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Content-Split Block Search Algorithm Based High Efficiency Video Coding

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In this paper, the video streaming generation in H.265 using novel technique based on content split block (CSB) search algorithm is presented. The proposed algorithm exploits the Inter and Intra prediction through motion estimation and compensation (IPME) encoded to use four different QPs: 22, 27, 32, and 37, during the redundancy analysis in order to improve the quality of video frame encoded. The proposed algorithm exhibits the useful property of block structure based on content-tree representation for each and every frame to IPME coded without affecting either the bit rate of video stream and perceptual quality of the video frame. The proposed Search algorithm improves the visual quality of coded video frame and reduces the blocking artefacts of video frame passed through multi-stages of H.265.

Keywords: H.265, Prediction, Content-split, block Search

Introduction

In video processing, the content analysis captured wide attention in many applications[1]. It is classified as text content and feature content[2]. The textual analysis in Video Processing is possible in text content[3]. This is a novel way of analyse the Video Codec, the main purpose is to analyse the image textual information by H.265[4] frame representation through multi-rate motion estimation technique[5].The High Efficiency Video Coding (HEVC) is a novel video coding standard[6]. It is proved to be dominantly[7] performing over other existing standards such as H.264. However, this is at the cost of complexity associated with the encoding scheme[7-9]. Encoding generally involves redundant activity where the process has to be carried out several times over several qualities using HEVC encoders, it is possible to enhance the performance when compared to reference encoder. In the existing video coding standard H.264/AVC is used as Macro block for encoding the process with fixed size 16x16.

Content Algorithm based Technique

Video coding standard High Efficiency Video Coding (HEVC) has an improved Rate Distortion Optimization performance compare to the previous video codec's, at the cost of single layer coding and increased encoding process[10]. Since dynamic streaming requires a coding standard which represent the multiple bitrates by improving the RD performance, which generally perform in single layer coding[9]. This paper limits the complexity. This paper limits the motion estimation and compensation by block structuring the video stream from a high content quality frame to low content quality frame by reusing the quantized bits for multiple fixed bitrates. Encoding by increasing the multiple bitrates to imply the degree of redundancy in the codec[10]. The context of multiple fixed bitrates[3] to perform motion estimation is analysed for single bit rate value for a reference video stream. The motion compensation[3-10] with the performed a severe degradation of RD optimization[11]. The proposed work achieves by encoding the video at multiple bitrates, with each bit rate at independent bit rate coding, which offers a higher Rate Distortion (RD) performance than H264[11]. The bit rate quantization can be improved by keeping the level of quantization uniform to bit rate and compress the video with the uniform bit rate value, which offers an efficient improvement in the coding efficiency. Multiple layer bit rate coding is made possible by encoding the highest quality frame content first as a reference level and preceding lowest quality frame content as a reference dependent at the next levels, which offers decreasing in encoding complexity[9]. By estimating the temporal prediction at highest level than spatial and estimating the highest less motion mode decisions, which offers a high-quality video frame content representation.

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The video frame content is simultaneously at different content qualities and thus multi bitrates to form content sets independently in a decoded multiple representations[9]. This proposed work multi-rate content encoding is well suited for RD performance optimization[10]. The proposed work is based on H. 265 for multiple bit rate RD.

Proposed Algorithm

In the proposed algorithm, the content in each motion vector with the dimensions of P X B frames having large magnitude refer to quick movement of the coding tree unit in the High Efficiency Video Coding. In H.264 the process of work has to be done with macro-blocks, but HEVC is replaced by coding tree units CTU. The presence of content block variations introduced during the slow movement of faster moving image objects are to be minimized. The technique of manipulating the video coding is obtained from HEVC standard. Proposed Content Split Block (CSB) search method is able to implement standard encodings from MPEG-2 to H.265/HEVC. CSB is mostly performed using single layer per frame through bit depth rate per frame using BL and CL bit depth module to allow CSB video coding at constant quantization and bit rate. A CSB video coding is a process flow applied at each video frame level. Group Of Picture (GOP) construction with motion estimation, inter and intra prediction for encoding the coded frames and transform information including decoding frame for inter prediction. The process flow initiates at frame extraction to acquire the frame information to be encoded. Pre-processing involves the GOP construction or motion estimation. Preceding inter and intra prediction is followed to encode the next coded frames which introduces latency between frame coding, can be reduced by coding decisions made by structuring the quad-tree transform and prediction coding information through Decoded Frame Buffer located at CL and BL. At the Coding Decisions, coding information carries reconstructed frame for inter prediction and reconstructs the frame as in the coding manner.

