www.ijiarec.com

ISSN:2348-

Volume-5 Issue-1

International Journal of Intellectual Advancements and Research in Engineering Computations

Accumulative speed using context based adaptive binary arithmetic coding in real world video firmness

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ABSTRACT

The ultimate goal of video source coding is bit-rate reduction for storage and transmission by exploring both statistical and subjective redundancies and to encode a "minimum set" of information using coding techniques. The performance of video compression techniques depends on the amount of reduction in complexity computation and efficiency contained in the image data as well as on the actual compression techniques used for M-coding. To achieve this, we combine the probability estimation based on the VP9 technique with approximation of Multiplication. Approximately that proposed algorithm is faster and better compression efficiency compared to the various coder in the CABAC entropy coding scheme.

KEYWORDS: Video compression, CABAC, standards, VP9, JCT-VC, MPEG.

1. INTRODUCTION

1.1 VP9 ENCODER

The VP9 bit stream format and its corresponding encoder were released by Google Inc. Per June 12, 2013. The VP9 encoder has a two-pass run option, similarly to x264, which results in the improved rate-distortion performance, and which was also used in our experiments, as further explained in the next section. Major milestones in the evolution of video coding standards are the well-known H.262/MPEG-2 Video and H.264/MPEG-4 Advanced Video Coding (AVC) standards, the development of which was coordinated by the ITU-T Video Coding Experts Group (VCEG) and the ISO/IEC Moving Pictures Expert Group (MPEG).

The first version of the H.264/MPEG-AVC standard (and its reference software JM) was developed in the period between 1999 and 2003 to satisfy the growing need for higher coding efficiency, especially with regard to standard-definition TV and video transmission over low data rate channels. As a result, the H.264/MPEG-AVC standard successfully achieved an increase of about 50% in coding efficiency compared to its predecessor H.262/MPEG-2 Video. H.264/MPEG-AVC was designed for both low- and high bit-rate video coding in order to accommodate the increasing diversification of transport layers and storage media. In turn, this gave rise to a wide variety of H.264/MPEGAVC-based products and services. Throughout sub sequent stages of development, additional efforts were made (mainly from 2003 to 2009) for further improving the coding efficiency as well as for integrating additional functionalities and features into the design of H.264/MPEGAVC by means of the so-called Fidelity Range Extensions (FREXT) with its prominent High profile, the Scalable Video Coding (SVC) extension and finally, the Multiview Video Coding (MVC) extension. As already noted above, H.264/MPEG-AVC provided significant bit-rate savings compared to H.262/MPEG-2 Video. However, both video coding standards, at least their first editions, were not initially designed for High Definition (HD) and Ultra High-Definition (UHD) video content, the demand for which is expected to dramatically increase in the near future (Note that the term UHD often refers to both 3840x2160 (4K) or 7680x4320 (8K) resolutions in terms of lama samples). As a consequence, ITU-T VCEG and ISO/IEC MPEG established a Joint Collaborative Team on Video Coding (JCT-VC) and issued a joint call for proposals (CFP) on video coding technology in 2010. In response to this CFP, a lot of proposals were submitted both from representatives of industry and academia, which in turn led to an intensive development of the so-called High-Efficiency Video Coding (HEVC) standard during the next two and the half years. The first edition of HEVC was officially finalized in January 2013, and after that, the final aligned specification was approved by ITU-T as Recommendation H.265 and by ISO/IEC as MPEG-H.

1.2 HM REFERENCE SOFTWARE CONFIGURATION

For the HM reference software encoder a Random Access (RA) configuration was selected, since it provides better results in term of coding efficiency compared to the Low Delay configuration. The Group of Picture (GOP) size was set to 8 pictures, and the Intra Period was set to 24, 32, 56, and 64 pictures for 24, 30, 50, and 60 fps video contents, respectively. Also, Hierarchical B pictures were used with a Quantization Parameter (QP) increase of 1 (i.e., the quantization step size increase of 12%) between each temporal level. Also, the coding order was set to 0, 8, 4, 2, 1, 3, 6, 5, and 7. It is noted that the above test conditions were selected similarly to the test conditions presented for selecting additional encoding parameters, the authors used the “CFG 16” configuration, which was presented in which was proven to be optimal both from coding efficiency and computational complexity points of view.

2. ADAPTIVE BINARY ARITHMETIC CODING

Arithmetic coding has attracted a growing attention in the past few years. It is an effective mode of coding and it is one of the very important algorithms in all image and video compression standards such as JPEG, JPEG-2000 and H.264/AVC, HEVC, Dirac. The algorithm is not only a lossless data compression method but also a type of entropy encoding. Only a lossless data compression method but also a type of entropy encoding. The Arithmetic coder used in these standards which is multiplication free adaptive binary arithmetic coder with bit-renormalization and look-up tables used for multiplication approximation and probability estimation.

A basic idea about arithmetic coding uses a single floating point instead of string of input symbols so that it can be obtain a more efficient compression. The method is representing the encoded information as an interval between real axes of 0~The interval is smaller than longer information, and indicating a longer information needs more number binary.

