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CONTROL ANALOGUE ARRIVAL DATA USING DIGITAL VISUAL INFORMATION

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ABSTRACT

Although digital radio signal is more immune to noise than analogue signal, it usually requires large space for storage or wide bandwidth for arrival. With the current feature of network, this makes it impossible for real-time radio communication or arrival. To reduce the requirement of space and bandwidth, radio data need to be compressed to a fraction of its original size before storage or arrival. To achieve good performance of radio compression, one way is to lose some of the relatively unimportant data which is not perceivable by the human visual system. Visual information is playing a more and more important role in our daily life and affects our way of communication and living in many aspects. Digital data and radio applications usually involve storage or arrival of vast amount data. The paper described about vast amount of data.

Keywords: Visual Information; Data compression; Radio arrival

INTRODUCTION

Research of digital image and radio coding are continue back decade and spatial differential pulse code modulation [1, 2] was utilized to encode still. Transform coding techniques were studied in 1970s and the well known block-based discrete cosine transform [3, 4] was proposed [2], motion estimation and compensation techniques were applied to radio coding which provide a significant compression gain over intra-frame coding [5,7] for radio compression. Discrete wavelet transform were also studied since 1980s for data and radio coding and have become the core technology for the still data coding standard. Today, modern data and radio processing techniques have been employed in many fields such as digital television broadcast, surveillance system, medical imaging for disease diagnosis, image/radio based web search, etc.

An illustration of a typical digital radio system is given in Figure 1. Usually, the source of a radio is captured by a camera or a radio recorder in analogue or digital format. For the radio in analogue format, it needs to be converted to digital format before further processing. After digitization, the bit rate produced by the raw radio can be very high. For example, the typical bit rate for a NTSC radio is about 150 Mbps, which is too much for today's typical network bandwidth. Therefore, compression techniques are necessary to be applied to digital radios before they can be further manipulated. Radio compression is the key technology that makes the wide applications of digital radio systems possible.

As illustrated in Figure 1, after compression, the radio is converted to the corresponding format that is appropriate for network arrival or storage on hard drives, disks, cassettes, etc. To date, various radio compression techniques have been developed and some of them in more details have been discussed in the paper.

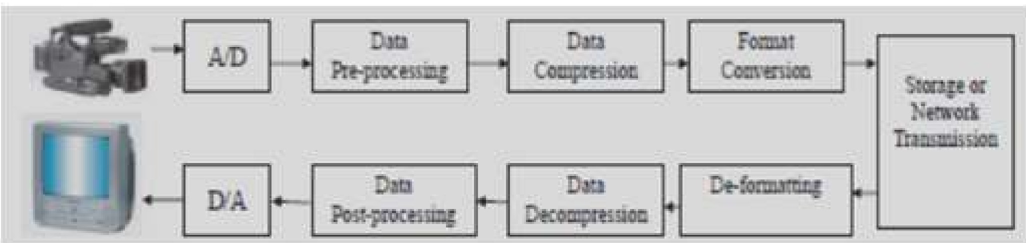

Figure 1: an Example of a digital video system

ANALOG CONVERTER

As can be seen from Figure 1, a digital radio system usually includes two parts, the encoder and the decoder. The quality of a radio is determined during the process of encoding. When decoding the radio, the decoder reconstructs the radio according to the data in the compressed radio stream which indicates the quality of the radio. A powerful encoder can carry out more smart strategies and complicate algorithms to achieve high radio quality while maintaining good compression ratio. Today, in the existing radio coding standards, a lot of freedom is allowed for the encoding process, that is, the standards do not specify or define the encoding process in a rigid way. This allows tradeoffs between radio compression ratio, frame quality, and encoder's complexity. Depending on different applications, different systems are developed which provide different radio quality. Some systems include only an encoder, such as online radio broadcasting systems, while other systems may have only a decoder, for example a DVD player. For most of the systems, both encoder and decoder are required. A typical example of them is a radio conference system.

LITERATURE

The compression ratio can be used for indicating the picture quality, since most of the compression techniques operate over a range of compression rate and decompression quality. Generally, the greater the compression ratio, the less the quality of the output images. The trade-off between compression ratio and the quality is an important factor to consider when compressing images.

The amount of data is measured in bits, which is the number of binary symbols required to represent the data. The following bitrates are commonly used to represent radio data:

- Bits per frame (bpf)
- Bits per pixel (bpp)
- Bits per second (bps)

Reference software

In this work, the H.264/AVC reference software codec JM17.2 [2] (referred to as the JM codec), is used as the reference radio codec. The JM codec is commonly used to test new algorithms in the radio coding community. The use of this reference software enables realistic comparison of the performance of different algorithms developed by different researchers. The source code (in the C programming language) for the JM codec can be downloaded . [3] The earlier and the later versions of the JM codec and the revised manual [7] for the H.264 reference software can also be found. [4]

The JM encoder reads input parameters from a configuration file. A wide range of encoding parameters can be changed using the configuration file. These include but are not limited to:

- Input radio sequence (concatenated YCrCb 4:2:0 format)
- Quantisation parameters for I, P and B slices
- Available MB partition modes
- I, P and B picture sequence
- Number of reference frames
- Rate-distortion optimisation - ON/OFF

The JM codec also provides useful encoding statistics such as bit rate of the encoded bit stream, radio quality in PSNR of luminance and chrominance components of the coded radio and encoding time. For the Scalable and the Multitier extensions similar software has been used [4,5] both of these are based on the JM software but written in C++.

