An Efficient Rate Distortion Approach for Video Compression

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Abstract

Rate distortion optimization (RDO) technique is used for improving the video quality. However, H.264 video compression is used to solve different problems by performing as video quality metric, it also measure the variations from the source material and the bit cost for every feasible decision result. In present paper proposed an analytical method which will solve the RDO problem by using a rate model for the entropy coding. The main property of rate distortion is that is has lower complexity and it is simple to implement. From the results this has been shown that the presented method will provide the global peak SNR of 52.665 db.

Keywords:

Local Peak signal to noise ratio, Rate distortion approach, video decoding, High definition television, High resolution.

I. INTRODUCTION

As from the long time period the video compression technique have been more popular and gaining the more attention. As today the consumer enjoy the HD qualities videos over the internet and surfing for the high definition content, so we cannot ignore the facilities that the digital video industry has given to us. These are the attributes of the video compression technique that we have used in our daily life, enhancement on mass storage media or streaming video/audio services.

The main development of MPEG-4 was initiated in early twenty first century, and now the MPEG-4 is the existing method that has been widely used now days and there are continuous addition of new part in this method due to development. The main successfully advancement in video standard is obtained by the abilities of video coding objects, but on the other hand if we improve the coding efficiency then it will also increase the complexity.

In this study we are mainly focused in video compression technology.

The complete paper is described in five sections. I section is introduction and describe in Section II Rate Distortion Optimization Section III describes the framework of the implementation used for proposed work. Section IV describe in Result & Discussion. Finally, Section V describes the conclusion of paper.

II. Rate Distortion Optimization

The rate distortion optimization has been used for enhancing the video quality in H.264 video compression. As this method has initially been used by the video encoder, we can use rate distortion optimization for improving the quality in any encoding condition, here the decision has to be taken which are thoroughly effect the file size and the quality of the video.

However, H.264 video compression is used to solve different problems by performing as video quality metric, it also measure the variations from the source material and the bit cost for every feasible decision result. Thus for determining the bit cost we have to multiply the bit rate with the Lagrangian, thus here we get the value which will show the relation between the bit cost and the quality at any certain level. And the changes are generally measure as the MSE, for the maximization of PSNR video quality metric.

As the computation of bit cost is a challenging task in the case when entropy decoder that are employed in video CODECS requires the RDO algorithm to pass each block of video that we need to test to entropy coder for the measurement of real bit cost. Also this has been observed that the maximum performance achieved by the CODEC has been limited to the coding tools. In this study we present the several performance examples and also discuss from some different literature studies present in this field which shows the H.264/AVC has capability of outperform the MPEG- 4Visual. Thus the performance is only a one of the factor among the various factors which will affect the technology present in the market an here we also discuss about some problem which will makes the commercial market of video coding.

Thus the main key to perform the good decisions in contrast has been capability of trading the number of bits which we use for the encoding of some signal part that we are going to compress, and also the error that is produce here by the use of number of bits. As we did not have any single point which we cannot compress one feature of signal in the case when degradation produce by this have the much significance as compare to the compression of further features that have less number of bits. [16].

We can also describe the rate distortion in the terms of Lagrangian multipliers. Thus there is also another method for defining this which is the principle of parallel slopes, this shows that we have to choose the coding parameters in such a way distortion variation rate that perform with respect to bit rate is similar for the all part of system.

Let’s assume here that we allocation B1 and B2 bits to the component X and Y respectively. That observes the slope of rate distortion curve along these points. By this it is noted that at B1 slop of X distortion with respect to bit rate is larger as compare to the slop of B2 that will compute the distortion variation rate along Y with respect to bit rate. From this it has been observe that this position is not significant for the bits. Thus to show this we raise the B1 with a small amount to $B1+\Delta$ and reduce the B2 up to the amount $B2-\Delta$. Thus by this the distortion will minimized without enhancing the total bit rate, because of disproportional drop in distortion along X.

