M.Sivaramaraju,Neelapala Anil Kumar/ International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 1, Issue 4, pp.2005-2008

COMPRESSION OF VIDEO SEQUENCES RELATED TO ARTERIAL BLOCKAGE IN HEART

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ABSTRACT:

An arterial blockage in the heart is the accumulation of plaque within one or more blood vessels in the body. Blood vessels or arteries usually get blocked due to high intake of fats or cholesterol contents in a person's diet over the years. There are mainly two types of tests for diagnosing arterial blockage in the heart. One group includes different kinds of stress tests, and the other includes coronary angiogram, (also known as heart cath and CT angiogram), that gives an actual image of the anatomy of the heart arteries.Here we consider Coronary angiography, which is an X-ray examination of the heart's arteries. This is an essential technique for diagnosis of heart damages. Image sequences from digital angiography contain areas of high diagnostic interest. Loss of information due to compression for regions of interest (ROI) in angiograms is not tolerable. Since Commercially available technology such as JPEG, etc does not satisfy medical requirements due to their severe block artifacts. In this paper, a new compression algorithm that achieves high compression ratio and excellent reconstruction quality for video rate or sub-video rate angiograms is presented.

1. ANGIOGRAM VIDEO

Recent advances in imaging technology have directly benefited diagnostic and corrective medicine. In the field of angiography, currently applied technology allows for the capture of an X-ray video of the heart which can be examined and processed in real-time. The current trend towards using digital representations of such data provides many tangible benefits over more traditional analogue-based approaches. . Furthermore the digital representation of the data allows for a more convenient approach to data storage and transmission. Due to the nature of the data however, and the typical duration of a procedure, the resulting uncompressed angiogram video is likely to be of huge bytes in size. This can cause some difficulties with the storage of the data, with particular problems concerning the transmission of the video data elsewhere, especially if the transmission bandwidth available is low. This problem would be alleviated if an efficient means of compression could be found.

1.1. INTRODUCTION

Lossless compression of digital images becomes increasingly important. several new applications, in fact, demand compression services without loss of original data. Current lossy video compression provides substantial compression efficiency at the cost of minimal degradation of quality. Historically, significantly less interest has been paid to the development of lossless video compression algorithms. Lossless video compression is important to applications in which the video quality cannot tolerate any degradation, such as archiving of a video, compression of medical and satellite videos, etc. Recently, there has been increasing interests in developing lossless video compression techniques [1]–[9].

This paper is organized as follows: in section 2 we presented the preliminary investigation of the main kind of redundancies that characterizes the kind of video sequences. In section 3 the proposed method of working is described. In section 4 results are presented and finally conclusions are discussed in section 5.

2.0 VIDEO SEQUENCE REDUNDANCY

2.1. SPATIAL PREDICTION

Spatial redundancy depends on the correlation between the pixels belonging to the same frame. In the proposed scheme, we use a simple but robust spatial predictor, the median edge detector (MED), as used in JPEG-LS [10].MED estimates the symbol to be encoded based on the values of the three previously encoded neighboring symbols. We use p(x,y) to represent the symbol to be encoded that is located at (x,y) in frame. The spatial predicted value of p(x,y) is represented as $p_i(x,y)$, which is given by

$$p_i(x,y) = \begin{cases} \max(A,B) & \text{IF } C \geq \max(A,B) \\ \min(A,B) & \text{IF } C \leq \min(A,B) \\ A+B+C & \text{OTHERWISE} \end{cases}$$

Where A= $p_i(x-1,y)$,B= $p_i(x,y-1)$ and C=$p_i(x-1,y-1)$

Thus spatial prediction residual is

$e_{1=}$ $p(x,y)-p_i(x,y)$ (1)

Fig1. Frame [i] and reference frame [i-1] of an angiogram video1

2.2. TEMPORAL PREDICTION

Temporal prediction depends on the correlation between the temporal adjacent frames. Let $p_i(x,y)$ be the symbol to be encoded. The proposed temporal predictor aims to find the best matched symbol in reference frame [i-1],which is denoted as the temporal predictor $p_i^T(x,y)$.Instead of exploiting the motion activity of $p_i(x,y)$ between adjacent frames directly, the predictor investigates the motion activity of the target window of $p_i(x,y)$ in frame i and frame [i-1] within a estimated search range W*H,where the target window is composed of the neighboring symbols of p(x,y).

The temporal predictor $p_i^T(x,y)$, of symbol $p_i(x,y)$ searches and locates the best matched target window in frame [i-1],which achieves the minimum cumulative absolute difference (CAD) within the search range, w

$$CAD(d)=\sum_{m,n\varepsilon d} pi(x,y) - pi(x+m, y+n) \qquad (2)$$

where d denotes the target window *w*, and $p_i(x,y)$,$p_{i-1}(x,y)$ the symbol values of the current frame and the reference frame , respectively, and where a motion vector (m,n) is determined for the region -W$\leq m \leq W, -H \leq n \leq H$ to minimize the CAD Similar to block motion compensation techniques, the best motion vector for the target window with the minimum CAD is determined by

(m_o,n_o) =arg{ min(CAD(d)}

Where (m_o,n_o) indicates the motion displacement of the target window $p_i(x,y)$. Then, the temporal predictor of can be obtained by

$p_i^T(x,y) = p_i(x+m,y+n)$ (3)

Where temporal error is

$e_2 = p_i(x,y)-p_i^T(x,y)$ (4)

2.3. DIRECT MODE

Because of the energy compaction property of the IWT, the wavelet coefficients in the high frequency sub bands usually have small amplitudes, which may be smaller than the amplitudes of the spatial prediction residuals and temporal prediction residuals. Therefore, in this case the wavelet coefficients are encoded and transmitted directly denoted as e_3.

3.0. MODE SELECTION

. The scheme adaptively selects the predictor among three candidates (e_1, e_2, or e_3) based on previous prediction accuracy.

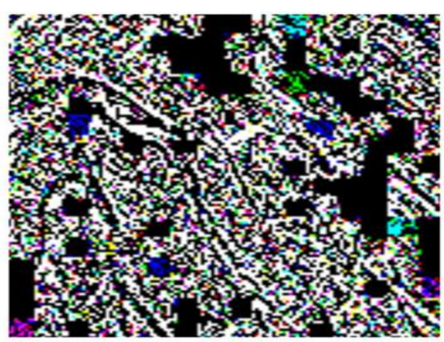

Fig2 .Final errors e_1, e_2, e_3

4. CONTEXT MODELLING

Context modelling is used for efficient coding of the prediction residuals. By utilizing suitable context models, the given prediction residual can be encoded by switching between different probability models according to already encoded neighboring symbols of the symbol to be encoded.

5. RESULTS

A lossless compression scheme for videos has been implemented. The proposed algorithm was tested on various medical angiogram sequences and the table below shows the compression ratios, compression bits, and bits per pixels obtained. We see that the proposed scheme offers the good compression for each sequence.

Angiogram videos	Original bits	Compressed bits	Bits /pixel	Compression ratio
1	2918400	426956	1.170	0.1102
2	1843200	174198	0.756	0.0945
3	3110400	85255	0.219	0.0274

Table1: results of bite rates and compression ratio for various video sequences

6. CONCLUSIONS

We presented a new technique for lossless coding of angiogram videos. This work has shown that the compression of video sequences can be improved by considering spectral and temporal correlations as well as spatial redundancy. Compared to general purpose algorithms and state-of –art lossless compression coders, the proposed technique provides best results with low delay and limited complexity.

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