

Title: Reconstruction of Reference Frames for Multi-view Video Coding

Status: Input Document to JVT

Purpose: Proposal

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Source: GIST

1. Introduction

This document describes the reconstruction of reference frames for multi-view video coding (MVC). After we explain the reconstruction of reference frames in Section 2, we present our experimental results and show the effectiveness of the proposed method in Section 3

2. Reconstruction of Reference Frames

The video compression efficiency depends on the correlation between the reference image and the image to be coded. Since MVC is also based on the video coding, it has the same problems associated with the video coding. Unlike video coding, MVC has a view prediction between the adjacent views as well as temporal prediction. Current MVC schemes employ same tools which are used in temporal prediction for view prediction. However video compression scheme are optimized to reduce the temporal correlation. Unfortunately spatial correlation, the correlation between adjacent views, much smaller compared to temporal correlation. So the process to increase the spatial correlation is needed to improve the efficiency of MVC. In this document, we called this process as reconstruction of reference frames and we try to reconstruct the reference frame close to the frame to be coded. Figure 1 easily shows the reconstruction of reference frames.

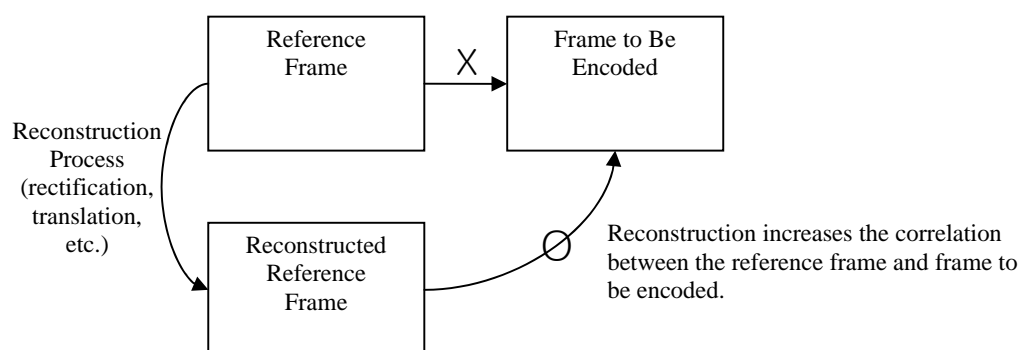


Fig. 1. Reconstruction of Reference Frames

One approach is application of image rectification. Each view of multi-view video sequence respectively has different epipolar geometry according to its intrinsic and extrinsic parameters. So, there exists geometrical distortion between reference view and view to be encoded. The proposed algorithm rectifies the reference view in terms of the view to be encoded. The rectified reference view is more similar to the view to be encoded than the non-rectified reference view is. In this document, we do not mention about rectification itself in detail. For more details see [1].

We use the [1]'s algorithm as the reference rectification scheme. The purpose of the reference rectification scheme is the transformation of each image to make its conjugate epipolar lines become collinear and parallel to horizontal axes. Figure 2 shows the results of rectification of two images. The important point is that both of the two images are rectified and modified. Due to this limitation, the rectification is applied as the pre-processing for original multi-view sequences in MVC.

However, the proposed algorithm modifies the reference rectification scheme suitable for MVC. We use the rectification scheme as the reconstruction of reference frames. While the previous rectification scheme defines the new extrinsic parameters for both frames, the proposed algorithm only employs the existing extrinsic parameters of view to be encoded. So, only the reference view is modified in terms of the view to be encoded. In addition, we do not use the vertical displacement condition. The purpose of this condition is to set the left and right vertical displacements to be the same. However, if we employ this condition, geometrical distortion increases. Figure 3 shows the results of the proposed rectification scheme. As you can see, the right image is not changed and only the left image is changed to be similar to the right image. The holes caused by transformation are filled by using mirroring technique.

