COMPRESSIVE TECHNIQUES APPLICABLE FOR VIDEO COMPRESSION

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Abstract
Communication over internet is becoming important part of our lives. Now days millions of peoples spend their time on you tube, video communication and video conferencing etc. Videos require large amount of bandwidth and transmission time. Lot of video compression standards, techniques and algorithms had been developed to reduce data quantity and gain expected quality as possible as can. Video compressions technologies are now become the important part of the way we create, consume and communicate visual information. Paper reviews no of video compression techniques. It divides those techniques based on used techniques and used concepts in survey papers. And shows that for which type of videos these techniques are useful.

Keywords: Video compression, SBT, ORVC, RCT, BAPME, GBST, RGB-CFA, L-SEABI.

I. INTRODUCTION

Raw data comes with lot of transmission cost, bandwidth and memory requirement. Image/ video compression is traditional concept that has used for compression of video and image data. Image/video compression means reducing the size of any type of data such as audio, video and text so it should save time, bandwidth and memory. As multimedia information becomes really a important aspect of today's life and generated in vast amount, image/video compression is becoming more and more important. Image/ video compression may lossy or lossless. Lossless transmission means reconstructed information is similar to originally transmitted information, while lossy compression comes with loss in information but gives better compression ratio. Even though there lot of techniques for compression of images/ videos, finding better compression techniques for diversified applications or improving performance of existing techniques is still concern of lot of researchers.

Images/videos are either get compressed by using lossless compression methods consist of Run length encoding (RLE), LZW (Lempel Ziv-Welch) Coding, Huffman coding, Area Coding or using lossy compression techniques consist of Transformation coding, Fractal segmentation, Vector quantization, Sub band coding and Block truncation coding. Even though most of us want image representation of content rather than text for better understanding and visual appearance, videos turned out to be standards now days and used by lot of applications such as DVD, digital TV, HDTV, Video calls and teleconferencing. Because of lot of advancement in network computing and communication technologies as well as advanced video compression techniques, this application becomes more and more feasible. Reducing 4 types of redundancies is main purpose of video compression techniques; consist of perceptual, spatial, temporal and statistical redundancies. Perceptual information is data which are unseen to human eye get reduced without affecting video quality.

As video is sequence of frames, reducing redundancies between pixels of each frame comes under spatial redundancy reduction. While redundancy reduction between two adjacent frames comes under the temporal redundancy reduction. Statistical redundancies uses binary codes to compress transform coefficients, motion vectors and other data at last stage of video compression. Paper reviews no of video compression techniques use transformation coding, motion estimation, motion segmentation etc. to compress the different types of videos. Application of techniques on videos comes with no of advantages such as bandwidth reduction, bit rate reduction, compression efficiency increment etc.

II. EXISTING TECHNIQUES IN VIDEO COMPRESSION

1. Truncation coding

Truncation coding is based on segmentation of images into no of blocks consist of pixels. And then assign threshold and reconstruction values to each block. Threshold value is sum of all the pixel values, while reconstruction value determined by finding bitmap for each block. As video is sequence of images, increase in image size results in required transmission bandwidth issue. EC (Embedded Compression) algorithms are useful to overcome this problems, but not single EC technique able to solve video compression for large size videos such as HD videos,[3] proposed method uses hardware with Significant Bit Truncation (SBT) to compress the HD videos reduces the required memory bandwidth upto 60% by and large. Reach out to 14.2pixels/cycle for throughput gain. Hardware architecture Hierarchical Average and Copy Prediction (HACP) uses as much as possible predictions on block to gain accurate prediction calculations than previously known prediction techniques. And then uses SBT for grouping of prediction errors with same length of bits and store them as compressed data. Bandwidth reduction is main purpose of frame recompression technique.

(MLL) Mixed Lossy Lossless reference frame recompression technique [6] used with video encoder to diminish the enormous transfer speed required by the external memory. Bandwidth reduction is done through by use of truncated pixel and embedded compression of truncated pixels (PR). It stores obtained data in levels: Base level and Enhancement Level. Base level is used for IME and enhancement level is used for FME and MC in combination with base level. Base level data get compressed by using 3b-truncation method which consist of tailing-bit truncation (TBT), in-block prediction (IBP), and small-value optimized variable length coding (SVO-VLC). And stores enhancement level data as it is in outer memory. It reduces outer memory bandwidth requirement upto 74.5%.

