OVERLAPPED FILTERING FOR SIMULCAST VIDEO CODING

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SUMMARY In video coding, layered coding is beneficial for applications, because it can encode a number of input sources efficiently and achieve scalability functions. However, in order to achieve the functions, some specific codecs are needed. Meanwhile, although the coding efficiency is insufficient, simulcast that encodes a number of input sources independently is versatile. In this paper, we propose postprocessing for simulcast video coding that can improve picture quality and coding efficiency without using any layered coding. In particular, with a view to achieving spatial scalability, we show that the overlapped filtering (OLF) improves picture quality of the high-resolution layer by using the low-resolution layer.

**key words:** simulcast, layered coding, post-filtering

1. Introduction

Streaming video technology that integrates coding and networking, such as adaptive streaming, is widely used over the Internet and is also being applied in visual systems for social infrastructure. Meanwhile, in social infrastructure such as video monitoring systems and broadcasting facilities, there are many restrictions owing to the need for compatibility with legacy systems and interconnection with other systems. Therefore, scalable systems compatible with existing systems and capable of employing the latest technologies are desired.

Many scalable video coding systems have been developed and they can transmit a number of video sources that differ hierarchically in terms of resolution and picture quality. In fact, in regard to coding efficiency, the bitrate saving of several tens of percent has been reported compared to simulcast, which transmits video sources independently that differ in terms of resolution and picture quality. However, with the exception of some teleconferencing systems, such scalable video coding systems are not currently popular, as a specific encoder and a specific decoder are required for scalability.

In this paper, we propose post-image processing to improve picture quality for simulcast video coding that encodes a number of input sources independently by using existing codecs. It is possible to reduce coding noise by overlapping and averaging the identical input images coded under different conditions. Hence, we call our method the overlapped filtering (OLF) and evaluate its performance. We consider OLF to be a type of multiple-description coding (MDC).

The rest of the paper is organized as follows. In Sect. 2, we present the principle of OLF and consider how to achieve spatial scalability functions. Section 3 reports on comparative experiments comparing our proposal and SHVC\cite{1}, which is the latest scalable coding, conducted in order to evaluate the performance of spatial scalability. Section 4, the final section of this paper, presents conclusions.

2. Overlapped Filtering (OLF)

It is well known that if multiple data from identical sources with different noises are averaged, the noises in the data can be reduced. If the encoded images from identical sources subject to different conditions are averaged, the coding noises may be reduced.

We propose a block diagram of overlapped filtering for spatial scalability as shown in Fig.2. Usually, in spatial scalability, there are two layers with low-resolution and high-resolution. First, the weighted average of the down-sampled high-resolution layer image and the low-resolution layer image are calculated. Then the sum of the up-sampled weighted average image and the difference between the high-resolution layer image and the down-sampled & up-sampled high-resolution layer image is output. In this block

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diagram, although the signal undergoes resolution conversions, the details are maintained since the difference between the signals with and without the conversions is compensated.

3. Performance Evaluation

In this section, the performance of spatial scalability is evaluated. HEVC contains a number of enhancements, one of which is SHVC standardized as scalable video coding. In the experiment, HM14.0, which is the reference software of HEVC, and SHM6.1, which is the reference software of SHVC, are used. The test condition is based on the common test condition [2] of SHVC and compared with the result of simulcast video coding. In order to examine the impact of the difference in picture quality between the low-resolution layer and the high-resolution layer, the QP of the high-resolution layer compared to that of the low-resolution layer is tested by increasing from 0 to 6, by two. This means that the delta QP is 0, 2, 4, or 6. Test video sources are seven sequences, of which two sequences are 2560 × 1600 pixels cropped 4K and the remaining five sequences are 1920 × 1080 pixels. The low-resolution layer sources are down-sampled to half size in horizontal and vertical directions from the high-resolution layer sources.

In this overlap filtering, the filter set [3] to create the test sequences is used for down-sampling and the interpolation filter of the SHVC is used for up-sampling. As a result of preliminary experiments, when the delta QP is 0, the PSNR of the down-sampled high-resolution layer shows about 5 dB higher than the PSNR of the low-resolution layer and when the delta QP is 6, both show similar levels. This means since the PSNR of the low-resolution images is lower than the PSNR of the down-sampled images, the images of the high-resolution layer have not been replaced by high-quality images of the low-resolution layer. Based on those experimental results, for each delta QP of 0, 2, 4 or 6, we decided to test each weighted ratio W of 15/16, 7/8, 3/4 or 1/2.

Table 1 shows the average of the results of PSNR improvement of the high-resolution layer by OLF. Table 2 shows a comparison between the result shown in Table 1 and the result of SHVC. The result of SHVC is evaluated by bitrate reduction of BD gain. Figure 3 shows the best case of R-D curve. In this example, relative to simulcast, the bitrate reduction of SHVC is 50.88% and that of OLF is 20.53%.

4. Conclusion

In this paper, a new image processing technology was proposed. In particular, we evaluated the performances of spatial scalability. The experimental results showed that although the performance of overlapped filtering (OLF) did not exceed that of SHVC, the picture quality of simulcast can be improved by the post-processing.

References