, and J. Meng, “Quantization table design revisited for image/video coding,” IEEE Trans. on Image Process., vol. 23, no. 11, pp. 4799-4811, Nov. 2014.

[7] T.Richter, “JPEG on STEROIDS: Common optimization techniques for JPEG image compression,” in Proc. IEEE Int. Conference on Image Process., pp. 61-65, Sept. 2016.

[8] G.Lakhani, “Modifying JPEG binary arithmetic codec for exploiting inter/intra-block and DCT coefficient sign redundancies,” IEEE Trans. on Image Process., vol. 22, no. 4, pp. 1326-1339, Apr. 2013.

[9] D.Liu, X. Y. Sun, F. Wu, S. P. Li, and Y. Q. Zhang, “Image compression with edge-based inpainting,” IEEE Trans. Circuits and Systems for Video Technology, vol. 17, no. 10, pp. 1273-1287, Oct. 2007.

[10] Z.W.Xiong, X. Y. Sun, and F. Wu, “Block-based image compression with parameter-assistant inpainting,” IEEE Trans. Image Process., vol. 19, no. 6, pp. 1651-1657, Jun. 2010.