



MEDIATEK

JVET-00281

CE4-related: Alignment of displacement bitdepths for BDOF and PROF

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Overall Summary

- Proposed to align the displacement bitdepths for BDOF and PROF
 - One mismatch between text and software is fixed
 - The displacement bitdepths for BDOF and PROF are both clipped within **[-32, 31]**
 - The clipping operations applied to the products of gradients and displacements in PROF are removed
- Experimental results
 - On top of PROF proposed in JVET-O0070

Compared to VTM-5.0	Proposed Method (Luma BD-rates)		
	Y	U	V
RA	-0.46%	-0.11%	-0.12%
LB	-0.30%	-0.09%	-0.18%

Mismatch between Text and Software

- The refinement part of BDOF in the VVC draft is derived as follows

$$\text{bdofOffset} = \text{Round}((v_x * (\text{gradHL1}[x+1][y+1] - \text{gradHL0}[x+1][y+1])) \gg 1) \\ + \text{Round}((v_y * (\text{gradVL1}[x+1][y+1] - \text{gradVL0}[x+1][y+1])) \gg 1)$$

- In VTM 5.0, the following equation is used

$$\text{bdofOffset} = ((v_x * (\text{gradHL0}[x+1][y+1] - \text{gradHL1}[x+1][y+1]) \\ + v_y * (\text{gradVL0}[x+1][y+1] - \text{gradVL1}[x+1][y+1]) + 1) \gg 1)$$

- Proposed to change the draft to match the software

Bitdepths Design Mismatch between BDOF and PROF

- BDOF in VTM-5.0:
 - The displacements derived by BDOF are in 1/64-sample precision and are clipped in the range of [-32, 32]
- PROF, proposed as CE4-2.1 in JVET-O0070:
 - The displacements derived by PROF are in 1/64-sample precision and are clipped in the range of [-64, 63]
 - The products of gradients and displacements are **further clipped within [-8192, 8191]** before refining prediction samples.

Proposed Methods

- BDOF in VTM-5.0:
 - The displacements derived by BDOF are in 1/64-sample precision and are clipped in the range of ~~$[-32, 32]$~~ $[-32, 31]$
- PROF, proposed as CE4-2.1 in JVET-O0070:
 - The displacements derived by PROF are in 1/64-sample precision and are clipped in the range of ~~$[-64, 63]$~~ $[-32, 31]$
 - The products of gradients and displacements are **further clipped within** ~~$[-8192, 8191]$~~ before refining prediction samples
- With the proposed changes for PROF, BDOF hardware can be reused for performing PROF

Simulation Results

- Implemented on top of VTM-5.0
 - Simulation results of limiting the BDOF displacement within $[-32, 31]$

Compared to VTM-5.0		Proposed Method		
		Y	U	V
RA	CTC	0.00%	0.00%	-0.02%

- Implemented on top of JVET-00070
 - Simulation results of limiting the BDOF and PROF displacements within $[-32, 31]$

Compared to VTM-5.0		Proposed Method		
		Y	U	V
RA	CTC	-0.46%	-0.11%	-0.12%
LB	CTC	-0.30%	-0.09%	-0.18%

Conclusion

- A mismatch is fixed by changing the text to match the software
- Proposed to align the bitdepths of displacement derived by both BDOF and PROF
- Experimental results
 - Provides nearly no BD-rate change with this modification
- Thank Qualcomm for cross-checking

