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Title: EE1: Depth Estimation Results on 'Pantomime' Sequence
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1. Introduction

This document reports experimental results of the depth estimation software on 'Pantomime' sequence as a response to EE1 in 3D Video Coding group [1]. We conducted the experiments with DERS distributed on January 8, 2009. As experts had agreed that the 'sub-pel precision' algorithm showed good performance, we generated the depth maps using 'quarter-pel' precision. In addition, we compared with effect of the temporal consistency algorithm [2] provided by GIST. The detail description of experiments will be described in the following chapter.

2. Depth Estimation Parameters

We have volunteered to report results of EE1, depth estimation on 'Pantomime' sequence, at Busan meeting. We used 'DERS' distributed by Nagoya University and 'VSRS_GIST_updated' distributed by GIST. We found an optimum parameter set by checking the best quality of synthesized image in order of 'precision', 'smoothing coefficient', 'filter', and 'matching method' as described in Fig. 1. After determining the optimal set, we conducted experiments of depth estimation on 'temporal enhancement'. Detail parameter values are represented in Table 1.

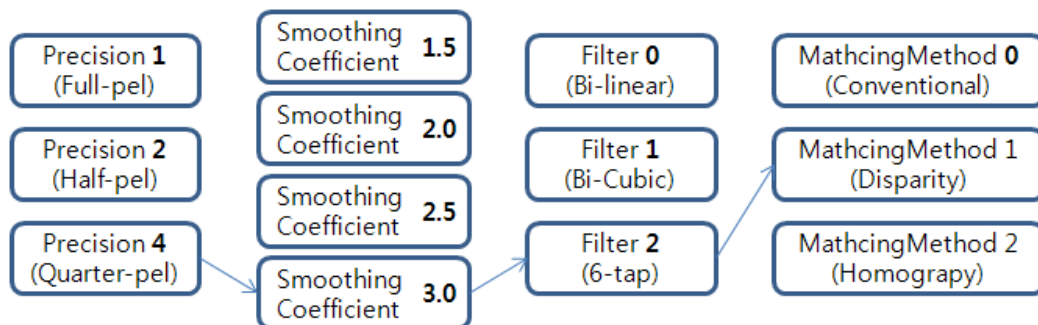


Fig. 1. Finding a best parameter set

Table. 1. Parameters of depth estimation

Target View	38		41	
Reference Views	Left Ref.	Right Ref.	Left Ref.	Right Ref.
	37	39	40	42
Disparity Range	0 ~ 32			
Search Range	0 ~ 32			
Smoothing Coefficient	3.0			
Depth Type	1 (Depth from the origin of 3D space)			
Baseline Basis	1 (maximum baseline)			
Precision	4 (Quater-pel)			
Search Level	4 (Quater-pel)			
Filter	2 (MPEG-4 AVC 6-tap)			
Matching Method	1 (Disparity-based)			
Temporal Enhancement	0/1 (off/on)			
	Threshold		1.00	

3. Results of Depth Estimation

In order to evaluate performance of the depth estimation software, we conducted experiments of view synthesis using depth maps generated by ‘VSRS’. General configuration of views is illustrated in Fig. 2. As described in the document “Description of Exploration Experiments in 3D Video Coding” [1], we calculated PSNR values for quality assessment between the original image and the synthesized image. One target view OL (original left) can be synthesized by using two reference views, NL (neighbor left) and NR (neighbor right). Each neighboring view has two types of data; reference color video and generated depth video.