III. Framework of the Implementation

In the proposed work, rate distortion approach is applied with the rapid development and continuous expansion of mobile communications, due to which the mobile internet service is most popular now days. As a result, mobile video applications, such as mobile video broadcasting, mobile video conference, and mobile video surveillance, have become an active research area in recent years. However, due to the fact that mobile devices typically have limited communication bandwidth, constrained power capacity, and various display capabilities, there are several fundamental difficulties in deploying high-quality video service for mobile devices over wireless networks. H.264/AVC has been uses the lesser size of transform as compare to the earlier standards that we have used. Thus there has been a trade off in between the size of the transform used. By suing the large transform we can facilitate the better energy compaction and better preservation of the detailed feature in the form of quantized signals than a small transform perform. There we use three common profiles for this purpose which is extended profile, main profile and the baseline profile. And among these the most commonly used profile is main and baseline profile, which we study here and here we analyze the PSNR metric for the several video input signals. Figure below shows the flowchart of the RDO based H.264.

Basically in a video file we have the container format in which in which we contain video data which is in coding format and also takes the audio data which is stores in audio coding format. Thus in this container we also have some data about the subtitle or the synchronization data etc. a standard video file type like the baseline is an profile which is specify by the restriction on which video and audio both the formats are permitted.

In standard video file type like the baseline profile which will specify by the constraint on the basis of which the video or audio coding formats are permitted in the container. The synth alongside theFFMPEG allows us to use following formats as FFMPEG which will import these files with the mentioned name extension shown below to use them in script :asf, avi,dvrms, .m1v, .mp2, .mp2v, .mpe, .mpeg, mpg, mpv2, .wm, and wmv.

