SET PARTITIONING IN HIERARCHICAL TREES BASED VIDEO CODEC IN WAVELET DOMAIN

Ilam Parithi 1, Murugan 2, Balasubramanian 3

1Research Scholar, 2 Assistant Professor, 3 Professor

1,3Department of Computer Science & Engineering Manonmaniam Sundaranar University
Tirunelveli, Tamil Nadu, India

2Department of Computer Science, M.S University Constituent College, Kadayanallur
Tirunelveli, Tamil Nadu, India

ABSTRACT:

Now a day video processing became very popular and necessary. On the contrary, video data requires large storage. To reduce storage area we need to remove redundant data present in the video sequence. Removing redundant data should also preserve quality. In this paper, we present a new approach using Wavelet domain and Set Partitioning In Hierarchical Trees (SPIHT) algorithm for video compression. The proposed method is tested and compared with the recent version of H.264/AVC and recent Wavelet Based Video Codec (WBVC). The performance of the proposed method is compared using parameters like Peak Signal to Noise Ratio (PSNR), compression size and computation time. It is proved that the average PSNR of the proposed method is 2.66dB greater than H.264/AVC and 1.62dB greater than WBVC method.

Keywords: Wavelet, SPIHT, Group of Pictures.

[1] INTRODUCTION

Multimedia communications plays a vital role in everybody life. The importance of digital processing algorithms and hardware has brought images, audio, and video into everyday life. There are varieties of standards (such as JPEG, MPEG-X Audio and Video, H.26X) on this progression. Such standards are also growing according to the needs of the user. Each standard outweighs the previous one due to its efficiency and usability. The basic
The objective of video compression is to reduce the size of the video for transmission or storage purposes while preserving the quality of reconstructed videos.

There are many video compression standards available so far. ITU-Ts Video Coding Experts Group (VCEG) and ISO/IECs Moving Picture Experts Group (MPEG) are developing H.26X series and MPEG series [1,2]. ITU-T H.264/MPEG-4 (Part 10) Advanced Video Coding (commonly referred as H.264/AVC) is the newest entry in the series of international video coding standards [3]. It is currently the most powerful and state-of-the-art standard, and was developed by a Joint Video Team (JVT) consisting of experts from ITU-Ts VCEG and ISO/IECs MPEG [4]. The compression techniques aim at the redundancies present in the video sequence. There are two types of redundancies in video sequences: Spatial and temporal redundancy. Spatial redundancies are redundancies present within a frame. Temporal redundancies are those present among frames. H.264/AVC uses Inter prediction method to reduce temporal redundancy. In this method, motion is estimated by dividing video frames into macroblocks. For each macroblock in the frame, matching macroblock in the reference frames is found using block matching algorithms [5, 6]. Block matching algorithms consume much time for computation. Due to this artifact, H.264/AVC encoding takes more time to encode video sequences.

Improved compression performance can be achieved by taking advantage of the large amount of temporal redundancies present in the video content [7]. Usually, much of the depicted scene is just repeated in frames without any significant change. We present wavelet based video compression algorithms. Wavelet theory is developed rapidly in recent years, and the research fields of wavelet theory are expanded fast as well [8]. Wavelet theory has been successfully utilized in many fields, such as still-image compression, the JPEG2000 (standard of image compression). In this paper, we mainly focus on the problem of video compression based on the wavelet transform technology. Video compression highly relies on wavelet image compressions and increase of signals dimension [9-10].

To avoid the mistakes of international standards, several embedded wavelet coefficients coding models are designed [11-12]. As wavelet has the characteristics of multi-resolution, time/frequency localization and lower time complexity, it is suitable to be used in video coding [13].

Wavelet based implementations of hierarchical motion compensation [14] and 3-D sub-band coding for multi-resolution compression [15] have been reported in [15-17]. The wavelet transform has been shown to be an efficient coding method for still images and video. Unlike block based coding, it does not suffer from blocking artifacts and hence it is able to produce better subjective quality especially at low bit rates.

The main innovation of this paper lies in that we utilize the wavelet transform in video compression. The low frequency data of temporal redundant frames are identified and are skipped in encoding. The low frequency data are identified using wavelet transform. The temporal redundant frames are identified using scene change detection which is introduced in [18].

The remainder of the paper is organized as follows. Section II describes the proposed encoder and decoder architecture. Section III gives the results obtained by the proposed
method and comparative analysis of the proposed method with recent wavelet video codec followed by conclusion in Section IV.


The system architecture of the encoder and decoder are shown in fig. 1 and 2. The proposed method works as follows:

Step 1: The input video sequence is split into group of pictures adaptively using scene change identification [18].

Step 2: The b-frames and p-frames are transformed to wavelet coefficients using bi-orthogonal wavelets.

Step 3: The i- or p-frame wavelet coefficients are quantized. Only the high frequency components are quantized in b-frames.

Step 4: The quantized data are given to SPIHT encoder which produced encoded bitstream.

Step 5: In the decoder, the encoded bitstream are given SPIHT decoder which is then inverse quantized and inverse transformed to produce the output video sequence.