As a common requirement for all these applications, there is need for a fast and efficient binary arithmetic coding scheme. Efficient implementations in arithmetic coding both in hardware and software, however are not only required in the application domains of image and video coding but also in the data compression scheme needs high throughputs of arithmetic codes.

2.1 VIDEO COMPRESSION

In video the amount of data is exorbitant. Image coding seeks to make the communication and /or storage image data manageable. Communication resources, for example have limited bandwidth. This is especially true in wireless communication media. Wireless handsets presented a example of the difficult environment for implementation of video data communication. Modern example of a video encoding approaches include MPEG-4 and H.264.The major video coding standard directly preceding the VP9 was H.264/MPEG-4 advanced video coding. It is widely used for many application, including video content acquisition, camcorders. It also used in real time conversational application such as video chat, video compressing and CCTV footage.

3. SELECTED ENCODER IMPLEMENTATIONS

In this section, a brief overview of the selected representative encoders is presented. A. H.264/MPEG-AVC Encoder for evaluating H.264/MPEG-AVC, an open H.264/MPEGAVC encoder implementation - the x264 encoder was selected. The first version of the x264 encoder was released in 2006, and since then, it has proven to be very fast, efficient, and reliable. Particularly, due to its flexible trade-off between coding efficiency and computational complexity, it was widely adopted in many network-based applications. Currently, the x264 video encoder is considered to be one of the most popular encoders for H.264/MPEG-AVC-based video coding .The x264 encoder has a two-pass run option, which refers to a multi-pass rate control. At the first pass, a file with the detailed statistic data about every input frame is generated. In turn, at the second pass, this information is used to improve the encoder rate-distortion performance. According to employing the abovementioned two-pass run, an average of about 7% decrease in bit rate is achieved for the same video quality (this bitrate decrease was also approved in authors' initial experiments). Therefore, the authors found the x264 encoder to be one of the best representatives of publicly available H.264/MPEG-AVC-based encoding implementations. Particularly, the authors used the latest version of the x264 encoder, i.e., the “r2334” version, which was released on May 2013.

3.1 VIRTUAL SLIDING WINDOW

These algorithm is mainly used for a synchronization of bit rates. The adaptive mechanism for estimating the probability of once at the output of binary non-stationary source. The alternative adaptive mechanism in Context- Based Adaptive Binary Arithmetic Coding (CABAC). An entropy coding scheme of H.264/AVC standard for video compression. The VSW method has integrated into an open source codec supporting H.264/AVC standard. These method is easy to implementation and does not require extra memory storage. The few condition wants to avoid for implementing the VSW algorithm, the condition were random value generation and floating point operation. The value of CABAC adaptation mechanism of average bit rate is 0.1 to 5.5% can be obtain. These method has more useful for implementing a digital signal processing. In common case the binary sources corresponding to these models are non-stationary.

Statistical properties of these sources can vary a great deal. This fact makes the problem of choosing window length for each source very significant. For stationary memoryless sources window length expansion increases probability estimation precision and improves compression rate. For arbitrary source window length expansion may reduce estimation precision optimal window length selection is a complex problem because statistical properties of sources corresponding to context models are unknown a priori. The simple heuristic algorithm of window length selection is proposed. The proposed “virtual sliding window” method for probability of one’s estimation is a development of ISW method. Like ISW, VSW method approximates work of “sliding window” algorithm but does not require to store the window in memory. An additional advantage of VSW is avoiding random value generation for state modifications. Methods similar to VSW were proposed in other works but distinguishing feature of VSW is integer implementation. As compared to probability estimation technique used in CABAC, the suggested method allows to obtain better compression rate. The compression gain is reached by assigning to different context models specific window lengths selected by statistical properties of corresponding source. Implementation of VSW method is not more complex than CABAC implementation. Moreover, VSW implementation on DSP has additional advantage. It does not need to store transition table for FSM used for modification of probability estimation.

4. CONTEXT MODEL SELECTION

A context model is a probability model for one or more bins of the binarized symbol. This model may be chosen from a selection of available models depending on the statistics of recently-coded data symbols. The context model stores the probability of each bin being 1 or 0.

5. ARITHMETIC ENCODING

An arithmetic coder encodes each bin according to the selected probability model. Note that there are just two sub-ranges for each bin (corresponding to 0 and 1).Bjøntegaard-Delta Bit-Rate Measurements as rate-distortion (R-D) performance assessment, the authors used a Bjøntegaard-Delta bit-rate (BD-BR) measurement method for calculating average bit-rate differences between R-D curves for the same objective quality (e.g., for the same PSNRYUV values) [26], where negative BD-BR values indicate actual bit-rate savings. The authors used R-D curves of the combined luma (Y) and Chroma (U, V) components, while the combined PSNRYUV value were calculated as a weighted sum of the PSNR values per each picture of each individual component, As a result, using the combined PSNRYUV and bit-rate values as an input to the BD-BR measurement method enables to determine a single average difference in bit-rate that considers the trade-offs between luma and Chroma component fidelity.

