A Novel Blurring based Method for Video Compression

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Introduction

The video compression focuses on removing the coding, perceptual, spatial and temporal redundancy to reduce the data footprint such that content can be transmitted, processed efficiently with no or minimum human perception loss on various display devices.

This paper, an extension of [1], proposes a novel spectrum based video compression technique to further reduce the data footprint with satisfactory quality metric. The main contributions are:

- Introduction of image spectrum orientation prior for natural images which states that the spectrum of natural images are oriented in vertical direction.
- A novel blurring based video compression technique (20 to 30% more compression with respect to MPEG compression) that can be used along-with other compression methods.

Principle

The proposed method is based on principle that 'Any information that can be restored, can be compressed'. We employ blurring to increase the correlation i.e. DC component between the pixels, which is efficiently coded by MPEG scheme.

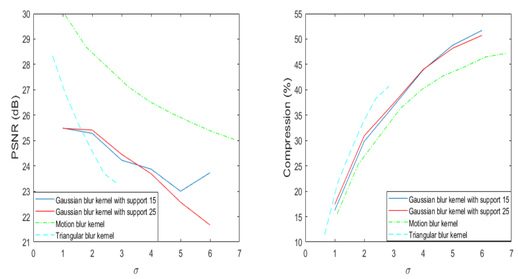

Figure 1: Effect of blur PSFs on PSNR and compression.

The blurring PSF is selected based on trade-of between achieved compression and quality of recovered output as shown in the figure above. The comparison between various blur kernels is performed based on equivalent Gaussian measurement function [1].

Proposed Method

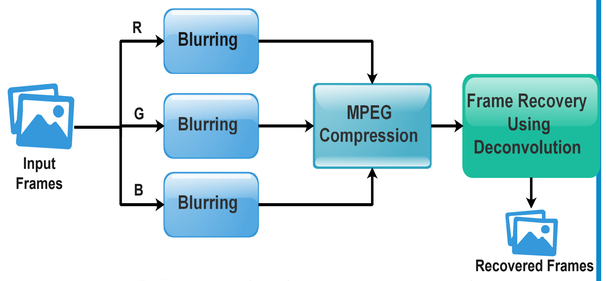

Figure 2: Proposed video compression scheme.

- Each video frame is separated into R, G and B components.
- The blurring PSF is selected in the direction of maximum frequency content in the frame.

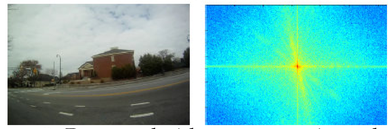

Figure 3: Proposed video compression scheme.

- Each of the R, G and B component is blurred with the selected blurring PSF.
- Boundary elements of blurring/convolution are preserved to attain higher deconvolution accuracy by preserving zeros in blurred output $Y(z) = X(z)H(z)$.
- The blurred R, G and B components are combined together followed by the standard MPEG compression.
- Frame by frame deconvolution with known blurring PSF is performed to recover the video.

No. of Images	No. of Images with $\angle S$ as		
	Direction Invariant	0°	90°
4107	2751	246	1110

Table 1: Spectrum Orientation Prior.

Only a small fraction images have spectrum horizontally oriented as observed in a database containing 4107 images from the internet. This is referred to as 'spectrum orientation prior'. On this basis, blurring PSF is selected in the vertical direction with reduced processing time (0.22 sec per frame of 640×480).

Results

Figure 4: Comparison of frames of Original, MPEG compressed and proposed compressed video.

Video	Frames	PSNR	SSIM	% compression
Book Arrival	99	32.47	0.857	41.8
Charlie	16634	30.27	0.888	31.0
MV2	8294	27.45	0.853	63.9
Newspaper	200	29.41	0.875	29.0
test	900	24.14	0.746	37.7
traffic	531	31.72	0.898	73.6

Table 2: Performance metrics of the proposed video compression scheme.

Discussion & Conclusion

Size (px)	Processing Time (s)
320x240	1.8
640x480	8.6
960x720	19.3

Table 3: Computational Time

(a) RGB (b) YCbCr

Figure 5: Frame quality comparison between YCbCr and RGB color formats in proposed compression scheme.

- The paper proposes a novel method for videos compression using blurring of the frames followed by MPEG compression.
- The blurring reduces the intensity variation among pixels which is efficiently encoded by transform such as DCT.
- Performance of the proposed compression scheme depends upon deconvolution accuracy.
- Characterization of quantization noise is an important aspect for such a framework.
- Fast deconvolution method is required to achieve the higher frame rates for real time applications.

References

[1] Himanshu Kumar, Sumana Gupta, and KS Venkatesh. A novel method for image compression using spectrum. In *Ninth International Conference on Advances in Pattern Recognition (ICAPR-2017)*, pages 1–6. IEEE, 2017.