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1. Introduction

This document reports experimental results of the view synthesis software on 'Pantomime' sequence as a response to EE2 [1]. The used two reference softwares are provided by Nagoya University and Thomson. GIST patched 'Boundary Noise Removal' algorithm on 'VSRS' distributed on January 13, 2009. We compared the quality of synthesized images using two versions of software; 'VSRS' and 'VSRS_GIST_updated'. Independently with Nagoya's software, we tested 'ViSBD 2.1' provided by Thomson which is distributed on January 8, 2009.

2. Experimental Results of View Synthesis

In the last MPEG meeting in Busan, experts in 3D Video Coding group agreed with the sup-pel precision algorithm by Nagoya's depth estimation tool shows stable and good performance through viewing test. After the Busan meeting, Nagoya University distributed view synthesis software on SVN server named 'VSRS', and GIST added and updated the 'Boundary Noise Removal' algorithm onto 'VSRS'. In the mean time, Thomson also released the updated 'ViSBD 2.1' software. Therefore, we compared three results; synthesized images by 'VSRS', 'VSRS_GIST_updated', and 'ViSBD 2.1'. A brief summary of finding parameters is shown in Fig. 1.

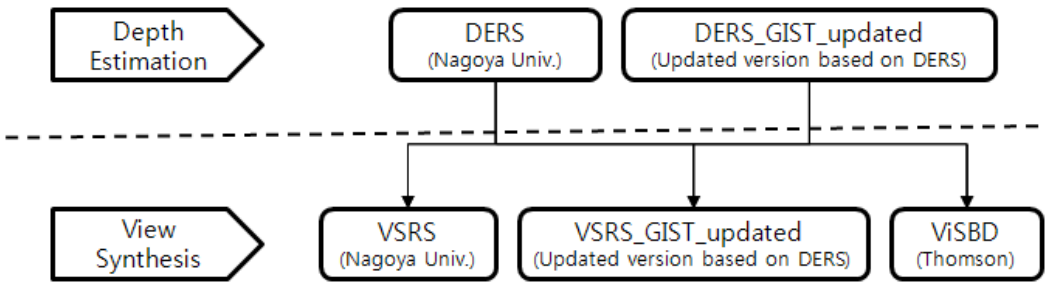

Fig. 1. Software for 3D Video

2.1. Results on 'VSRS'

Since view synthesis algorithm under consideration for 3D video takes depth map of two views, we exploited depth maps generated by 'DERS' in order to synthesize intermediate view image. There are two kinds of depth map; depth map without temporal enhancement and depth map with temporal enhancement. We included both results of depth map for a input data on view synthesis.

Software 'VSRS' provided by Nagoya University has only three options: 'ColorSpace', 'Precision', and 'Filter'. However, the last two parameters are predetermined by depth estimation, and 'ColorSpace' has rather low portion in performance. Therefore, we set the 'ColorSpace' parameter to zero (YUV). Moreover, since GIST has updated the 'Boundary Noise Removal' algorithm on 'VSRS' and released on January 13, 2009, we tested both results. Table 1 explains the parameter set used in view synthesis.

Table 1. Parameter set for view synthesis tool 'VSRS'

Depth Type	Synthesis Mode	Color Space	Precision	Filter	Boundary Noise Removal
1	1	0	4	2	0/1 (both)

Table 2 shows PSNR values for the synthesized images. Overall quality of synthesized image is higher than 33 dB in PSNR and showed relatively good results.

Table 2. Average PSNR values on synthesized images using 'VSRS'

Temporal Enhancement	off				On			
Boundary Noise Removal	off		on		off		On	
Viewpoint	39	40	39	40	39	40	39	40
PSNR (dB)	35.431	33.257	35.393	33.247	35.415	33.215	35.378	33.207
Average PSNR	34.344		34.320		34.315		34.293	

One considerable improvement on view synthesis comes from the effect of temporal consistency. Figure 2 shows two synthesized images of 197th frame of 'Pantomime_39'. The second image is a result of 'without temporal consistency' and the third image is a result of 'with temporal consistency'. Almost of all objects are well-synthesized except for the bag on background. If the depth estimation doesn't use the temporal consistency algorithm, the shape of bag is distorted easily. This phenomenon occurs frequently through the whole frames.

Another improvement on view synthesis is reduction of background noise due to 'Boundary Noise Removal' algorithm. In terms of PSNR, the value decreased little as shown in Table 2, but subjective quality is improved. Figure 3 shows the comparison of synthesized images. Since 'Pantomime' sequence is somewhat simple scene, there is few

boundary noise but we can recognize the boundary noise on the bag. The third image shows the noise removed image.

(a) Original Image (b) Synthesized Image without Temporal Consistency (c) Synthesized Image with Temporal Consistency

Fig. 2. Comparison of Synthesize images on Temporal Consistency

(a) Original Image (b) Synthesized Image without Boundary Noise Removal (v) Synthesized Image with Boundary Noise Removal

Fig. 3. Comparison of Synthesize images on Boundary Noise Removal

2.2. Results on 'ViSBD 2.1'

Thomson has released 'ViSBD 2.1' on January 8, 2009. There are seven parameters. Similar with depth estimation, we found the optimal parameter set by checking the quality of synthesized images. As Thomson recommended the default parameter set in 'Config2.txt', we used default option and changed only one parameter. For example, in order to find the best 'SplattingOption' parameter, we changed the value from 0 to 2 with default values for other options. We found an optimal parameter set for 'Pantomime' sequence as represented in Table 3.

Table 3. Parameter set for view synthesis tool 'ViSBD 2.1'

SubPel Option	Splatting Option	Boundary Growth	Merging Option	Depth Threshold	Hole Count Threshold	UpsampleRefs
4	1	50	0	100	30	4

Table 4 describes PSNR values for the synthesized images. The average PSNR values are over 35 dB. It is better result than that of 'VSRS'.

Table 4. Average PSNR values on synthesized images using 'ViSBD 2.1'

Input Depth Map	Synthesized Image without Temporal Enhancement		Synthesized Image with Temporal Enhancement	
Viewpoint	View 39	View 40	View 39	View 40
PSNR (dB)	34.0868	35.9675	34.0415	36.0266
Average PSNR (dB)	35.027		35.034	

3. Conclusion

We have reported the results of view synthesis as a response of EE2. In this experiment, we used the input depth map generated by EE1 and synthesized the intermediated viewpoint images using two different type of software. Since GIST have distributed the updated 'VSRS', we have checked the results as well. In conclusion, the 'Boundary Noise Removal' algorithm removes some noises on the bag in 'Pantomime' sequence although the PSNR value is somewhat decreased. Comparing two types of software, 'ViSBD 2.1' generated better quality of images than 'VSRS'. However, the complexity of 'VSRS' is simpler than 'ViSBD 2.1'. All result files will be displayed at the viewing site in Lausanne metting.

4. Acknowledgements

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5. References

[1] ISO/IEC JTC1/SC29/WG11 "Description of Exploration Experiments in 3D Video Coding," N10173, October 2008.