CODING OPTION	CHOSEN PARAMETER
Encoder version	HM10.0
Reference frames	4
R/D optimization	Enabled
GOP	8
Hierarchical encoding	Enabled
Intra period	1 sec
DE blocking Filter	Enabled
Asymmetric Motion Portioning(AMP)	Enabled
Fast encoding	Enabled

TABLE 5.1 ANALYSIS OF PARAMETER USING IN VP9

6. EXPERIMENTAL SET UP

Vp9 is customized for video resolutions beyond high-definition video (UHD) and also enables lossless compression.vp9 supports HDR video Hybrid Log Gamma (HLG) and Perceptual Quantizer (PQ).

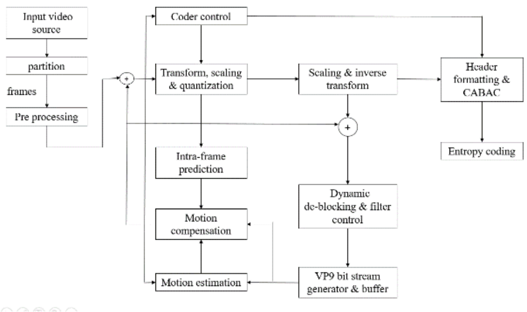

FIGURE 6.1 BLOCK DIAGRAM OF VP9 ENCODER

6.1 VIDEO ACQUISITION

Source of the video sequence which is output in a digital form. The acquisition process may temporally and locally compressed by the following processes

6.2 PRE-PROCESSING

Operations on the raw uncompressed video source material such as trimming, colour format conversion, colour correction, or de-noising.

6.3 TRANSFORM CODING

Transform coding is used to convert spatial image pixel values to transform coefficient values. Since this is a linear process and no information is lost, the number of coefficients produced is equal to the number of pixels transformed.

6.4 QUANTIZATION

It is involved in the image and video compression for truncate the data.it is lossless compression used in a video coding technique. When the number of discrete symbols in a given stream is reduced, the stream becomes more compressible.

6.5 INTRA-FRAME PREDICTION

The term intra-frame coding refers to the fact that the various lossless and lossy compression techniques are performed relative to information that is contained only within the current frame, and not relative to any other frame in the video sequence. In other words, no temporal processing is performed outside of the current picture or frame. Non-intra coding techniques are extensions to these basics. It turns out that this block diagram is very similar to that of a JPEG still image video encoder, with only slight implementation detail differences.

6.6 MOTION ESTIMATION

The motion estimation stage operates on a prediction block level and is only part of the encoder. The estimator takes the current prediction block to be used and tries to find the best matching area in an available reference picture. The determination of what the best match would be is subject to the employed cost criterion. A traditional search method is to shift the current prediction block over a search area around the collocated block position in the reference picture, and to determine the cost criterion for each position, see the illustration.

6.7 DEBLOCKING FILTER

It is a video filter applied to decoded compressed video to improve visual quality and prediction performance by smoothing the sharp edges which can form between macroblocks when block coding techniques are used. The filter aims to improve the appearance of decoded pictures. It is a part of the specification for both the SMPTE VC-1 codec and the ITU H.264 (ISO MPEG-4 AVC) codec

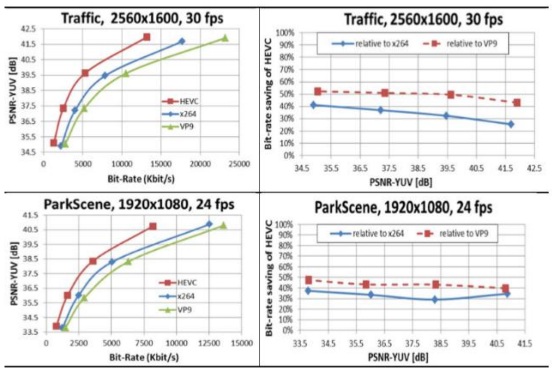

FIGURE 6.7.1 R-D CURVES AND CORRESPONDING BIT-RATE SAVING PLOTS FOR SEVERAL TYPICAL EXAMPLES OF TESTED SEQUENCES.

	HEVC vs. VP9 (in %)				VP9 vs. x264 (in %)			
Sequences/QPs	22	27	32	37	22	27	32	37
Traffic	708	625	580	576	15168	16365	17448	17692
PeopleOnStreet	104	929	856	869	9866	11105	11880	11551
Kimono	1047	948	850	801	10220	12231	13821	14777
ParkScene	691	638	587	578	11724	15296	16365	17706
Cactus	761	626	594	591	10307	13365	14795	15247
BQTerrace	799	588	517	507	8223	9987	12384	13837

TABLE 6.7.2 COMPARISON TABLE FOR VP9 VS HEVC, AVC

7. CONCLUSION

A performance comparison of H.265/MPEG-HEVC, VP9, and H.264/MPEG-AVC encoders was presented. According to the experimental results, the coding efficiency of VP9 was shown to be inferior to both H.264/MPEG-AVC and H.265/MPEG-HEVC with an average bit-rate overhead at the same objective quality of 8.4% and 79.4%, respectively. Also, it was shown that theVP9 encoding times are larger by a factor more than 100 compared to those of the x264 encoder.

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