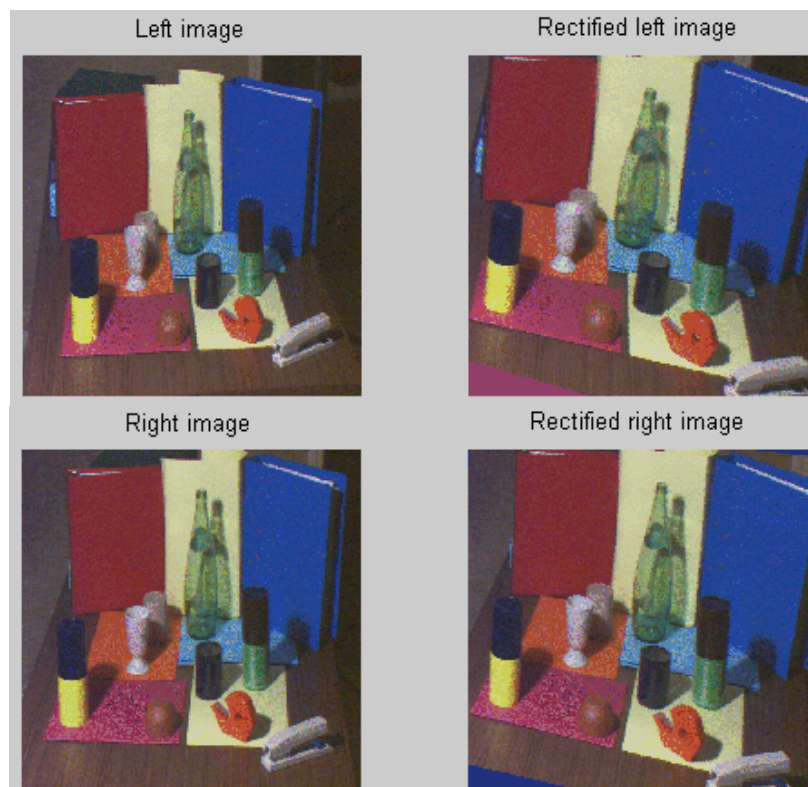


Fig. 2. Results of the Reference Rectification Scheme

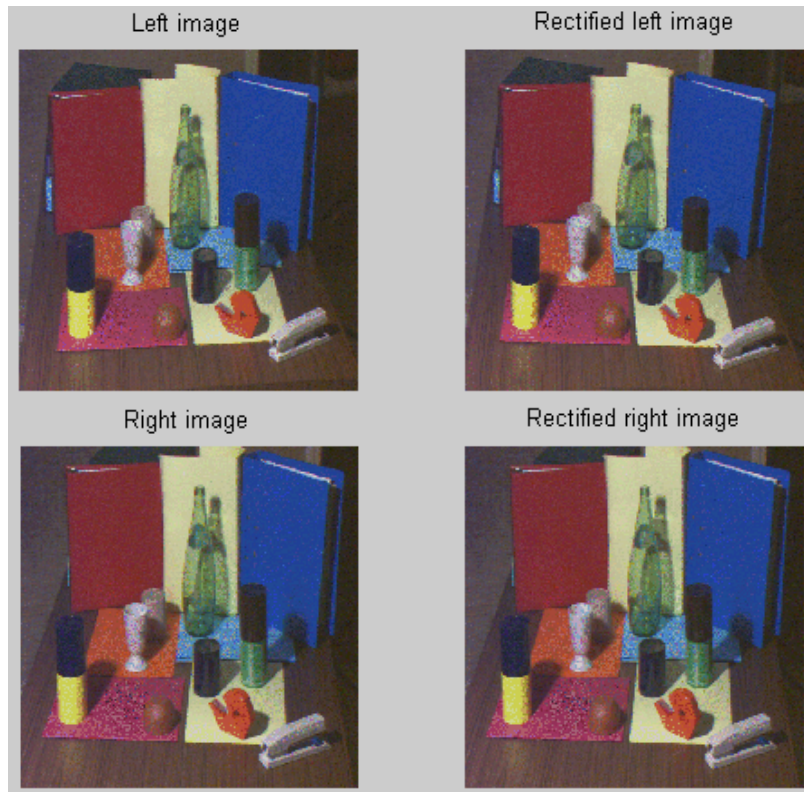


Fig. 3. Results of the Proposed Rectification Scheme

3. Experimental Results and Analysis

In order to evaluate the proposed method, we have experimented with “Race1” and “Uli” sequences which are non-rectified sequences [2]. We only tested the first 8 frames in view prediction. The following tables and figures show the coding results of the proposed method compared to the results of the reference software.

