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Rate-distortion optimization of HEVC using Lagrangian multiplier

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ABSTRACT

Different level of compression on real-time video streaming has successfully reduced the storage space complexities and bandwidth constraints in the recent times. To design and develop a novel concept towards the enhancement of perceptual quality of a real-time video ultra HD frames. Video compression is one of the important applications in data compression on its image. Image data requires huge amount of disk space and large bandwidths for transmission. Hence, Video compression is necessary to reduce the amount of data required to represent digital image .Discrete Wavelet Transform (DWT) based image compression has been paid much attention in the past decades. DWT has been adopted as a new technical standard for still image compression. Set Partitioning in Hierarchical Trees (SPIHT) is the DWT-based image compression algorithm which is more powerful, efficient and more popular, due to the properties of fast computation, low memory requirement. Discrete wavelet transform (DWT) based Set Partitioning in Hierarchical Trees (SPIHT) algorithm is widely used in many image compression systems. The experimental outcomes also show that the proposed protocol achieves better performance ratio.

Keywords: High Efficiency Video Coding (HEVC), Rate-Distortion Optimization, Lagrangian Multiplier.

INTRODUCTION

In recent years there has been an astronomical increase in the usage of computers for a variety of tasks. With the advent of digital cameras, one of the most common uses has been the storage, manipulation, and transfer of digital images. The files that comprise these images, however, can be quite large and can quickly take up precious memory space on the computer's hard drive. In multimedia application, most of the images are in colour. And colour images contain lot of data redundancy and require a large amount of storage space. In this work, we are presenting the performance of different wavelets using SPIHT algorithm for compressing colour image. In this R, G and B component of colour image are converted to YCbCr before wavelet transform is applied. Y is luminance component; Cb and Cr are chrominance components of the image. Lena colour image is taken for analysis purpose. Image is compressed for different bits per pixel by changing level of wavelet decomposition. Matlab software is used for simulation. Results are analysed using PSNR and HVS property. Graphs are plotted to show the variation of PSNR for different bits per pixel and level of wavelet decomposition.

EXISTING SYSTEM

Working

The existing method comprises a series of steps involving video input, conversion of the input video into sequence of frames. The frames later converted from the RGB to Greyscale. The

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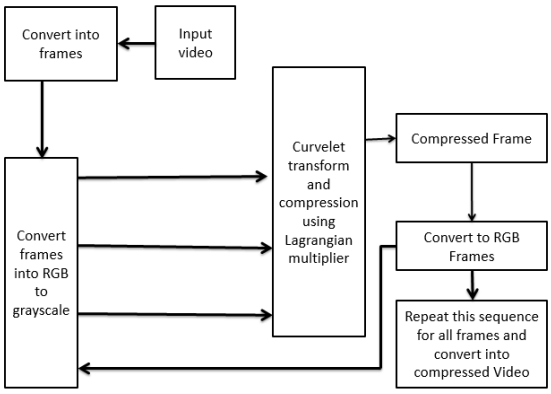
converted greyscale frames are subjected to Curve-let transform and is compressed using Lagrangian Multiplier. Thus the compressed frames obtained is reverted into RGB components. If the compression ratio is still not enough, the RGB frames are again converted into greyscale images and compression is applied. If not the frames obtained are converted into sequence of frames to form a compressed video output.



Existing system disadvantages

- Coefficient Bit allocation for each block.
- Computational Time high.
- Compression ratio and image Quality may less.
- Video coding is quite complex, the extensive statistical analysis made an excellent ground to develop the algorithm.
- Inefficient compression ratio
- Visual quality is low

EXISTING SYSTEM CONCLUSION

The Lagrangian multiplier adjustment compression method for a set of clustered video. We notice that the clustering can be time consuming if one collection is too large. Determine the prediction structure of each image collection by a feature domain distance measure.The disparity between images is then reduced by joint global and local compensations in the spatial domain. In the frequency domain, the redundancy between the compensated and target images is reduced and the remaining weak intra correlations are further exploited in our entropy coding.

