

# Various Leveled Prediction and Context Adaptive Coding for Lossless Color Image Compression

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**Abstract:** Lossless image compression is a class of image compression algorithms that allows the original image to be perfectly reconstructed from the compressed image. This undertaking shows another lossless color image compression algorithm based on pixel prediction and arithmetic coding. Lossless squeezing of a Red, Green and Blue (RGB) picture is carried out by first decorrelating utilizing Reversible Color Transform (RCT). The got Y part is then compacted by a conventional lossless grayscale picture clamping strategy. The chrominance image is encoded utilizing Arithmetic coding and pixel prediction system. By utilizing RCT the forecast lapse is characterized and arithmetic coding is connected to the mistake signal. The packed image and encoded picture is joined to structure a lossless compacted RGB picture. It is demonstrated that this system diminishes the bit rates contrasted and JPEG 2000 and JPEG-XR. With a specific end goal to further lessen the bit rate the compression strategies and the pixel prediction strategy can be altered for better execution.

**Keywords-** Lossless image compression, Pixel Prediction, Arithmetic Coding, RCT, Huffman coding

## 1. INTRODUCTION

Lossless image compression is a class of image compression algorithms that allows the original image to be perfectly reconstructed from the compressed image. Recent years have seen an increased level of research in image Compression. Certain application such as medical imaging, image archiving & remote sensing require or desire lossless compression. As cameras and display systems are going high quality and as the cost of memory are lowered. We may also wish to keep our precious and artistic photos free from compression artifacts. Hence efficient lossless compression will become more & more important.

### 1.1 Lossless Image Compression Algorithm:

Among a variety of algorithm, the most widely used one may be lossless JPEG [2], JPEG-LS [3], LOCO-I [4], CACIC [5], JPEG 2000 & JPEG XR [6].

JPEG - JPEG turned into an universal standard in 1992.jpeg is the ISO/IEC global standard 10918-1: advanced pressure and coding of ceaseless – tone still pictures, or the ITU-T suggestion T-81. it may be utilized as an umbrella term to allude to all lossless layering plans created by the Joint Photographic Expert group

LOCO-I: LOCO-I (Low Complexity Lossless Compression for Images) is the calculation at the center of the new ISO/ITU standard for lossless and close lossless pressure of consistent tone pictures. It is focused around a straightforward altered setting model. Connection model needs

a factual model, for a great expectation of pixel quality. The model is tuned for proficient execution in conjunction with a more distant family of Golomb-sort codes, which are adaptively picked, and an installed letters in order expansion for coding of low-entropy picture districts. LOCO-I accomplishes packing proportions comparable or better than those got with condition of-the-craftsmanship plans focused around number juggling coding. In addition, it is inside a couple of rate purposes of the best accessible packing proportions, at a much lower intricacy level.

CALIC: Context-based, adaptive, lossless image codec It puts substantial accentuation on picture information displaying. A special gimmick of CALIC is the utilization of an expansive number of demonstrating connections (states) to condition a nonlinear indicator and adjust the indicator to fluctuating source insights. The nonlinear indicator can amend itself by means of a slip input instrument by gaining from its slip-ups under a given connection previously. In this learning procedure, CALIC gauges just the desire of forecast slips molded on an extensive number of diverse connections as opposed to evaluating countless lapse probabilities. The previous estimation procedure can manage the cost of countless connections without misery from the setting weakening issue of inadequate including measurements as the recent methodology, nor from unnecessary memory utilization. The low time and space complexities are additionally ascribed to effective systems for CALIC gave a normal lossless bit rate of 2.99 b/pixel on the 18 8-b test pictures chose by JPEG for proposal assessment, thought about with a normal bit rate of 3.98 b/pixel for lossless JPEG on the same set of test pictures. JPEG (Joint Photographic Experts Group) (1992) is a calculation intended to layer pictures with 24 bits profundity or grayscale pictures. It is a lossy squeezing calculation. One of the attributes that make the calculation extremely adaptable is that the layering rate can be balanced. On the off chance that we layer a ton, more data will be lost, however the result picture size will be littler. With a littler pressure rate we get a superior quality, yet the extent of the ensuing picture will be greater. This layering comprises in making the coefficients in the quantization framework greater when we need more squeezing, and littler when we need less pressure. The calculation is situated in two visual impacts of the human visual framework. To start with, people are more delicate to the luminance than to the chrominance. Second, people are more delicate to changes in homogeneous zones, than in territories where there is more variety. JPEG is the most utilized arrangement for putting away and transmitting pictures in Internet.

