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Source	**Sungkyunkwan University (SKKU)**
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Title	**[MPEG-I Visual] Report on Dense Light Field Compression in VVC**
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1 Introduction

This document aims to show the results of exploration experiments (EE) in VVC for three Plenoptic 2.0 test sequences: NagoyaOrigami, NagoyaFujita, NagoyaDataLeading. This document provides results of VVC and Class-F configuration for lenslet video (EE_LL).

Based on [1], where it was shown that screen content coding tools improved the performance of Dense Light Field compression, this document provides the results of EE_LL is compressed by VVC and class-F configuration of VVC for three test sequences, respectively. Motivated by lenslet video contains a substantial number of repetitive patterns, EE has been conducted with SCC and intra block copy.

Class-F configuration enables three coding tools for SCC, (1) intra block copy (IBC), (2) hash-based motion estimation (HashME), (3) block-based delta pulse code modulation (BDPCM). The main purpose of class-F configuration is to explore the use of the IBC. Also, this document provides CU mode selection ratio that indicate impact of IBC in lenslet video compression. The results clearly indicate that the use of the Class-F configuration improve coding performance in VVC.

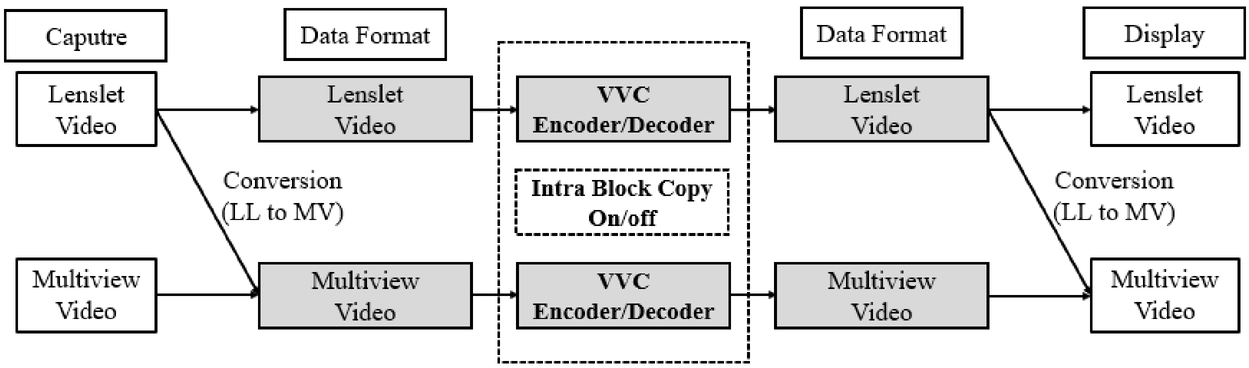


Fig. 1. The flowchart of EE

2 Experimental Results

Table 1 shows experimental conditions on three test sequences. Especially, QPs of EE_LL are derived from [2]. We performed experiments only for RA condition. For the experiment, 30 frames are tested using default configuration files included in the reference software. The reference software version is VTM9.3 and HM-16.9+SCM-8.0.

Table 1. Experimental Conditions

Frame count	30
QPs	[36, 40, 45, 49]
Reference software version	VTM-9.3 / HM-16.9+SCM8.0
Configuration	RA (random access)

Table 2. Y-PSNR BD-rate (HEVC v.s.VVC)

HEVC v.s. VVC	
Sequence name	BD-rate (%)
NagoyaDataLeading	-40.38%
NagoyaFujita	-34.06%
NagoyaOrigami	-25.98%
Average	**-33.47%**

Table 3. Y-PSNR BD-rate (VVC v.s. VVC+class-F)

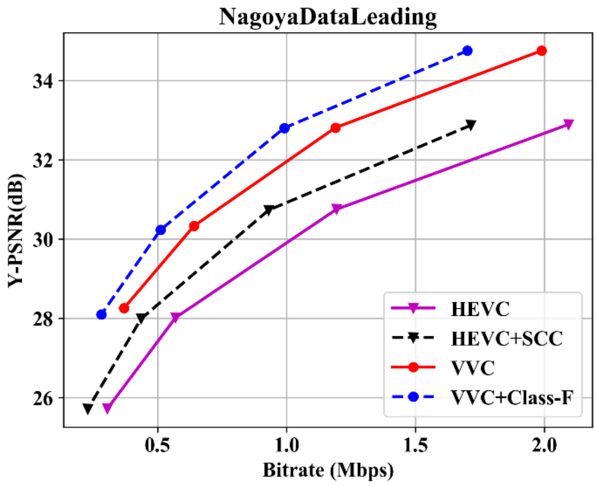
VVC v.s. VVC+class-F	
Sequence name	BD-rate (%)
NagoyaDataLeading	-17.30%
NagoyaFujita	-2.73%
NagoyaOrigami	-2.72%