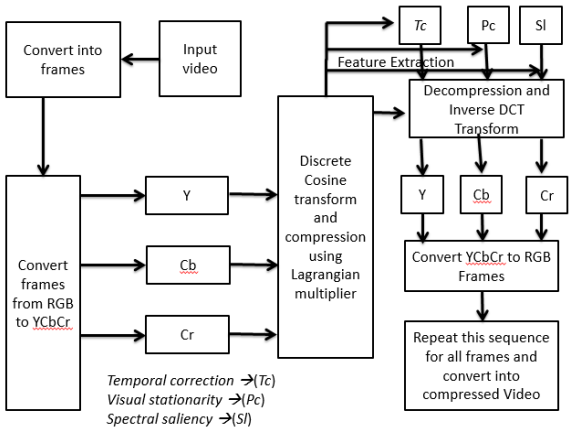
PROPOSED SYSTEM

Working

Convert input video into number of frames.The input colour Frame in RGB components is converted to the YCbCr components. The converted YCbCr Components as input to the Wavelet Transform to encoding the image and then compresses the YCbCr Components using SPIHT algorithm. The compressed YCbCr components then decompressed using SPIHT algorithm and the decompressed YCbCr components given to Inverse Wavelet Transform to decoding the image. The YCbCr Components converted into RGB components and original image as the output of Colour Image Compression.Repeat the sequence again from converted YCbCr components Steps.Convert compressed frames into video.

Module description

- Conversion of colour images (RGB) to YCbCr image.
- Discrete Cosine Transform (DCT).
- Lagrangian Multiplier.
- Rate-Distortion Optimization (RDO).
- Inverse Discrete Cosine Transform (Inverse DCT).
- Conversion of YCbCrto Colour Image (RGB).



Performance parameters

- Compression Ratio (CR)
- Mean square error (MSE)
- Peak Signal to Noise Ratio(PSNR)
- Error Sensitivity Measures
- Correlation-based measures
- Edge-Based Measurements

DISCRETE COSINE TRANSFORM

A discrete cosine transform (DCT) is defined and an algorithm to compute it using the fast Fourier transform is developed. It is shown that the discrete cosine transform can be used in the area of digital processing for the purposes of pattern recognition and Wiener filtering. Its performance is compared with that of a class of orthogonal transforms and is found to compare closely to that of the Karhunen-Loève transform, which is known to be optimal. The performances of the Karhunen-Loève and discrete cosine transforms are also found to compare closely with respect to the rate-distortion criterion.

LAGRANGIAN MULTIPLIER

The Lagrangian multiplier λ is employed to solve the afore mentioned optimization problem by transforming it to an unconstrained form:

min {J} ,

where $J = D + \lambda R$,

Where J is the Lagrangian cost function. A high-rate assumption has been made to obtain the rate and distortion models of the uniform source distribution, respectively in terms of entropy-constrained scalar quantization and mean square error within each quantization interval:

$$\mathbf{D = q^2/12,\ R(D) = \tfrac{1}{2} \log_2(\delta^2/D)}$$

Where q is the quantization step size. λ can be therefore determined as

$$\mathbf{\lambda = -\ dD/dR = c.\ q^2}$$

RATE-DISTORTION OPTIMIZATION

To achieve a better coding efficiency, the RDO is typically used at the encoder side to select the best mode which has the smallest R-D cost. The aim of RDO is to minimize a distortion D at rate smaller than target rate RT, which can be described as

min {D} **s.t R< R_T**

The so-called Lagrangian multiplierλis employed to solve the aforementioned optimization problem by transforming it K. Rouiset al.: Perceptually Adaptive Lagrangian Multiplier for HEVC Guided Rate-Distortion Optimization to an unconstrained form:

min {J} where $J = D+\lambda R$

Temporal Correction (Tc)

The error propagation in HEVC coding structures is addressed by the temporal correction feature. Indeed, the compression distortions of the reconstructed CTUs are investigated from the previously encoded frame. Theses altered blocks would affect the prediction of forward co-located ones.

Visual Stationarity Pc

The stationarity of visual scenes is basically related to the displaced areas/objects between successive frames. In other respects, the aims to identify the displacement associated to the relevant CTUs. It is a frame-level feature measured in the Fourier domain and following the phase correlation concept.

Spectral Saliency (Sl)

The saliency is predicted in the frequency domain using a proper adaptation of the method described in .The log spectrum and residual representations constitute the frequency space of this prediction. Moreover, we will adopt this method to the UDCT windowed basis functions which represents an effective framework for scale invariance property and accurate curves' singularity detection.

Advantages

- Efficient compression ratio
- Accuracy is high
- Visual quality is high
- Security is high

CONCLUSION

Compressing color images efficiently are one of the main problems in multimedia applications. So we have tested the efficiency of color image compression using SPIHT algorithm. The SPIHT algorithm is applied for luminance (Y) and chrominance (Cb, Cr) part of RGB to YCbCr transformed image. Reconstructed image is verified using human vision and PSNR. Huffman and arithmetic coding can be added to increase the compression. Transmission while using encryption and decryption is applicable for security purpose. We can test the channel behaviour by sending compressed image between two computer and check the reconstructed image.

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