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Title & Abstract Pages

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LINE-BASED INTRA PREDICTION FOR 4×4 BLOCKS IN H.264

Gyo-Yoon Lee[1] and Yo-Sung Ho[2]
[1] Gwangju Institute of Science and Technology (GIST)
261 Cheomdan-gwagiro, Buk-gu, Gwangju 500-712 Republic of Korea
[e-mail: gyoyoon@gist.ac.kr]
[2] [e-mail: hoyo@gist.ac.uk]
*Corresponding author: Yo-Sung Ho

Abstract

In this paper, we propose a new intra prediction method for 4×4 blocks in H.264. The proposed intra prediction method adopts line-based prediction that uses the values of the nearest four pixels to predict the current pixel value. However, the line-based prediction values can be different between the encoder and the decoder due to the quantization error. Although we need to use the reconstruction values of the decoder to avoid the mismatch problem, we cannot use them in the line-based prediction process. Therefore, we design a new reconstruction process that is appropriate for the proposed method. Experimental result shows that the proposed method achieves about 8% bit savings compared to H.264.

Keywords: H.264, intra prediction, line-based prediction

1. Introduction

The latest international video coding standard H.264 was developed by JVT of ITU-T VCEG and ISO/IEC MPEG [1]. In order to achieve high coding efficiency, H.264 adopts the prediction coding method; it encodes residual data that is the difference between the original data and predicted data [2]. The prediction method is classified by inter prediction and intra prediction methods. The inter prediction method uses the property of high temporal correlations; in contrast, the intra prediction method uses spatial correlations.

Since temporal correlations are higher than spatial correlations in general, the inter prediction method provides better coding performance than the intra prediction method. In order to overcome this problem, we propose a more accurate intra prediction method by using higher spatial correlation pixels.

2. Intra Prediction in H.264

Luma intra prediction was performed in three block sizes: 4×4, 8×8, and 16×16 intra modes. The 4×4 intra prediction has nine prediction modes. Each prediction was performed in the direction of each prediction mode. Since the upper and left pixels have previously been encoded and reconstructed, they are available for the intra prediction process in both the encoder and the decoder. In the vertical and horizontal modes, we use the upper and left pixel values directly; in other modes, we use the average or weighted average value to predict the current 4×4 block.

The 8×8 intra mode also uses nine prediction modes as in the 4×4 intra mode. In the 16×16 intra mode, there are four prediction modes: vertical, horizontal, DC, and plane modes. The vertical, horizontal, and DC modes are similar to the directional modes in the 4×4 intra mode

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3. Proposed Method

In this paper, we propose a line-based prediction method for the 4×4 intra prediction mode. If we use neighboring pixel values for prediction, we can increase accuracy. Thus, we predict the first horizontal and vertical lines using the pixel values of the just upper or left lines.

In order to avoid the mismatch problem, we design a new reconstruction process to generate more accurate prediction values. First, we obtain residual data 1, 2, 3, and 4 between the current line and the reference pixels. In general, since the differences between the consecutive pixels in the prediction direction are small, we substitute the residuals of the first line for the remaining pixels, as shown in Fig. 1.

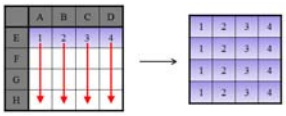

Fig. 1. Conversion of 4×4 block in vertical mode

Figure 1 explains how to obtain 4×4 residual data in the vertical mode. The 4×4 residual block is passed through encoding and decoding processes in the regular order. As a result, we obtain the reconstructed residual values. The residual values are used as the reference pixels to predict the next (second) line.

Figure 2 explains the next procedure of the prediction process. Since the reconstruction process is already performed for the first line, the reconstructed residuals are generated. In order to make the prediction values, we add the reconstructed residuals to the original reference pixels A, B, C, and D. After making the residuals 5, 6, 7, and 8 between the original second line and the predicted values, we copy the residuals into the remaining three lines. Finally, we perform the reconstruction process to generate the reconstructed values which are used as the reference values in the next (third) line process.

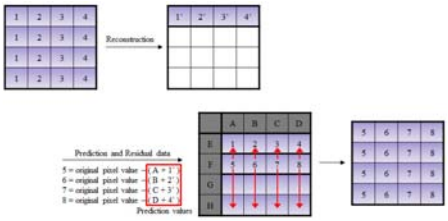

Fig. 2. Prediction of next line by using reconstruction

We repeat the mentioned prediction and reconstruction processes until we obtain the 4×4 residual block. After four repetition of the proposed prediction method, we obtain residual data for a macroblock. The obtained macroblock is encoded by using the conventional processes.

4. Experimental Results

In this paper, we presented an efficient line-based intra prediction method. To verify coding performance of the proposed algorithm, we have performed our experiments on various sequences of the YUV 4:2:0 and 8 bits per pixel (BPP) format. We used the JM 12.4 software [3]. Table 1 shows our experimental results.

Table 1. Experimental Results

Sequence	BDBR(%)
Akiyo	-9.61
Foreman	-7.14
Football	-2.95
Basketball	-12.64
Parkscene	-8.21
Average	-8.11

5. Conclusions

In this paper, we proposed an efficient line-based intra prediction method. We predict pixel values using the nearest pixel using suitable reconstruction process in the vertical and horizontal modes. The proposed method provides approximately 8.11% bit saving, compared to the H.264. Especially, our method shows pefromacne improvement in gradually varying regions and simple regions.

References

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[3] http://iphome.hhi.de/suehring/tml/download/old_jm/jm12.4.zi p, Joint Video Team, Reference Software Version 12.4.