JPEG 2000 (Joint Photographic Experts Group 2000) - is a wavelet-based image compression standard. It was created

by the Joint Photographic Experts Group committee with the intention of superseding their original discrete cosine transform based JPEG standard. JPEG 2000 has higher compression ratios than JPEG.

## 2. COLOR TRANSFORM

The reason for this paper is to create a Pixel expectation systems in lossless compression are focused around the raster filter forecast which is some of the time wasteful in the high recurrence locale. In this paper we outline an edge controlled indicator and setting versatile model for this Pixel plan. For the squeezing of color pictures RGB is initially changed to Ycucv by a RCT [12].

### 2.1 RCT

Reversible color transform for 16-bit-color (hicolor) picture coding. The work is inspired by the expanding needs of sight and sound applications on low-end gadgets, for example, cell telephones and PDAs. They have restricted assets and up to 16-bit shows. Current picture/feature coding frameworks can scarcely deal with this case successfully. To improve coding productivity on this condition, a reversible color change redid for hicolor frameworks is gotten from Y'crCb and Jpeg2000 Reversible Component Transformation (RCT) [15]. The change demonstrates basic however very decorrelating, and ready to lessen the processing time of disentangling. Correlation examination shows the adequacy of this change with equivalent or significantly higher coding effectiveness on low-end gadgets with 16-bit display mode.

## 3. ENCODING

### 3.1 HUFFMAN CODING:

It is an entropy encoding algorithm [14] utilized for lossless data squeezing. The term alludes to the utilization of a variable-length code table for encoding a source image, (for example, a character in a document) where the variable-length code table has been determined in a specific manner focused around the evaluated likelihood of event for every conceivable estimation of the source image. It utilizes a particular technique for picking the representation for every image, bringing about a prefix code that communicates the most well-known source images utilizing shorter series of bits than are utilized for less normal source images.

### 3.2 ARITHMETIC CODING:

Adaptive Arithmetic coding as a normative part of the new ITU-T/ISO/IEC standard H.264/AVC for video compression is presented. By combining an adaptive binary arithmetic coding technique with context modeling, a high degree of adaptation and redundancy reduction is achieved. The Context based adaptive arithmetic coder (CBAC) framework also includes a novel low-complexity method for binary arithmetic coding and probability estimation that is well suited for efficient hardware and software implementations. CABAC significantly outperforms the baseline entropy coding method of H.264/AVC for the typical area of envisaged target applications. For a set of test sequences representing typical material used in broadcast applications and for a range of

acceptable video quality of about 30 to 38 dB, average bit-rate savings of 9%–14% are achieved. It is a special kind of entropy coding. Unlike Huffman coding arithmetic coding does not use a discrete number of bits for each symbol to compress. The central concept behind arithmetic coding [16] with integer arithmetic is that given a large-enough range of integers, and frequency estimates for the input stream symbols, the initial range can be divided into sub-ranges whose sizes are proportional to the probability of the symbol they represent [4, 5]. Symbols are encoded by reducing the current range of the coder to the sub-range that corresponds to the symbol to be encoded. Finally, after all the symbols of the input data stream have been encoded, transmitting the information on the sub-range is enough for completely accurate reconstruction of the input data stream at the decoder.

## 4. PIXEL DECOMPOSITION AND PIXEL PREDICTION

The chrominance channels Cu and Cv coming about because of the RCT normally have diverse insights from Y, furthermore not the same as the first shade planes R, G, and B. In the chrominance channels, the general sign variety is smothered by the color change, however the variety is still huge close to the article limits. [13] Hence, the expectation blunders in a chrominance direct are tremendously decreased in a smooth district, however remain moderately huge close to the edge or inside a surface area. For the effective lossless compression, it is essential to precisely assess the pdf of expectation blunder for better setting demonstrating, alongside the precise forecast. For this, we propose a Pixel decay plot in which demonstrates that pixels in an info picture X is divided into two sub pictures: an even sub picture Xe and an odd sub picture Xo. At that point, Xe is encoded first and is utilized to anticipate the pixels in Xo. Moreover, Xe is likewise used to gauge the insights of forecast lapses of Xo. In real execution, Xe is decayed again as will be clarified later. For the compression of Xo pixels utilizing Xe, directional forecast is utilized to keep away from extensive forecast blunders close to the edges.