Table 1. Coding Results for “Race1” Sequence

Basis QP	Bit Rate (kbps)		PSNR (dB)	
	JSVM	Proposed	JSVM	Proposed
24	2952.69	2903.28	42.08	42.03
26	2217.21	2201.04	40.84	40.86
28	1722.09	1708.34	39.70	39.69

Table 2. Coding Results for “Uli” Sequence

Basis QP	Bit Rate (kbps)		PSNR (dB)	
	JSVM	Proposed	JSVM	Proposed
28	5176.13	5170.09	37.60	37.64
30	4186.10	4146.37	36.58	36.61
36	2154.50	2108.96	33.22	33.20

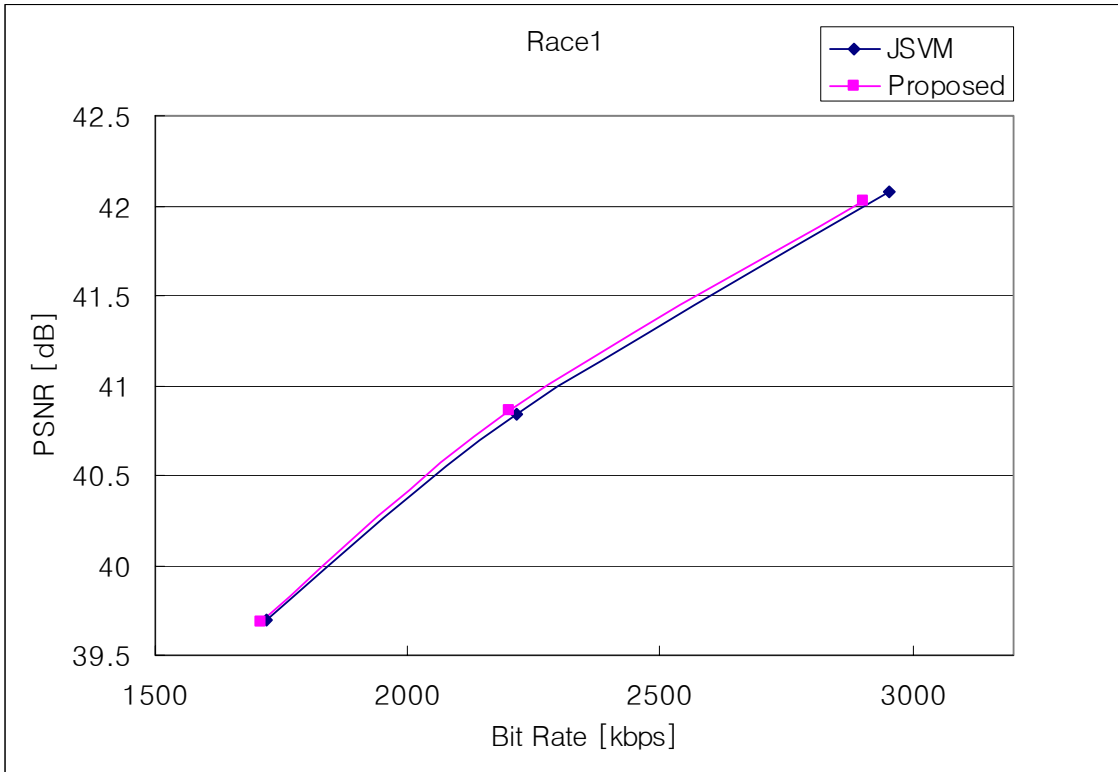


Fig. 4. Rate-Distortion Curve for "Race1"