Table 4. Y-PSNR BD-rate (HEVC+SCC v.s. VVC+class-F)

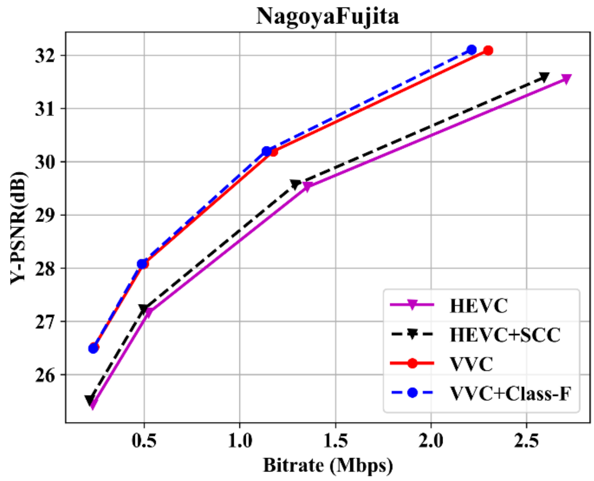
HEVC+SCC v.s. VVC+class-F	
Sequence name	BD-rate (%)
NagoyaDataLeading	-37.95%
NagoyaFujita	-31.30%
NagoyaOrigami	-24.62%
Average	**-31.29%**

When testing under EE_LL RA configuration, VVC achieves luma BD-rate gain by an average of 33.47% relative to HEVC as shown in Table 2. Table 3 shows VVC+class-F can achieve a maximum of 17.30% luma BD-rate gain relative to VVC. As a result of experiment, VVC+class-F outperforms VVC for the three sequences in EE_LL. Especially, 'NagoyaDataLeading' sequence shows highest BD-rate gain in VVC+class-F over VVC.

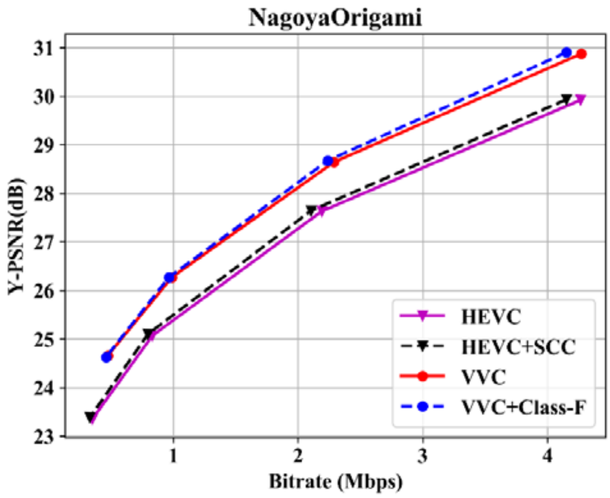
In the [1], 'NagoyaDataLeading' sequence already shows highest gain for HEVC+SCC over HEVC. Also, Table 4 shows VVC+class-F outperforms HEVC+SCC by an average of 31.29%.



(a)



(b)



(c)

Fig. 2. RD curves of EE_LL results for (a) NagoyaDataLeading, (b) NagoyaFujita, and (c) NagoyaOrigami under random access configuration.

Table 5. CU mode selection ratio in VVC+class-F

Sequence name	Intra mode	IBC mode
NagoyaDataLeading	66.46%	33.54%
NagoyaFujita	78.97%	21.03%
NagoyaOrigami	83.34%	16.66%

Table 5 shows CU mode selection ratio for VVC+class-F. 'CU mode selection ratio' means the ratio of area to CU size, not the ratio to the number of CU modes selected in each mode. As shown in the table, 'NagoyaDataLeading' sequence shows highest IBC mode selection ratio. This analysis is conducted with QP36 and I-Slice only.

