The new video coding standard H.264/Advanced Video Coding

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Abstract

H.264/Advance Video Coding (H.264/AVC) is the most recent video coding standard, developed by JVT (ITU-T Video Coding Experts + ISO/IEC Moving Picture Experts Group). This new standard offers better compression ratios, more sophisticated and advanced techniques and more flexibility over a broad variety of network types and application domains. This work consists in the evaluation and comparison of the H.264/AVC standard performance with the other coding standards, both in terms of lossy and lossless coding.

1 Introduction

Video coding has been one of the most explored areas in the last years. The main reason is the increase of the number of video applications in several areas such as video communications, security, industry and entertainment (Digital TV, Internet video streaming, DVD and more recently Blu-ray and HD-DVD). To support all this applications, it is necessary to develop new, more robust and modern video compression techniques. The Join Video Team (JVT), developed a new standard that promises to outperform the earlier MPEG-4 and H.263 standards, providing better compression of video sequences. The new standard, entitled 'Advanced Video Coding' (AVC), emerged to fulfill the needs of the present and future society, having better coding efficiency and robustness/flexibility over a variety of network types and applications. Moreover, it is the first standard supporting lossless video coding [6, 8].

2 H.264/Advanced Video Coding

The structure of the H.264/AVC video coder is illustrated in Fig. 1. The main layers are the Video Coding Layer (VCL) and the Network Abstraction Layer (NAL). The VLC is based on conventional block-based motion-compensated hybrid video coding and it is the core of the video coding process itself, where the video data is represented efficiently. The NAL is specified to format the compressed data and to provide header information in a manner appropriate for conveyance by the transport layers or storage media [4].

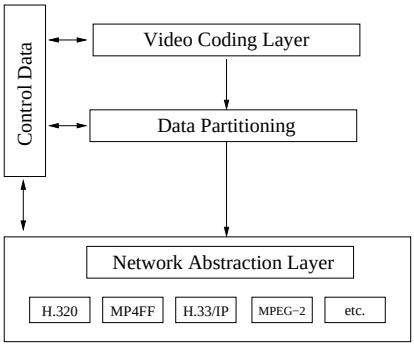

Figure 1. Structure of H.264/AVC video encoder (adapted from [8]).

2.1 Video Coding Layer (VCL)

The core of the Video Coding Layer of H.264/AVC is similar to other standards such as MPEG-2 Video. It consists on a hybrid temporal and spatial prediction, in conjunction with transform coding [4]. The main differences are:

- Improvements in motion compensation
- Variable block size
- In-loop deblocking filter (inside the coding process)
- Entropy coding more efficiently (CAVLC and CABAC)

More details about the H.264/AVC VCL can be found in [5, 7].

3 Experimental results

In this section we present experimental results regarding the use of the H.264/AVC both for lossy and lossless coding. The results are divided in two groups. In the first group, we present the lossy compression results. The lossless compression results are in the second group.

Fig. 2 presents the performance of the H.264/AVC standard comparatively to the MPEG-x standards, at different bitrates. As we can see, at low bitrates the H.264/AVC have the highest performance results comparatively to MPEG-1, MPEG-2 and MPEG-4 (X-VID). As we expected, the new functionalities that had been incorporated in H.264/AVC render this standard the best choice for lossy video coding.

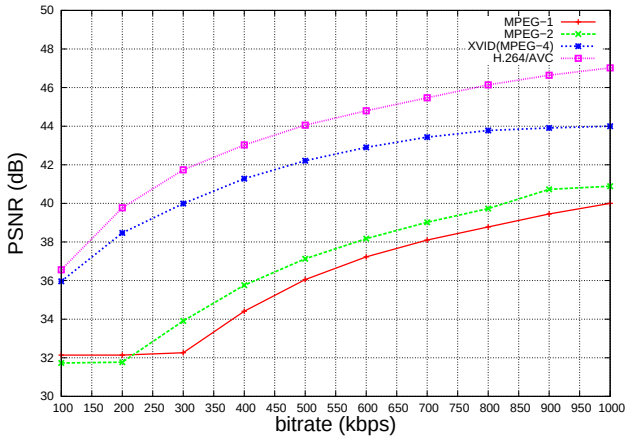

Figure 2. Bitrate vs PSNR of the video sequence "news_cif" (lossy compression).

The H.264/AVC is the first video coding standard that supports lossless coding. In order to compare the performance of the H.264/AVC, we used the most important image compression standards that support lossless coding (JBIG, PNG, JPEG-LS, JPEG 2000). Analysing Fig. 3, we can conclude that the best choice for lossless coding is JPEG 2000. The H.264/AVC had the worst results. Recent works have been proposed to improve the H.264/AVC lossless coding functionality [1, 2, 3].

4 Conclusions and Future Work

The results obtained in the simulations show that the H.264/AVC is the standard with the highest performance in lossy coding, regardless of the bitrate used. For the lossless coding, the H.264/AVC does not provide the best compression results. The best standard for lossless coding of video sequences seems to be JPEG 2000. In the coding process of JPEG 2000, there is a reversible color transformation (RGB ↔ YUV) step. Using the YUV color space, the

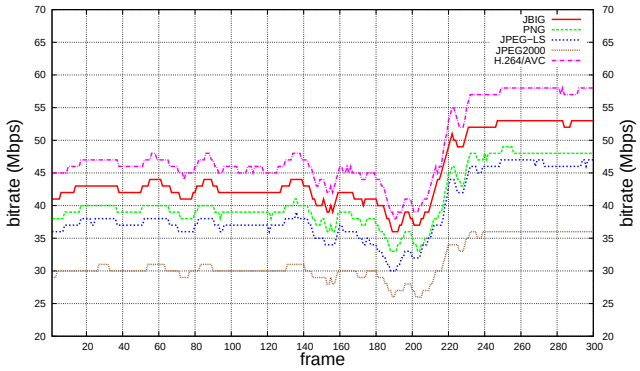

Figure 3. Bitrate of the video sequence "foreman_cif", using JBIG, PNG, JPEG-LS, JPEG 2000 and H.264/AVC (lossless compression).

coding process becomes more efficient. For future work, it would be interesting study in more detail the NAL and perform some simulations using compound images (i.e., composed of text, graphics and pictures).

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