Simulation

Proposed work uses the block search algorithm which can be explained using the following steps.

a) Using MATLAB, get a block unit from the H.265 stream as shown in figure 1 and 2.
b) Analyse content of each block's header to determine if this is an IPME content block in IBBPBBI sequence.
c) In case of an IPME block:
   (i) Extract the block payload in order to get the pixel values,
   (ii) Feature the content into new data into the low bits of the pixels,
   (iii) Compare the content block with sequence of blocks,
   (iv) Store the block back to the frame unit.
d) Go to step (a).

In this work, when we select different thresholds for the magnitude of motion vector, the result will be different. The smaller threshold, with the more content blocks we can get, and the larger with the only content analysis. This is reason because of the less modification to the video, so less analysis will be introduced. Therefore, in the practical application, we should select appropriate threshold based on the requirement, for the purpose of obtaining considerable content block-search, and at the same, keeping good perceptive effect of video quality as well. Using HM

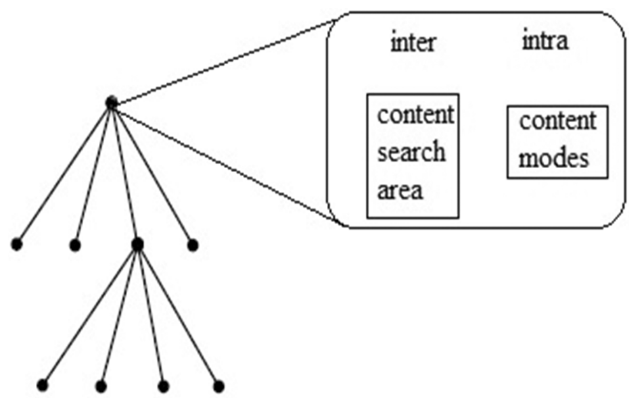

Fig.1 — Block Mode: Schema of the CTU content search area to analyse each CU and content modes

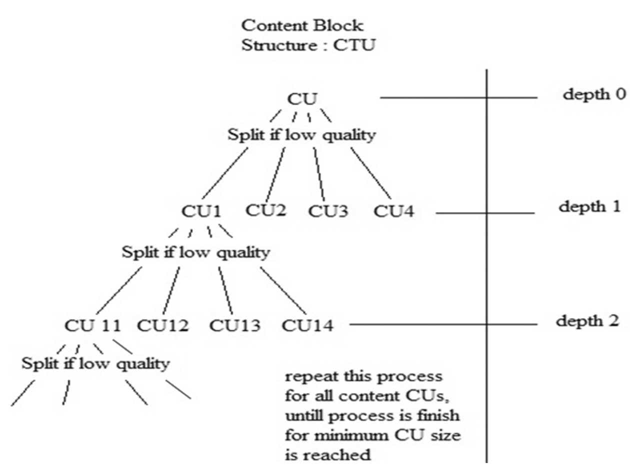

Fig.2 — Block Mode: Proposed content CU process to derive the block structure from high content quality to low content quality

16.4, a video slice is first divided in multiple CTU which comprise a content-tree structure whose leaves are called coding units (CU).

The decision of the prediction mode (e.g., inter/intra) is made at the CU level. The size of a CU is given by its depth in the content-tree with depth 0 corresponding to the biggest block size and a greater depth corresponding to a smaller block size

Determining the block structure is a major part of RDO, which is the most time consuming part of HEVC. The Multiple Rate Distortion Optimization (MDO) could be shortened if information about the block structure were available beforehand.