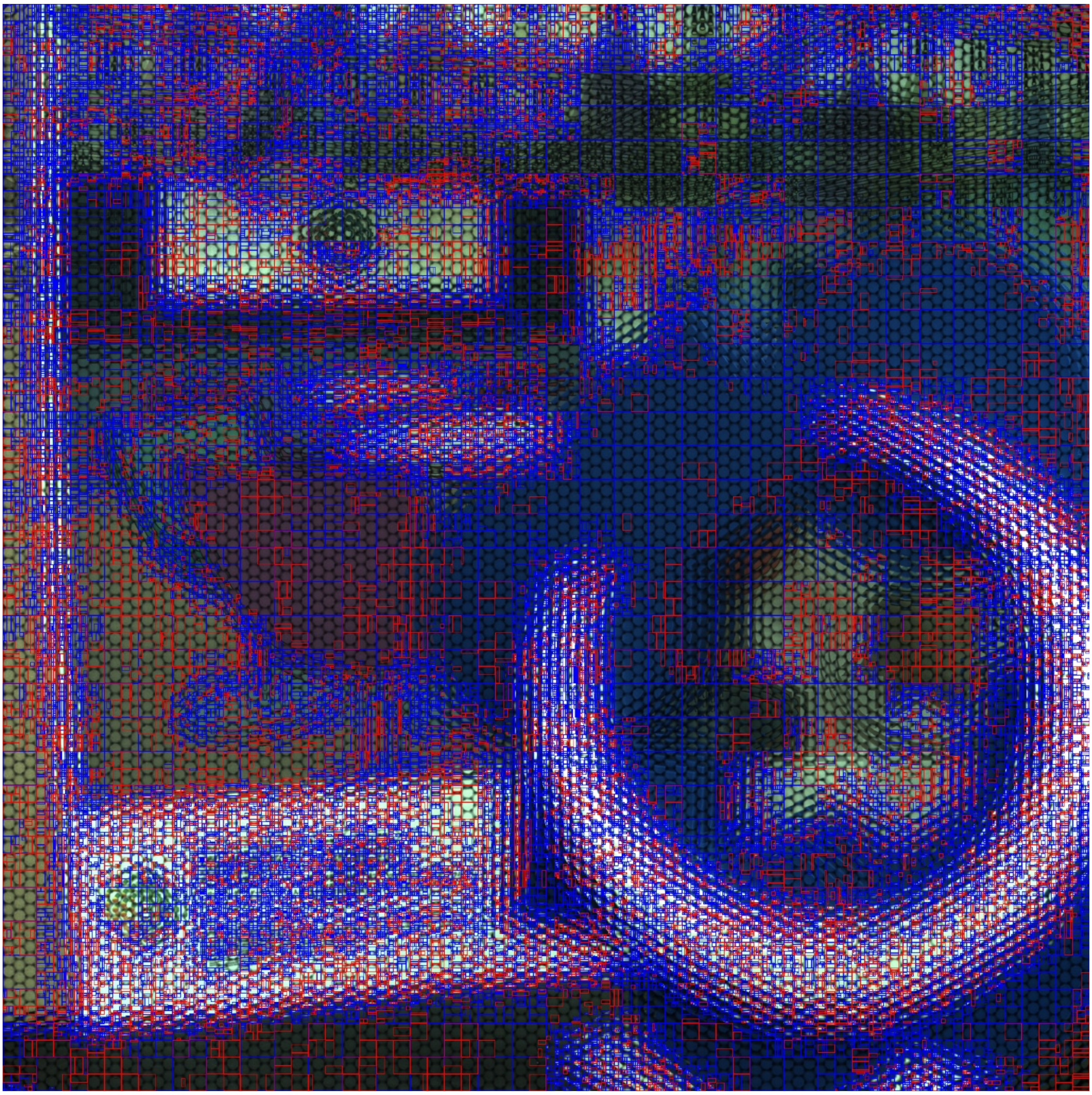


Fig. 3. Visualization of CU mode selection in ‘NagoyaDataLeading’ I-Slice.
Intra mode (blue), IBC mode (red)

