

JVET-M0241

***CE9-related: A Simple gradient calculation
at the CU boundary for BDOP***

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Introduction

❑ VTM-3.0 BDOF

- ❖ Use **bi-linear filters** to generate additional samples in the extended region around the current CU

❑ CE9.1.1.c

- ❖ Only **use the prediction samples that are inside the current CU** for the BDOF derivation
→ **avoid the interpolation of the extended samples**
- ❖ apply **different gradient calculation method** for prediction samples on the CU boundaries and inside CU

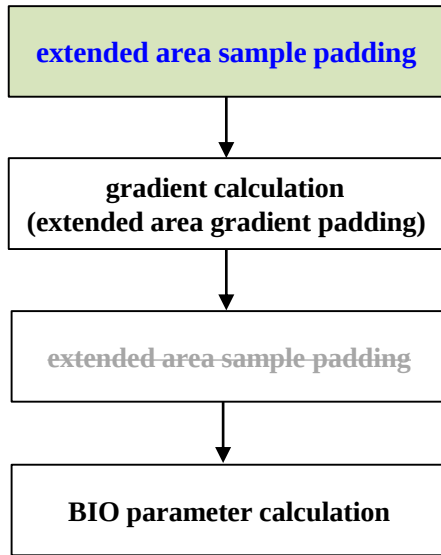
❑ Proposal

- ❖ Only **use the prediction samples that are inside the current CU** for the BDOF derivation
→ avoid the interpolation of the extended samples
- ❖ **CU boundary samples are copied into the extended region** to generate prediction samples in the extended regions
- ❖ Apply **an identical gradient filter, [-1, 0, 1]**, for prediction samples on the CU boundaries and inside CU

Proposed Method

❑ Proposed Method

- ❖ Before the gradient calculation, **the extended area's samples are padded with the samples on CU boundaries**



$$\frac{\partial I^{(k)}}{\partial x}(i, j) = \begin{cases} \left(I^{(k)}(i+1, j) - I^{(k)}(i-1, j) \right) \gg 4 & 0 < i < W-1 \\ \left(I^{(k)}(i+1, j) - \mathbf{I^{(k)}(i, j)} \right) \gg 4 & i = 0 \\ \left(\mathbf{I^{(k)}(i, j)} - I^{(k)}(i-1, j) \right) \gg 4 & i = W-1 \end{cases}$$

$$\frac{\partial I^{(k)}}{\partial y}(i, j) = \begin{cases} \left(I^{(k)}(i, j+1) - I^{(k)}(i, j-1) \right) \gg 4 & 0 < j < H-1 \\ \left(I^{(k)}(i, j+1) - \mathbf{I^{(k)}(i, j)} \right) \gg 4 & j = 0 \\ \left(\mathbf{I^{(k)}(i, j)} - I^{(k)}(i, j-1) \right) \gg 4 & j = H-1 \end{cases}$$

BDOF refinement process for the current CU
(proposed method S/W)

- ❖ **No additional operations** are required for extended area's prediction samples
- ❖ Sample padding process is already included in BDOF to derive BIO parameter
- ❖ **MC interpolation process need not to be changed** to generate prediction samples in the extended region.

Experimental Results

❑ Anchor: VTM-3.0

	Random access Main10				
	Over VTM-3.0			EncT	DecT
	Y	U	V		
Class A1	0.06%	-0.04%	-0.03%	99%	99%
Class A2	0.12%	0.01%	0.00%	99%	98%
Class B	0.10%	0.03%	-0.04%	99%	98%
Class C	0.15%	0.01%	0.06%	99%	98%
Class E					
Overall	0.11%	0.01%	-0.01%	99%	98%
Class D	0.26%	-0.02%	0.12%	98%	97%
Class F	0.03%	0.00%	-0.02%	99%	99%

❑ Anchor: CE9.1.1c

	Random access Main10				
	Over CE9.1.1c			EncT	DecT
	Y	U	V		
Class A1	0.04%	-0.03%	-0.04%	100%	100%
Class A2	0.06%	0.02%	-0.01%	100%	100%
Class B	0.00%	0.02%	0.00%	100%	100%
Class C	-0.04%	-0.08%	-0.04%	100%	100%
Class E					
Overall	0.01%	-0.02%	-0.02%	100%	100%
Class D	-0.13%	-0.17%	-0.06%	100%	99%
Class F	0.00%	0.03%	-0.01%	100%	101%

Conclusion

- ❑ **We propose a simple gradient derivation method at CU boundaries** to avoid the interpolation of the extended samples
 - ❖ **CU boundary samples are padded to extended region** for generating prediction samples of extended region
 - ❖ **An identical gradient derivation** is applied to the samples on CU boundary and inside CU

$$\frac{\partial I^{(k)}}{\partial x}(i, j) = \left(I^{(k)}(i + 1, j) - I^{(k)}(i - 1, j) \right) \gg 4$$

$$\frac{\partial I^{(k)}}{\partial y}(i, j) = \left(I^{(k)}(i, j + 1) - I^{(k)}(i, j - 1) \right) \gg 4$$

- ❖ **MC interpolation process need not to be changed** to generate prediction samples in the extended region.
- ❑ **Suggest to study in CE**
- ❑ **Thanks to Sharp for cross-checking**