2. Filters

Novel chroma subsampling proposed in [10] is mosaic video compression technique uses RGB-CFA structures. First it subsamples 2*2 YUV blocks of mosaic image frames into 4:2:0 formats. And then performs sampling of those U and V components that consist of required information by calculating quality twisting between original YUV block and sampled block. By performing experimental results on 28 video sets the proposed method gives best quality and bitrate tradeoff than proposed methods.

In-loop filtering useful in increasing the compression performance of videos. Existing techniques based on in-loop filters mainly uses local smoothness prior information for compression. Proposed method in [13] first time uses nonlocal prior information for compression of videos. This method considers the in-loop filter as an optimization issue by applying low level constraints on each category of image patches separately. And then solves it by matrix consist of singular values made up of image patches of similar categories. It models the image adaptive threshold derivation model for image patch groups depending on properties of encoded image patches, quantization variables and encoding manners. It improves the CR performance of existing video encoding standards like HEVC and saves upto 16% bit rate. A professional video application comes with noise affect video compression performance. It is possible for HEVC to compress the professional videos. But low to medium QPs (Quantization Parameters) consist of noise that could affect compression performance of HEVC. So that’s why proposed method in [5] uses an explicit in-loop reference frame denoising filter in professional video application. Proposed method improves coding efficiency for LDP settings.

3. Prediction Based Compression

Increase in surveillance video applications creates new challenges for highly efficient surveillance video compression techniques. The CR of surveillance videos got affected by the “exposed background regions” is those areas show up in current frames however canvassed by objects in the reference frames. BMAP method uses BPR (Background Reference Prediction) and BDP (Background Difference Prediction) to compress surveillance videos gives better CR than AVC. BMAP Uses various prediction manners for various types of blocks. BPR used for background coding while BDP used for background and foreground coding. By and large, there are 7.15%/6.25% (IPPP) and 5.28%/4.79% (IBBP) increment in the compression time over AVC on SD/CIF groupings [4].

Low complexity lossless/near lossless video codec design is used as an embedded compression engine reduces the required bandwidth for transmission of HD videos to transfer them over wireless network [11]. Gives the CR 21% and 46% over the low-unpredictability competing technologies like JPEG-LS and FELICS respectively. The near lossless compression concept reduces bit-rate upto 6%–18% and gives PSNR value which is either 50 dB or higher than that. The compressed video quality of the proposed scheme is also 4–8 dB better than the rival schemes can achieve. Recent markov process is either used for improvement of prediction step or transform step, but not for the both. Proposed method in [8] uses 2D markov process obtains both intra prediction and transformation. It achieves largest BD-BR bitrate saving about 6.7% for RIP+KLT system gives enhanced coding additions and creates less blocking impacts at low bitrates while expanding computational many-sided quality. Proposed scheme [7] uses superresolution L-SEABI algorithm to improve video compression gives better coding efficiency and reduces complexity than state-of-art technique H.264. It increases bitrate of conventional compression but reduces time required by the codec upto 71%. The proposed scheme compresses lower resolution images on compressor side and performs resizing of images at decompressors side. Proposed calculation ends up being most reasonable for use in decreased many-sided quality downsampled compression plans.

4. Motion Estimation and Segmentation

Backward Adaptive Pixel-based fast Predictive Motion Estimation (BAPME) method is pixel-level based motion estimation technique achieves better entropy reduction and reduces computation complexity than pixel-based full search for JPEG-LS, CALIC, ADAP and LI. BAPME works through 2 stages :(i) It uses 4 predictors: west predictor, neighbor predictor, median predictor and center predictor for pixel in current frame for generation of motion vector scheme. (ii) By setting up target window around the pixel it searches in previously obtained frame and find the motion vector that minimizes whole of outright contrast (SAD) of the objective window. Proposed motion estimation outperforms than block-based full search. It increases the speed and gives better entropy encoding [1].

In[12], three motion estimation algorithms: diamond search algorithms, adaptive motion estimation algorithm and full search algorithm in combination MPEG-4 are compared with other in terms of no of checkpoints, execution time and visual quality shows that adaptive motion estimation algorithm is better than other two. It improves time of existing techniques by 76.5% and PSNR by 0.0650 compared to full search algorithm. Compression using EZW and 7 different block matching algorithms has been proposed in[19]. Used EZW algorithm is intra compression technique while 7 different algorithms are mainly used for motion estimation. The calculations that have been actualized are Simple and Efficient TSS (SES), Exhaustive Search (ES), Four Step Search (4SS), Diamond Search (DS), Three Step Search (TSS), Adaptive Rood Pattern Search (ARPS) and New Three Step Search (NTSS). PSNR execution of ES is superior to all others.