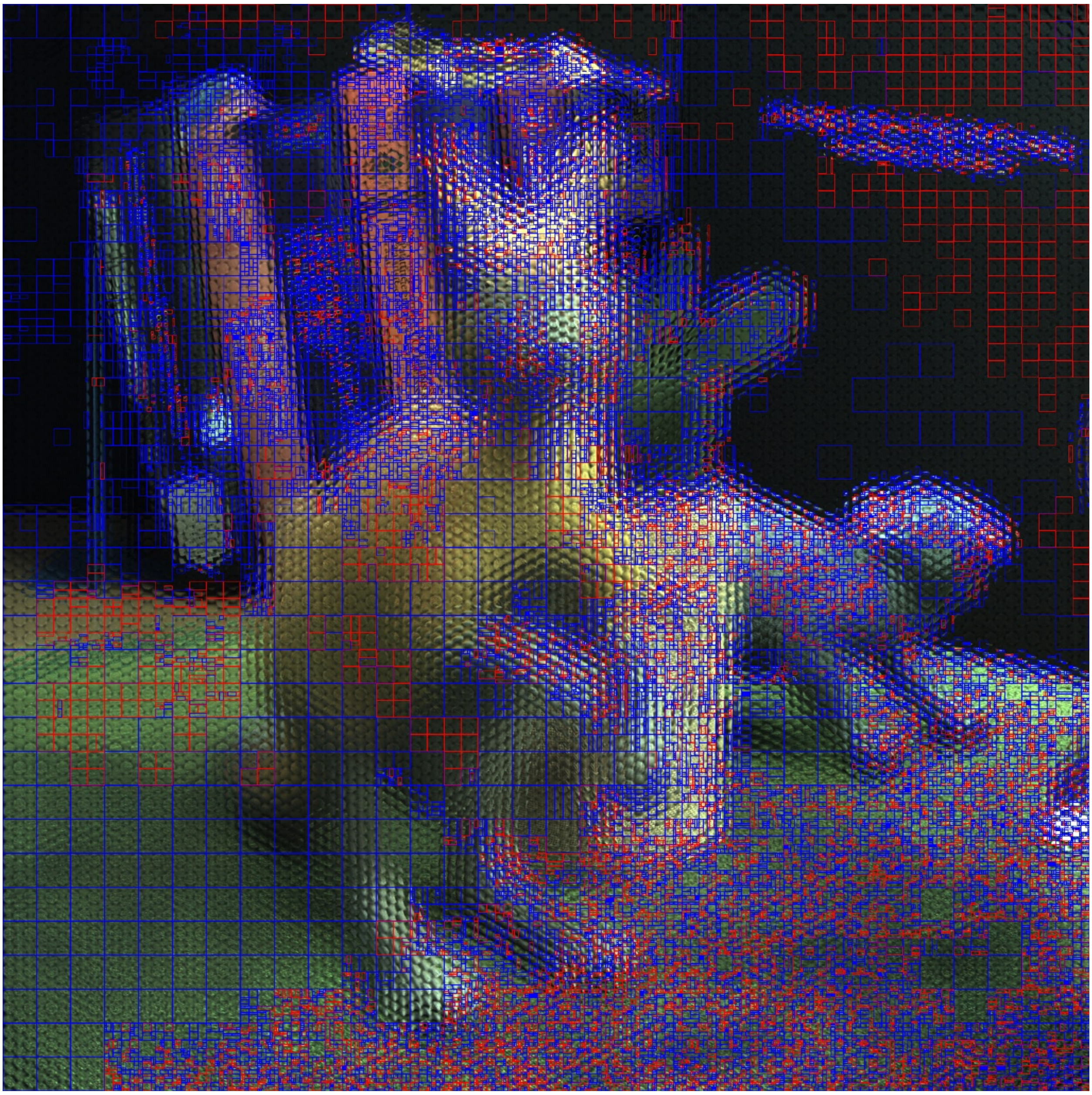


Fig. 4. Visualization of CU mode selection in ‘NagoyaFujita’ I-Slice.
Intra mode (blue), IBC mode (red)