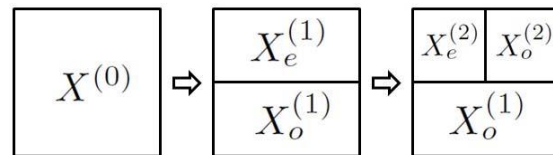


Fig.1. Pixel decomposition

## 5. EXPERIMENTAL RESULTS

Compression method may be the CALIC, which shows higher coding gain than the JPEG-LS (or LOCO-I), at the cost of higher computational complexity. For the compression of color image, the JPEG2000 and JPEG-XR lossless provide better coding gain than the independent encoding of each channel by CALIC and also than the encoding by CALIC after RCT. Hence, for fair comparison, we also perform experiments with the same RCT, the results of which are denoted as —JPEG2000 with RCT and —JPEG-XR with RCT in Table I. It can be seen that the recent RCT

improves the coding gain though not significant. On the average, the proposed algorithm improves 7.10% and 18.89% over JPEG2000 and JPEG-XR respectively.



Fig.2. Digital camera images

Table 1 Average of compressed bit rates (bpp) for 24 kodak images

COMPRESSION	BPP
JPEG2000	9.5353
JPEG2000 with RCT	9.4586
JPEG-XR	10.9214
JPEG-XR with RCT	10.8587

Table 2 Compressed bit rates for digital camera images

	Size	JPEG2000	JPEG-XR	Proposed
Flower	4032 x 3024	6.4141	8.1298	6.0655
Park	4032 x 3024	5.8977	7.6534	5.5622

## 6. CONCLUSION

We have proposed a lossless color image compression technique focused around a Pixel prediction plan and arithmetic coding. For the layering of a RGB picture, it is initially changed into Ycuv color space utilizing a RCT. After the color change, the luminance channel Y is layered by a traditional lossless picture coder. Pixels in chrominance channels are anticipated by the Pixel decomposition and directional forecast. At long last, a suitable connection

displaying of forecast residuals is presented and math coding is connected. The proposed technique and a few routine techniques have been tried on the Kodak picture set, some medicinal pictures, and advanced cam pictures, and it is demonstrated that normal bit rate diminishments over JPEG2000 for these sets are indicated to be 7.10%, 13.55%, and 5.52% separately.

## 7. REFERENCES

- i. A.said, "Arithmetic coding in lossless Compression Handbook," k.sayood, Ed.san Diego,CA, USA: Academic, 2003.
- ii. W.B .Pennebaker and J.L.Mitchell, "JPEG still Image Data Compression standard," New York, NY, USA: Van Nostrand Reinhold, 1993.
- iii. Information Technology-Lossless and Near Lossless Compression of Continuous-Tone Still Images (JPEG-LS), ISO/IEC Standard 14495-1, 1999.
- iv. M. Weinberger, G. Seroussi, and G. Sapiro, "The LOCO-I lossless image compression algorithm: Principles and standardization into JPEG-LS," IEEE Trans. Image Process., vol. 9, no. 8, pp. 1309–1324, Aug. 2000
- v. X.Wu and N. Memon, "Context - based, adaptive, lossless image coding," IEEE Trans. Commun., vol. 45, no. 4, pp. 437–444, Apr. 1997
- vi. ITU-T and ISO/IEC, JPEG XR Image Coding System — Part 2: Image Coding Specification, ISO/IEC Standard 29199-2, 2011.
- vii. [7] Ashwin Swaminathan, Gaurav Agarwal "A COMPARATIVE STUDY OF IMAGE COMPRESSION METHODS"
- viii. Bryan Usevitch, "A Tutorial on Modern Lossy Wavelet Image Compression: Foundations of JPEG 2000," IEEE Signal Processing Magazine, 2001.
- ix. Zixiang Xiong, Kannan Ramchandran, Michael T. Orchard, and Ya-Qin Zhang, "A Comparative Study of DCT and Wavelet-Based Image Coding," IEEE Transactions on Circuits and Systems for Video Technology, Vol. 9, No. 5, 1999.
- x. Amir Said, Willian Pearlman, "A New Fast and Efficient Image Codec Based on Set Partitioning in Hierarchical Trees," IEEE Transactions on Circuits and Systems for Video Technology, 1996.
- xi. Zixiang Xiong, Onur Guleryuz, Michael Orchard, "A DCT-Based Embedded Image coder," IEEE Signal Processing Letters, 1996.
- xii. S. Pei and J. Ding, "Improved reversible integer-to-integer color transforms," in Proc. 16th IEEE ICIP, Nov. 2009, pp. 473–476
- xiii. Seyun, Nam Ik cho, "Pixel prediction and context adaptive coding for lossless color imagecompression," IEEE Trns., vol.23, no.1, January 2014
- xiv. A. Mallalah, S. K. Shabbir, T. Subhashini, "An Spiht Algorithm With Huffman Encoder For Image Compression And Quality Improvement Using Retinex Algorithm"