Evaluation of MPEG-5 Part 2 (LCEVC) for Live Gaming Video Streaming Applications

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ABSTRACT

This paper presents an evaluation of the latest MPEG-5 Part 2 Low Complexity Enhancement Video Coding (LCEVC) for live gaming video streaming applications. The results are presented in terms of both objective and subjective quality measures. Our results indicate that LCEVC outperforms both x264 and x265 codecs in terms of bitrate savings using VMAF. Using subjective results, it is found that LCEVC outperforms the respective base codecs, especially for low bitrates. This effect is much more dominant for x264 as compared to x265, with marginal absolute improvement of quality scores for x265.

KEYWORDS

Gaming, Video Codecs, LCEVC, x264, x265, Codec Comparison

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1 INTRODUCTION

In Oct 2020, MPEG finalized the MPEG-5 Part 2 Low Complexity Enhancement Video Coding (LCEVC) standard, which is shown to reduce the overall encoding complexity with negligible impact on the coding efficiency and, in several cases, even improvement in the coding efficiency [2]. LCEVC uses any existing codec (H.264, H.265, AV1, etc.) and encodes the videos at a lower resolution and very efficiently compresses the residuals, which are then used to correct the artefacts produced during the re-scaling of the encoded lower resolution video to native resolution. The enhancement achieved by using the residuals improves the details and sharpness of the final decoded video sequence.

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2 EVALUATION METHODOLOGY

We use 14 reference gaming video sequences from the Cloud Gaming Video DataSet (CGVDS) [3]. which are of 30 seconds duration of 1920x1080 resolution and 60 fps and are from various genres and complexity. The reference videos were then encoded at the native resolution at five different bitrates (800 kbps upto 6 Mbps) using the Constant Bitrate (CBR) mode of encoding. Two different presets were used to simulate real world application requirements taking into account the codec complexity: medium preset for x264 and LCEVC-x264 and veryfast for x265 and LCEVC-x265.

3 RESULTS

3.1 BD-BR Analysis

In terms of BD-BR, we observed that, while using VMAF as the objective quality metric, LCEVC enhancing x264 (medium) and x265 (veryfast) outperforms both the base codecs, x264 and x265, used alone at full resolution, with BD-rate-VMAF of −42.14% for x264 and −38.86% for x265 respectively. LCEVC-x264 (medium) outperforms x265 (veryfast) with a BD-rate-VMAF of −13.64%. x265 results in 29.74% bitrate savings than x264 (considering VMAF). However, in terms of BD-BR analysis using PSNR, while LCEVC-x264 outperforms x264, x265 actually outperforms LCEVC-x265.

3.2 Subjective Assessment

A subjective test was conducted for five source video sequences by an independent lab, VABTECH in Italy adhering to the ITU-T Rec. P.809 [1]. A pair of videos from the same codec family (e.g., x264 vs. LCEVC-x264) were shown sequentially (in random order), and subjects were asked to rate both of them using two separate 7-point scales provided after watching both sequences. In general, LCEVC results in a higher subjective scores compared to the base codec, especially at the lower bitrates. At higher bitrates, especially when considering x265 vs. LCEVC-x265, the absolute differences between the implementations are very small. A three-way analysis of variance (ANOVA) using the game, bitrate, and base codecs and their respective LCEVC implementations as independent variables, indicated that for x264 there is a major effect of the codec implementation and also an interaction effect of the codec implementation with the game as well as with the bitrate. However, this effect is much stronger for lower bitrates. For x265 and corresponding LCEVC-x265 encoded video sequence, the ANOVA also highlighted a main effect of the codec implementation, but the effect size is much smaller.

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