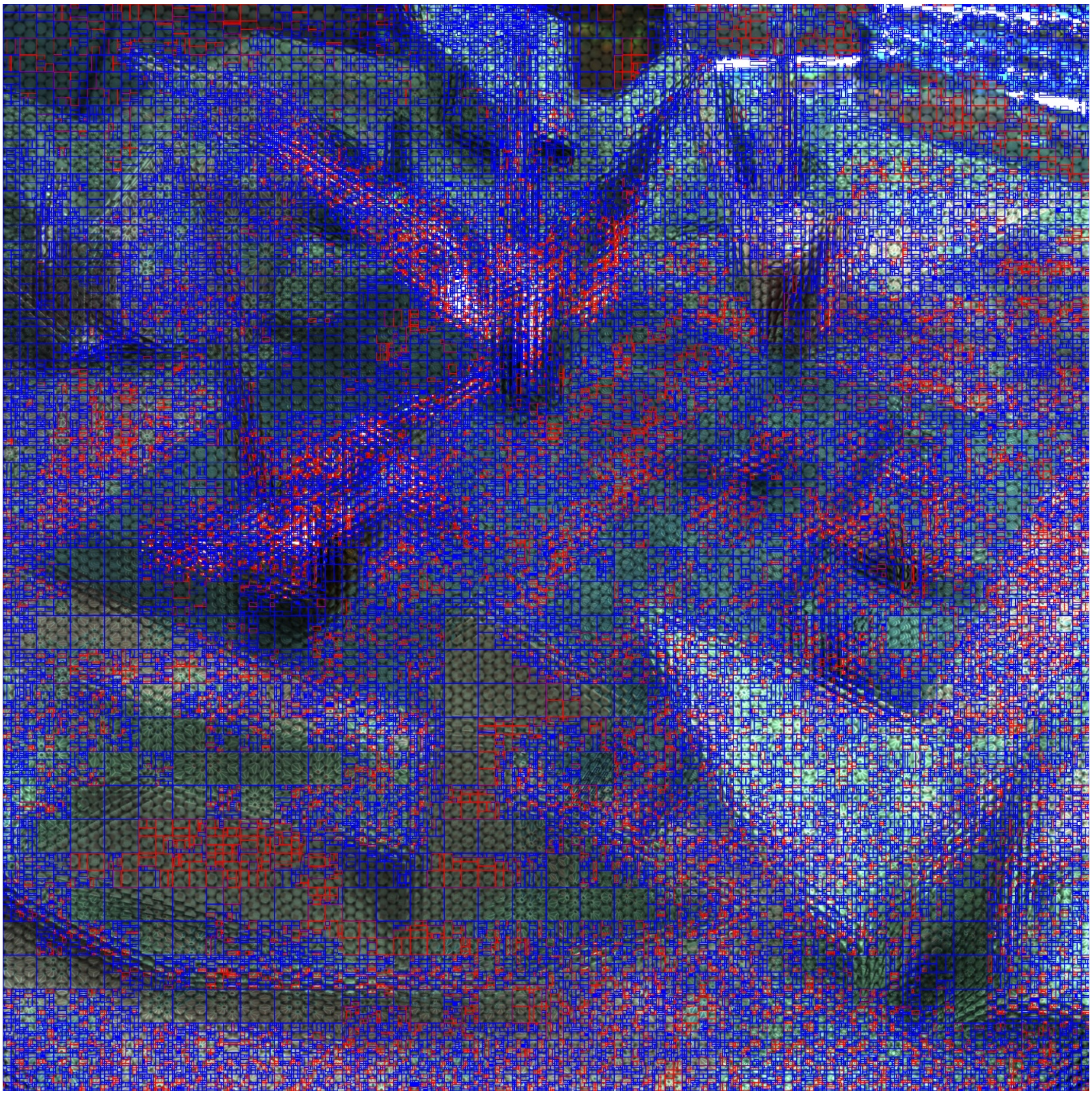


Fig. 5. Visualization of CU mode selection in ‘NagoyaOrigami’ I-Slice.
Intra mode (blue), IBC mode (red)

3 Conclusion

In this document, EE_LL is conducted for sequences NagoyaDataLeading, NagoyaFujita, NagoyaOrigami in VVC and class-F configuration of VVC. The results clearly indicate that the use of the Class-F configuration improve coding performance in VVC. Also, this contribution analysis CU mode selection in three sequences. It is generally confirmed that, ‘NagoyaDataLeading’ sequence has highest IBC mode selection, which also shows highest BD-rate gain to the IBC.

4 References

[1] Gun Bang, Jinho Lee, Jungwon Kang, “EE Results on Dense Light Field Compression”, ISO/IEC JTC1/SC29/WG11 MPEG2020/M54746, Online.

[2] Mehrdad Teratani, Xin Jin, Gauthier Lafruit, Lu Yu, “Exploration Experiments and Common Test Conditions for Dense Light Fields”, ISO/IEC JTC1/SC29/WG11 MPEG2020/N19223, Online.