Data extraction was accomplished by GOP basis. For a GOP, the control information in I frame should be accurately extracted firstly. Variable length decoding is performed to obtain the quantized Discrete Cosine Transform (DCT) coefficients and the middle frequency coefficients are selected. By taking with least significant bits from these coefficients, we can obtain control information.

In this work, Reference Software is HM16.4 (HEVC Test Model 16.4), QP sizes 22,27,32,37, Processor is Intel Core i7x990, 3.47Ghz, Operating system is Ubuntu 16.4.

Results and Discussions

In the simulation based experimentation, the considered video sequence comprises of people street, cactus, BQ Terrace and Basketball pass with resolution (2460 x 240), (1920 x 1080), (832 x 480) and (416 x 240) respectively. The reference software used in HM 16.4 and compiler is MSVC 2012. The number of frames is 150, 240, 600 and 500 respectively with the four video sequences, while the corresponding frame rate is 30fps, 24 fps, 60 fps and 50fps. For all the cases, the bit-depth is fixed to be '8'. One of the frames from the example video considered is as shown in Fig.3 along with the reconstructed. In the block mode, the parameters considered are CU=64, depth =4, Motion Search Range=64, Intra period=32, GOP size=8, Lossy Coding, Search Window Range=8, Chroma Format=4:2:0, CABAC (Context Adaptive Binary Arithmetic Coding) =enabled with Frame based Coding. The corresponding results are presented in Table 1.

The proposed work is compared with HEVC Reference software[9] in terms of encoding time which is presented for different QP values in Table 2.

Conclusions and future scope

The proposed Search algorithm for content analysis in video operates as compressed bit stream. With the analysing content, the corresponding block based video processing was made possible. We implement and assess the proposed method based on the reference HEVC software and show that we can significantly reduce the encoding time for multiple HEVC representations without notably degrading the rate distortion performance. Proper trade-off between reconstruction and analysis is also observed. The performance is evaluated in terms of time which appeared to be less for encoding with the proposed scheme. The LTE (Long Term Evaluation) has been standardised by the 3rd Generation Partnership Project

Fig. 3 — The (a) Input and (b) Result of Proposed Algorithm

Table 1 — Different QP values with PSNR in dB

Sequence	QP	Y-PSNR	U-PSNR	V-PSNR	YUV-PSNR	Bytes Written to file	Total Time(sec)
PeopleStreet	22	41.90	40.86	40.86	41.52	4457092	67.489
Cactus	22	41.34	40.67	40.67	41.09	6673881	121.70
BQTerrace	22	40.72	40.39	40.39	40.61	10947093	192.779
BasketballPass	22	40.80	40.43	40.43	40.66	1164452	20.63
PeopleStreet	27	35.82	35.39	35.39	35.67	3577551	75.30
Cactus	27	36.06	35.50	35.50	35.86	5473639	117.614
BQTerrace	27	35.84	35.40	35.40	35.69	9015298	189.207
BasketballPass	27	35.86	35.43	35.42	35.71	958440	21.14
PeopleStreet	32	30.87	31.52	31.52	31.08	2921620	63.06
Cactus	32	30.91	31.56	31.55	31.11	4443387	113.741
BQTerrace	32	30.87	31.53	31.53	31.08	7354247	188.50
BasketballPass	32	30.90	31.56	31.54	31.10	782635	21.12
PeopleStreet	37	25.97	28.56	28.55	26.68	2346636	68.38
Cactus	37	26.01	28.59	28.58	26.71	3572090	113.569
BQTerrace	37	25.97	28.55	28.55	26.67	5899839	185.112
BasketballPass	37	25.98	28.58	28.56	26.69	628844	18.91

Table 2 — Comparative results with Proposed Work for Encoding time in Secs

	HEVC with HM Reference software		Proposed (Block)
22	3218.59	3083.78	20.63
27	2533.15	2352.79	21.14
32	2020.79	1853.21	21.12
37	1764.24	1583.61	18.91

consortium since 2008. HEVC has been standardised by Moving Picture Expert Group since 2012, and video compression technology targeted to deliver high definition video content to the users by exploiting the encoding features such as motion estimation and compensation techniques in HEVC.

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