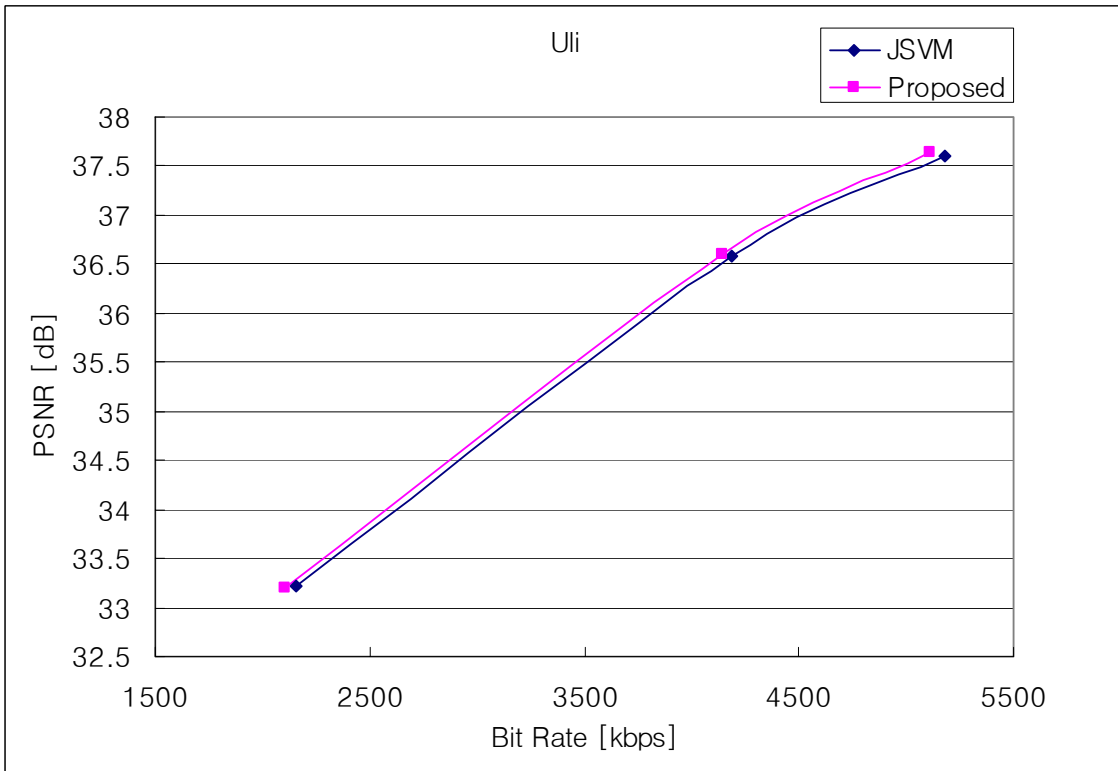


Fig. 5. Rate-Distortion Curve for "Uli"

4. Conclusion

In this document, we have proposed the reconstruction of reference frames for MVC. With some test sequences, we have verified quality improvement compared to the coding scheme of JSVM. However, due to the time limitation we did not yet experiment with all sequences. Next time, we will show more results.

5. Acknowledgements

This work was supported in part by the Information Technology Research Center (ITRC) through the Realistic Broadcasting Research Center (RBRC) at Gwangju Institute of Science and Technology (GIST), and in part by the Ministry of Education (MOE) through the Brain Korea 21 (BK21) project.

6. References

- [1] Andrea Fusiello, Emanuele Trucco, and Alessandro Verri, "A Compact Algorithm for Rectification of Stereo Pairs," in *Machine Vision and Application*, vol. 12, pp. 16-22, March 2000.
- [2] ISO/IEC JTC1/SC29/WG11 W8019, "Description of Core Experiments in MVC," April 2006.

(Append for Proposal Documents)

JVT Patent Disclosure Form

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Joint Video Coding Experts Group - *Patent Disclosure Form*

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