Object Based Real Time Lossless video compression technique [17] is mainly based on separation of moving object from stationary background and then compress it. It has advantage over hybrid-based and block based coder. This technique also provides the ability to selectively encode, decode, and manipulate individual objects in a video stream and, hence, supports content-based functionalities such as object scalability and object manipulation easily.

5. Transform Coding

Transformation is process of dividing the image into smaller n×n blocks and apply unitary transformation on it.[14] Graph-Based Separable Transform(GBST) is mainly based on different factual characteristics of residual blocks. It uses the two line charts on each row and column with optimized weight for each prediction mode and then uses Graph-Based Transform (GBT) over rows and columns to construct GBST in separable manner. It uses two basic Gaussian Markov random field (GMRF) models to analyze the optimality of GBST by applying them on inter and intra residual signals. In comparison with separable KLT and Hybrid DCT/ADST proposed method outperforms regarding to BD-PSNR and BD-rate standards. Neural networks with wavelet transform are useful lossless video compression technique. Artificial Neural Network (ANN) is concept comes from human brain where this neural network is used to solve specific problem.

Proposed method in [16] based on ANN and Wavelet transform goes through 4 stages: video segmentation, scene identification, variance matrix computation and video compression. At video compression stage it uses wavelet transformation technique to compress pixels that have been changed in each frame and keep the original pixel neutralized. Compare to previous methods it gives better energy efficiency. Row-Column Transform (RCT) is combination of 2 1-D linear transforms and a premise requesting change defined as 2-D non-separable transform. Like we have seen in[15] this method is transformation based method which goes through 2 stages:(i) make best use of 1-D transforms technique used over columns and rows of the matrix block and (ii) finding the best change coefficient requesting. RCT-based encoding scheme gives better results than the KLT scheme with D-R execution and reach near to the SOT-based execution scheme. No of video compression techniques uses DCT (Discrete Cosine Transform). But DCT have certain issues such as artifacts blocking. Proposed method in [20] uses DWT (Discrete Wavelet Transform) and block matching method to compress the video. It uses frame separation, background separation and motion compensation process as preprocessing stage to compress the input data. By using DWT we get more efficient PSNR value.

TABLE I
TECHNIQUES AND THEIR ADVANTAGES

Approaches	**Method**	**Advantages**
Truncation coding	SBT	Reduces Required Bandwidth upto 60%, Achieves the throughput of 14.2 pixels/cycle.
	MLL reference frame recompression technique	Reduces bandwidth upto 74.5% for storage memory.
Transform Coding	GBST	In comparison with separable KLT and Hybrid DCT/ADST proposed method outperforms regarding to BD-PSNR and BD-rate standards.
	Neural network with Wavelet transform	Gives better energy efficiency.
	RCT	Outperforms the KLT encoding scheme with D-R execution reach near to the SOT-based implementations.
	DWT and block matching	Gives more efficient PSNR value.

Motion Estimation and Segmentation	BAPME	Better than block-based full search. Increases the speed and entropy reduction.
	Adaptive motion estimation algorithm	Improves time by 76.5% and PSNR by 0.0650 as compared to full search algorithm.
	EZW and 7 different block matching algorithms	Gives good CR or Compression Factor.
	ORVC	Backings content-based functionalities, for example, question adaptability and protest control effectively.
Prediction Based Compression	BMAP method	There are 5.28%/4.79% (IBBP) and 7.15%/6.25% (IPPP) increase in the compression time over AVC on SD/CIF sequences.
	Low complexity lossless/near lossless video codec design	It outperforms 21% and 46% than low-unpredictability competing technologies such as JPEG-LS and FELICS respectively.
	L-SEABI algorithm	Achieves largest BD-BR bitrate saving about 6.7% for RIP+KLT system.
	2D markov process based prediction	Reduces time required by the H.264 upto 71%.
Filters	RGB-CFA	Gives best quality and bitrate tradeoff than proposed methods.
	In-loop filtering	Improves coding efficiency for LDP settings.
	Explicit in-loop reference frame denoising filter	Saves upto 16% bit rate.

III. Conclusion

Video Compression come up with no of techniques based on their approaches saves bandwidth, memory, time or improves performance of existing methods or standards. We reviewed some of techniques based on their proposed approaches. They either uses transform coding, truncation or motion estimation etc. for compression of different types videos such as HD videos, professional videos, mosaic videos etc. These techniques work on either on pixels or blocks or on frames of videos, which is useful for reduction of spatial redundancies of each frame and temporal redundancy between the frames. The methods are either lossless or lossy techniques based on used concepts.

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