The underlying supposition behind motion estimation is that the patterns corresponding to objects and background in the frame of wave sequence move within the frame to form corresponding objects on the subsequent frame. The idea behind block matching is to divide the current frame into a matrix of macro blocks that are then compared with corresponding block and its adjacent neighbours in the previous frame to create a vector that stipulates the movement of a macro block from one location to another in the previous frame. This movement calculated for all the macro blocks comprising a frame, constitutes the motion estimated in the current frame.

In order for the compressed frame to look like the original, the substitute block must be as similar as possible to the one it replaces. Hence a matching criteria or a distortion function is used to quantify the similarity between the target block and candidate blocks. If due to a large search area, many candidates blocks are considered, then the matching criteria will be evaluated many times. Thus the choice of the matching criteria has an impact on the success of the compression. If the matching criterion is slow then the block matching will be slow. If the matching criterion results in bad matches then the quality of the compression will be adversely affected. Fortunately a number of matching criteria are suitable for use in wave compression.

Mean Absolute Error Criteria:

The matching criteria mostly used in the literature is minimum mean absolute error, which at point (i, j) for an NxN block and search window of size ±p, is defined as –

$$MAE(i,j) = \frac{1}{N^2} \sum_{x,y} |c(x,y) - r(x+i, y+j)|$$

Where, −p<= i , j<= +p and c(x,y) and r(x,y) are pixel values at position (x,y) in the current and reference frame respectively. Motion vector is defined as the value of (i, j) for which MAE(i, j) is minimum. Obviously, the residue error between the predicted and actual block in the current frame should be minimum for good matching.

Vector Matching Criteria

In MAE based criteria, the average error value is considered while ignoring the individual error term. Proposed vector matching criteria for block matching is to overcome this drawback. In this approach, each NxN block is represented by a vector. Further, each block is subdivided into smaller blocks of size like 2x2, which is represented by a component of the corresponding vector and MAE is calculated between each temporally adjacent sub block in the current and reference frame.

A threshold value is chosen by exhaustive search and vector components (out of N2 / 4, assuming the sub block size as 2x2) having value smaller than the threshold value is counted for a given block. Finally, the block having maximum number of such vector components within the defined search area is declared to be the best matching block.

Smooth Constrained Mean Absolute Error Criteria:

In wave data compression, the residue frame which is calculated by taking the difference of the current and the predicted frame is coded using transform coding technique, called Discrete Cosine Transform (DCT). According to the characteristics of this transform, the number of bits required to code a smooth residue frame will be smaller than the non smooth residue frame. Therefore a smooth constrained based MAE as block matching criteria for motion compensation to reduce the required number of bits for coding besides minimizing the total distortion was proposed. [2] In this method, not only the MAE over the residue block is taken into consideration but also the maximum and minimum residue value error, denoted as MME, is taken care of as well. Since DCT is applied over 8x8 blocks, each residue block (16x16) is divided into four equal size sub blocks (8x8) and MME is calculated for each sub block as

$$MME_i = r^i_{max} - r^i_{min}$$

$$SC - MAE = MAE + \alpha \sum_{i=1}^{4} MME_i$$

Where alpha is a weighing factor. The block which has minimum SC-MAE value in the search area, is declared as the best matched block.

PROPOSED SCALED VALUE CRITERION

Though VMC and SC-MAE based methods have partially reduced the drawbacks of MAE criterion, but they are not suitable for input wave data especially with rotation and zoom effect. Further, the similarity measurement of blocks in VMC is dependent on the input threshold value. In this section, a new criterion for block matching is being proposed which not only removes all the shortfalls of MAE but also gives better results than VMC and SC-MAE based techniques.

Let R and C are two frames of equal size (NxN) in the reference frame and current frame respectively. Further, let R = $[R_1, R_2, \ldots, R_{N_2}]$ and $C = [C_1, C_2, \ldots, C_{N_2}]$

be the pixel values in these blocks. Since the image block may have different range of pixel values along each dimension, the pixel values are redefined on the basis of the higher range of intensities in the frame. If the minimum and maximum intensity values in reference block R are R_{min} and $R_{ma}x$, and same for the current block are C_{min} and C_{max} , then the new intensity values of the reference block R_{new} and current block Cn_{ew} are defined as given below:

If $(C_{max} - C_{min}) \leq (R_{max} - R_{min})$ then,

$$R_{new} = (R_{old} - R_{min})$$

And

$$C_{new} = (C_{old} - C_{min})\, round\{\frac{(R_{max} - R_{min})}{(C_{max} - C_{min})}\}$$

Otherwise,

$$C_{new} = (C_{old} - C_{min})$$

And $$R_{new} = (R_{old} - R_{min})\, round\{\frac{(C_{max} - C_{min})}{(R_{max} - R_{min})}\}$$

This gives new rescaled intensity values for all the pixels. The matching function M(R,C) between block R and block C, is defined as -

$$M(R,C) = \frac{1}{N^2}\sum_{k=1}^{N^2} f(|(R_{new}) - (C_{new})|, \tau)$$

Where f (d, $\boldsymbol{\tau}$) is,

$$f(d, \boldsymbol{\tau}) = \begin{cases} d & if\ d \leq \boldsymbol{\tau} \\ max(R_{max}, C_{max}) & else \end{cases}$$

The function $f(|(R_{new})-(C_{new})|,\mathbf{T})$ measures the degree of matching between R_{new} and C_{new} and the positive threshold parameter $\mathbf{T}= max((C_{max}-C_{min}) , (R_{max}-R_{min}))$, determines the selection of pixels for matching purposes, i.e. for a value of **T** only those pixels will contribute in matching for whom $|(R_{new}) - (C_{new})|$ **T.** Finally, the location of any such block R in the reference frame in a given search window for which the value of M(R, C) is minimum, gives motion vector.

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