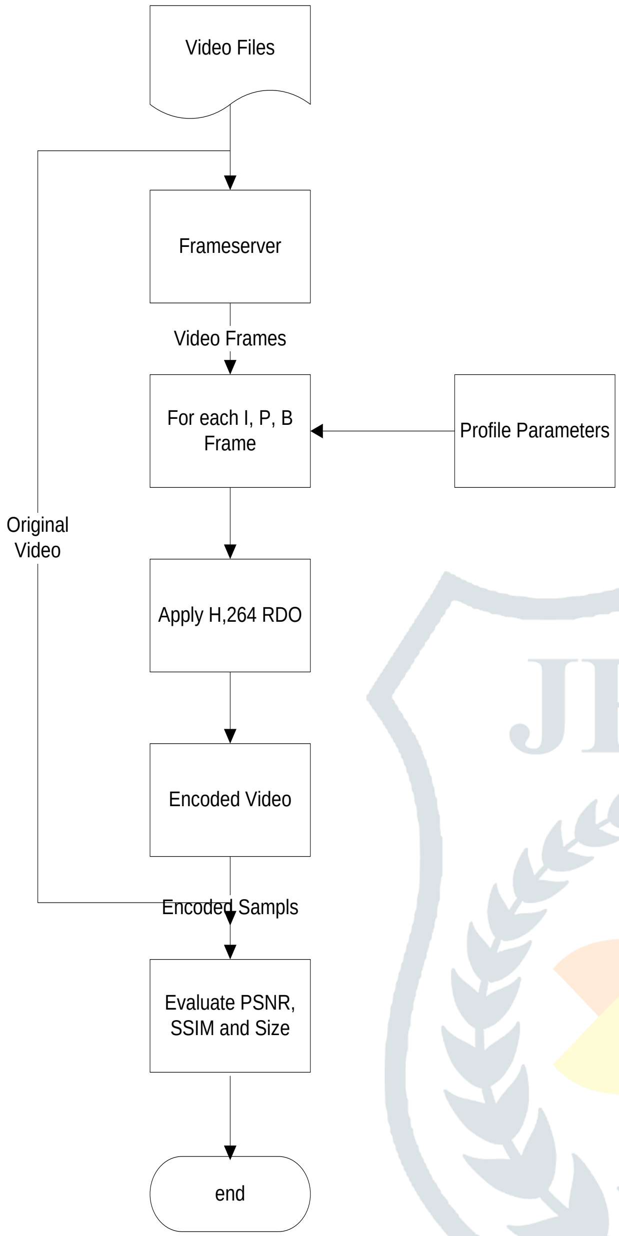


Fig 1. Proposed Flow chart of RDO enabled H.264 supporting I, P and B frames

IV. Results&Discussion

The CODEC quality that we use in generally based on the compression formats that we use in system. As the CODEC is not a format and thus there are several CODEC can be use for the similar compression. There are collections various video samples of different formats with different profiles including codec, Resolution and Bitrate. The Comparison of the baseline and High (advances) profile are made using PSNR and SSIM. Although both follow the same general framework, there are several fundamental changes are in the profiles for ARM computers. As Described in previous chapter the comparison will be based upon PSNR and SSIM. PSNR for a video sample can be described using equation 1:

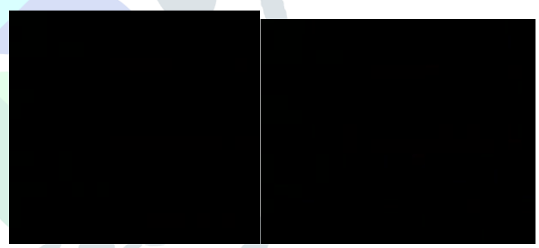
$$PSNR_{est[DB]} = 10.Log_{10}\frac{255^2}{MSE_{est}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

But as video files contain multiple frames and are much more complex than still image samples, that's why we will use $PSNR_{AVG}$ and $PSNR_{Global}$for comparison of video samples. Similarly for SSIM, for two input samples x and y, can be described using equation 2:

$$\mathrm{SSIM}(x,y) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)(\sigma_x^2 + \sigma_y^2 + C_2)} \ldots\ldots\ldots\ldots\ldots(2)$$

- $\mu_x$the average of x.
- $\mu_x$the average of y;
- $\sigma_x$the variance of x;
- $\sigma_y$the variance of y;
- $\sigma_{xy}$the covariance of x and y;

The Mean SSIM for whole video sample is collected, i.e. $SSIM_{MEAN}$.



(a) (b)

(c) (d)

(e) (f)

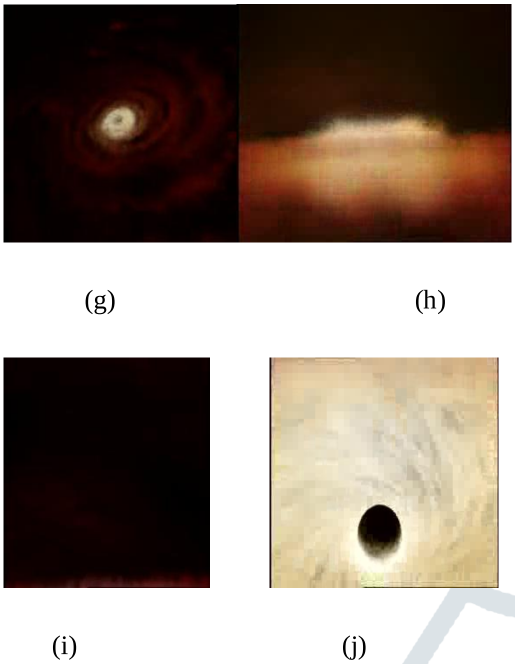


Fig. 2 Frames of Database video

Fig 2 represents different frame of database video. The fig 2 (a-j) represents 10 frames of the video. The complete video is divided into frames & these frames divided into images. These images are then divided into pixels.

Some of the samples we collected are described in compression will use the lossy data compression thus in this case the quality measurement problem is crucial.

Table 1. Input Video Samples for x264 with profiles.

Video Sample	**Format**	**Resolution**	**Bitrate (Kbps)**
grb_1	AVI	640x480	776.15
m84_1	AVI	320x240	365.1
wg_gdo_1	AVI	1280x720	2185.66
wg_gdo_2	AVI	1280x720	2502.45
wg_gdo_3	MP4	560x320	33.91

Represents the comparative analysis of the size reduction of video using baseline approach & rate distortion profile.

