Error Robustness Assessment of MV-HEVC Encoded Data

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ABSTRACT

Error resilience (ER) and error concealment (EC) algorithms play a vital role in reducing the error propagation effect in video standards. However, the implementation of a robust ER or EC algorithm depends on analyzing the effects of error propagation in the video data. This paper examines the sensitivity of MV-HEVC bitstream under error-prone conditions. This analysis focuses on error propagation within the Network Abstraction Layer (NAL) and its impact on the Video Coding Layer (VCL) and the Non-VCL. The experimental results show that the VCL NAL and the Non-VCL active area are the most sensitive encoded data in the MV-HEVC bitstream.

Keywords: MV-HEVC Bitstream, NAL units, Error rates

1 Introduction

Multi-View Video (MVV) sequences offer a rich array of perspectives on a scene, greatly enhancing interactivity and providing deeply immersive experiences in the realm of 3D content distribution. The introduction of the latest Multi-View High Efficiency Video Coding (MV-HEVC) standard has broughtabout a remarkable reduction in data rates and a substantial improvement in coding efficiency for MVV sequences [1]. However, under error-prone transmission conditions, especially when dealing with large GOP (Group of Pictures) sizes, errors can severely impact the bitstream, leading to synchronization issues between encoder and decoder. Existing error resilience techniques, such as Error Resilience (ER),Feedback Channel (FC), Forward Error Correction (FEC), and Multiple Description Coding (MDC) aimto mitigate these effects [2]. Despite this, there is limited research on error-sensitive encoded data in MV- HEVC. Consequently, this research investigates the sensitivity of the MV-HEVC bitstream under error-prone conditions. It evaluates different components within the MV-HEVC bitstream, including NetworkAbstraction Layer (NAL) unit types for both Video Coding Layer (VCL) and Non-Video Coding Layer(Non-VCL), subjected to varying bit error rates (BERs). The study aims to identify the most sensitive compressed data during MVV transmission.

2 Methodology

Two MVV sequences in YUV format is initially encoded using MV-HEVC HTM 16.6 benchmark software [3]. Sequences details and the encoding configurations settings are reported in Table 1.

Table 1: *HD-MVV & MV-HEVC Encoder configurations*

Sequence	Resolution	Frames	Frame Rate(fps)	GOP Length	Structure	BERs	Profile
Kendo	1024x768	300	30	8	IP (2 Views)	(0,2,4,6,8) $\times 10^{-4}$	Main
Sharek	1088x1920						

After the encoding process, experimental work is conducted in error-prone environments with randomly placed bit or burst errors to obtain the desired NAL unit error, using a block diagram shown in Figure 1.

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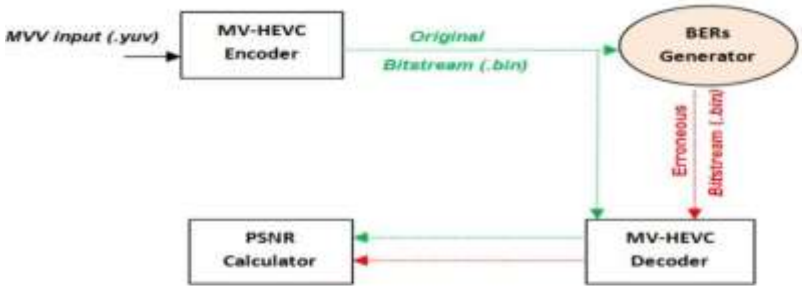

Figure 1: *MV-HEVC error sensitivity evaluation diagram.*

3 Results and Discussion

The results between the original and modified bitstreams of the MV-HEVC are obtained by using PeakSignal to Noise Ratio (PSNR) [4]. The obtained results are shown in Figure 2.

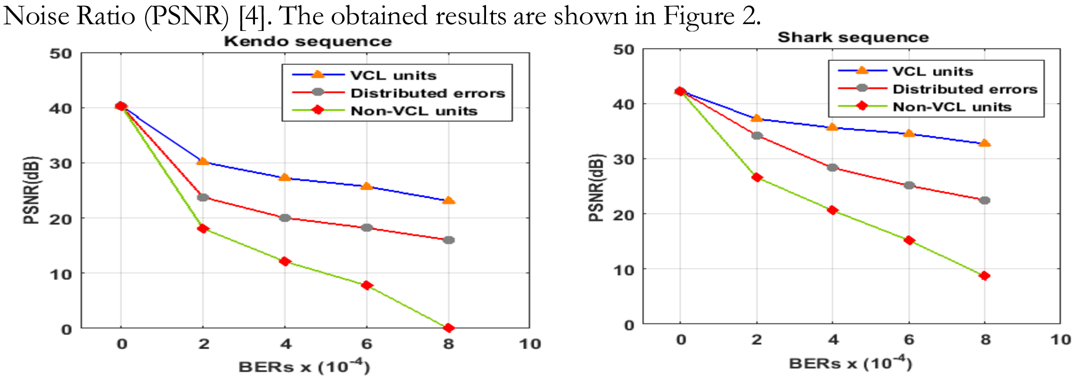

Figure 2: *Encoding error sensitivity for non-VCL NAL and VCL-NAL units at various BERs.*

Analysis results show that all parts of the NAL units suffer from a steady decrease in PSNR as the BERs increase, whether for Kendo or Shark video sequences. What is striking is the Non-VCL NAL data that suffer from a high degradation in video quality. For instance, the PSNR of Non-VCL NAL units at thehighest BERs is reduced by 18 dB for Kendo and 12 dB for Shark compared to evenly distributed BERinjection. At the same condition, the quality of VCL NAL units is reduced by 5 dB for Kendo and 7 dBfor Shark when injecting BERs into all MVV encoded data.

4 Conclusion

In this paper, the study evaluates the sensitivity of MV-HEVC bitstreams in error-prone environments, focusing on the impact of random errors on VCL NAL and Non-VCL NAL units. The research finds that errors significantly degrade multi-view video quality due to MV-HEVC predictive coding and inter-view dependencies. Future work should explore error sensitivity in M-HEVC to identify data that shouldbe transmitted through more secure channels.

How to Cite

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