Fig. 1 Proposed Encoder Architecture
The powerful wavelet-based image compression method called SPIHT [19], as it is the benchmark state-of-the-art algorithm for image compression. In SPIHT encode, the wavelet coefficients are quantized using simple uniform quantization. Then SPIHT encoding is used for encoding. The SPIHT method deserves special attention because of the following characteristics:

- Good Image Quality, High PSNR, Especially For Color Images.
- It Is Optimized For Progressive Image Transmission
- Produces A Fully Embedded Coded File
- Simple Quantization Algorithm
- Fast Coding/Decoding (Nearly Symmetric)
- Has Wide Applications, Completely Adaptive

[3] EXPERIMENTAL RESULTS

Experiments were conducted for various types of QCIF (size – 144 x 176) video sequences. After splitting the video frames into GOP using in [18], the video sequence is transformed using bi-orthogonal filter 6.8. It is then given to SPIHT compression. In SPIHT compression, PSNR is compared for several wavelet decomposition levels (n=1 to 8). Figure 3 shows PSNR value of several decomposition levels for Claire and Carphone sequence.

From the Figure 3, it is observed that PSNR is increasing for increasing decomposition level and reaches maximum for the last decomposition level, which is 8. Hence, the proposed method with a decomposition level 8 is used for further analysis.
For decomposition level 8, the quality of the video sequence is also maintained. Four QCIF sequences are selected for testing, including “akiyo”, “carphone”, “suzie” and “coastguard”. The performance of the proposed method is evaluated using PSNR, compression size and computation time.

The results obtained by the proposed method are given in Table 1. The proposed method is compared with the state-of-art H.264/AVC and the recent WBVC [19]. The H.264 reference software JM19.0 is used on a PC platform (Intel Core i5, 1.70GHz, 4G RAM). The coding conditions are as follows:

- Reference frame number: 2,
- Search range: 32,
- Encoding: UVLC,
- RDO: off,
- GOP size: IPPP, (Proposed – Adaptive)
- Frames to be coded: 100,
- Frame rate: 30Hz,
- Quantization Parameter: 32

The other parameters use the default setting

<table>
<thead>
<tr>
<th>Method/Sequence</th>
<th>PSNR(dB)</th>
<th>Compressed Size(KB)</th>
<th>Computation Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastguard</td>
<td>44.25</td>
<td>118.47</td>
<td>1.12</td>
</tr>
<tr>
<td>Suzie</td>
<td>43.7</td>
<td>114.52</td>
<td>0.75</td>
</tr>
<tr>
<td>Akiyo</td>
<td>45.3</td>
<td>102.7</td>
<td>0.45</td>
</tr>
<tr>
<td>Claire</td>
<td>41.7</td>
<td>101.86</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Fig. 4 shows the results obtained by the proposed method. Fig 5 shows the comparison of PSNR of the proposed method with H.264/AVC and recent wavelet based codec.

Fig. 4 (a) and (c) Input frame, (b) and (d) Results obtained by the proposed method for Suzie and Claire sequence respectively
Fig. 5 PSNR comparison of the proposed method with H.264/AVC and WBVC

From Fig. 5, it is observed that the PSNR obtained by the proposed method is better than other methods. But for Claire sequence, the PSNR obtained by H.264/AVC is better than other methods. This is because; there are many scene changes in that sequence. Hence the number of B-frames is lesser. As the proposed method removes low frequency components in B-frames, it is efficient when there are more numbers of B-frames. Table 2 compares the computation time and compression size of the proposed method with that of the existing methods.

Table 2 Comparison of the proposed method with H.264/AVC and WBVC

<table>
<thead>
<tr>
<th>Method/Sequence</th>
<th>Time (min)</th>
<th>Compression Size (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H.264/AVC</td>
<td>WBVC</td>
</tr>
<tr>
<td>Coastguard</td>
<td>56</td>
<td>1.01</td>
</tr>
<tr>
<td>Suzie</td>
<td>90</td>
<td>0.88</td>
</tr>
<tr>
<td>Claire</td>
<td>58</td>
<td>0.82</td>
</tr>
<tr>
<td>Carphone</td>
<td>54</td>
<td>1.12</td>
</tr>
<tr>
<td>Average</td>
<td>64.5</td>
<td>0.96</td>
</tr>
</tbody>
</table>

From Table 2, the average computation time is tremendously reduced when compared to H.264/AVC and 0.2 min lesser than the WBVC method. Also, the compression size is lesser than H.264/AVC and still lesser than WBVC method.
[4] CONCLUSION

In this paper, we present a wavelet-based video coding algorithm using scene change identification. The low frequency components in temporal redundant frames are removed using wavelet transform. The temporal redundant frames are identified using scene change detection algorithm. This method is compared with recent version of H.264/AVC and recent wavelet based video codec. The experiments proved that the proposed method is better than H.264/AVC in terms of computation time, PSNR and compression size. The average PSNR of the proposed method is 2.66dB greater than H.264/AVC and 1.62dB greater than WBVC method.

REFERENCES