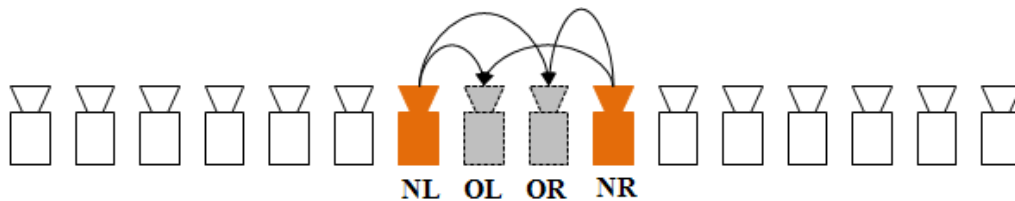


Fig. 2. Configuration of View Synthesis

The average PSNR values are above 33 dB for all views as represented in Table 2. We may accept this result as ‘DERS’ performs well on ‘Pantomime’ sequence. In addition, we can see that the PSNR values are very similar. It is that the temporal enhancement tool does not reduce the PSNR quality in view synthesis.

Table. 2. Average PSNR (dB) values for the results

Without Temporal Enhancement		With Temporal Enhancement	
View 39	View 40	View 39	View 40
35.431	33.257	35.415	33.215

Unit: dB

Since the purpose of temporal enhancement is to reduce flickering effects on background, we checked the variation of texture on background in synthesized images. As shown in Fig. 3, flickering effects are reduced on background. The shape of bag maintains well.



Fig. 3. Comparison of Synthesized Images on Temporal Enhancement

4. Conclusion

We have explained the results of depth estimation. We conducted experiments of depth estimation using Nagoya’s ‘DERS’ as well as the temporal enhancement. The average PSNR values on synthesized image are above 33 dB. ‘Temporal Enhancement’ maintains the shape of objects in background. In conclusion, we may accept ‘Pantomime’ sequence as a reference.

5. Acknowledgements

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6. References

- [1] ISO/IEC JTC1/SC29/WG11 “Description of Exploration Experiments in 3D Video Coding,” N10173, October 2008.
- [2] ISO/IEC JTC1/SC29/WG11 “Experimental Results on Improved Temporal Consistency Enhancement,” m16063, February 2009.

Appendix A

Followings are the configuration file for depth estimation.

DepthEstimation_pantomime_38.cfg

```
#===== INPUT PARAMETERS =====
DepthType                      1
SourceWidth                    1280
SourceHeight                   960
StartFrame                    0
TotalNumberOfFrames           500
LeftCameraName                 param_ptm37
CenterCameraName              param_ptm38
RightCameraName                param_ptm39
MinimumValueOfDisparitySearchRange 0
MaximumValueOfDisparitySearchRange 32
MinimumValueOfDisparityRange   0
MaximumValueOfDisparityRange   32
SmoothingCoefficient           3.0
FileLeftViewImage             ptm_37.yuv
FileCenterViewImage           ptm_38.yuv
FileRightViewImage            ptm_39.yuv
FileOutputDepthMapImage       ptm_d_38.yuv
FileCameraParameter           cam_param_pantomime.txt

BaselineBasis                  1
Precision                      4
SearchLevel                    4
Filter                         2
MatchingMethod                 1

TemporalEnhancement            1
Threshold                      1.00
```

DepthEstimation_pantomime_41.cfg

```
#===== INPUT PARAMETERS =====
DepthType                      1
SourceWidth                    1280
SourceHeight                   960
StartFrame                    0
TotalNumberOfFrames           500
LeftCameraName                 param_ptm40
CenterCameraName              param_ptm41
RightCameraName                param_ptm42
MinimumValueOfDisparitySearchRange 0
MaximumValueOfDisparitySearchRange 32
MinimumValueOfDisparityRange   0
MaximumValueOfDisparityRange   32
SmoothingCoefficient           3.0
FileLeftViewImage             ptm_40.yuv
FileCenterViewImage           ptm_41.yuv
FileRightViewImage            ptm_42.yuv
FileOutputDepthMapImage       ptm_d_41.yuv
```

FileCameraParameter	cam_param_pantomime.txt
BaselineBasis	1
Precision	4
SearchLevel	4
Filter	2
MatchingMethod	1
TemporalEnhancement	1
Threshold	1.00