While comparison of CODECS, PSNR present the approximation for the human perception to reconstruct the quality. The large value of PSNR shows that this reconstruction is of high quality, and in some of the cases it will not.

Table 2 Final File size Video Samples for both Baseline and rate distortion profile.

Video Sample	Original Size	baseline Profile	RDO
grb_1	3409.92	285	225
m84_1	1587.20	319	278
wg_gdo_1	2027.52	178	152
wg_gdo_2	3041.28	306	239
wg_gdo_3	374.00	28.4	28.7

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The resultant files size compression of the different technique is given in fig 3

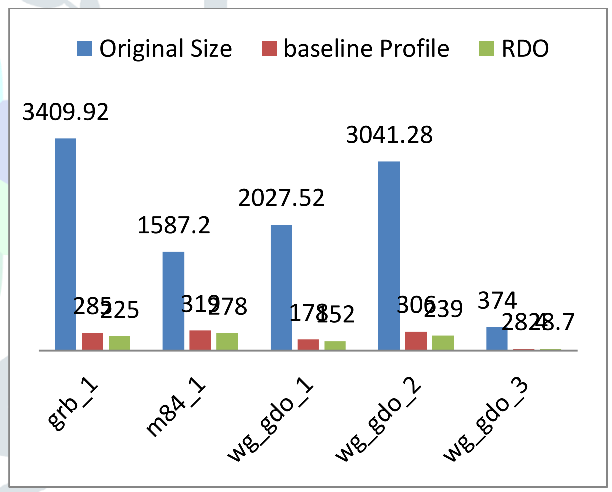

Fig. 3 Resultant File Size Comparison H.264 baseline and rate distortion profile.

For the range of validation of metric we must be much careful; as this is not only decisively important when we use it for the comparison of outcomes of same CODEC and for the similar content. Table 3 shows the Global PSNR Rate for Video Samples in H.264 baseline and rate distortion profile.

Table 3 Global PSNR Rate for Video Samples H.264 baseline and rate distortion profile.

Video Sample	baseline Profile	RDO
grb_1	36.0171	40.176
m84_1	38.187	42.734
wg_gdo_1	39.9087	44.857
wg_gdo_2	36.7407	41.293
wg_gdo_3	46.8072	52.665

Table 3 Gives the Global peak signal to noise ratio for the different video signal. Max PSNR is achieved up to 52.665

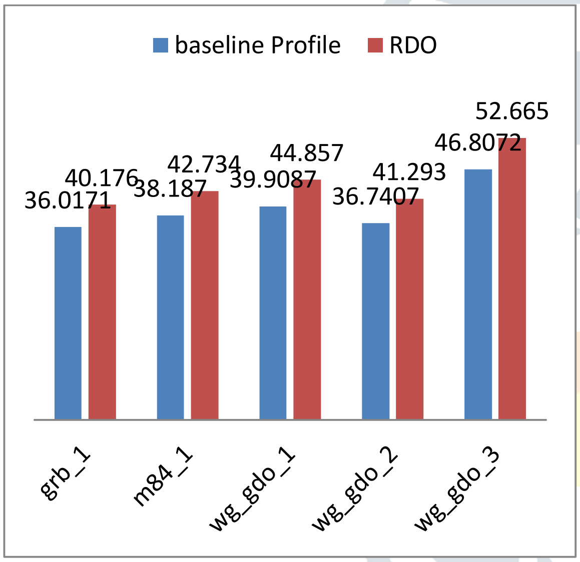

Fig 4 Global PSNR Rate for Video Samples

Fig 4 Represents the graphical representation of the global PSNR.

V. Conclusion

The comparative evaluation of RDO codec and baseline profile hasbeen presentedin this paper in terms of PSNR and SSIM with respect to MPEG-2 codec.This comparison has been done by the developers of each codec from the design prospective, it has been observed that RDO codec has better PSNR and SSIM than the baseline profile. Also from above elevation we have seen thatthe H.264 codec produces excellent video output of less than 1/3.

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