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# Non-SCE3.3: Modified Interlayer SAO with highpass processing

Shih-Ta Hsiang, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei

Presented by Yu-Wen Huang
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# Overall Summary

- **Objective**
  Simplify the inter-layer SAO in SCE 3.3 for lowering complexity

- **Proposed Method**
  Use the new sample classification method with highpass processing only for the horizontal and vertical classes

- **Average overall BD rate savings**
  **Y: 0.6 %, U: 0.6%, V: 0.6%**

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# SCE3.3: Sample classification by highpass filtering (JCTVC-N0140)

- Category index determined by

$$cat\_idx = sign(((2*c-c_{-1}-c_1+2)>>2) - ((2*c_1-c-c_2+2)>>2)) +$$
$$sign(((2*c-c_{-1}-c_1+2)>>2) - ((2*c_{-1}-c_{-2}-c+2)>>2)) + 2$$

- Processed by highpass filter [-1, 2, -1]/4 for sample classification

- Four neighboring pixels employed for sample classification

- SAO parameters coded by CABAC at the beginning of slice segment data
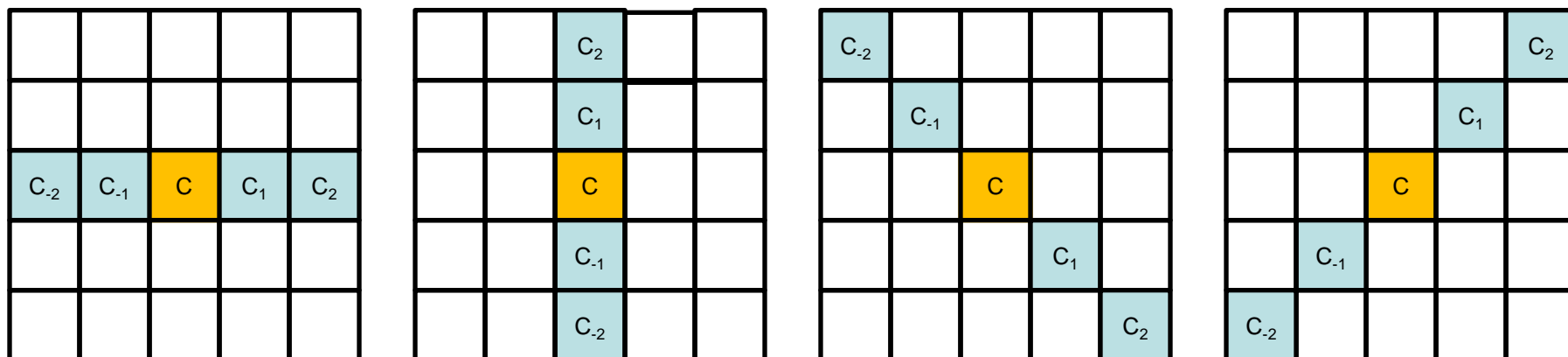
# Proposed Method

- Use highpass processing for sample classification only for the horizontal and vertical classes

- Re-use the existing base-layer SAO module for processing the two diagonal EO classes

- Use VLC for coding SAO parameters in the slice segment header

- Benefits: saving additional memory access and processing for highpass filtering when the two diagonal EO classes are selected.

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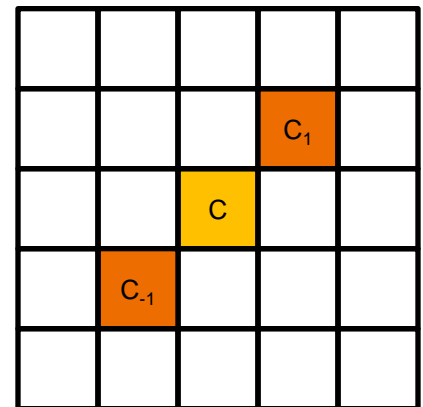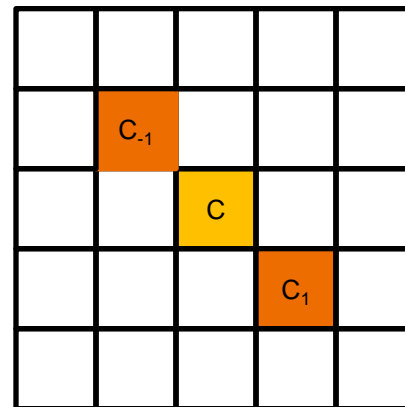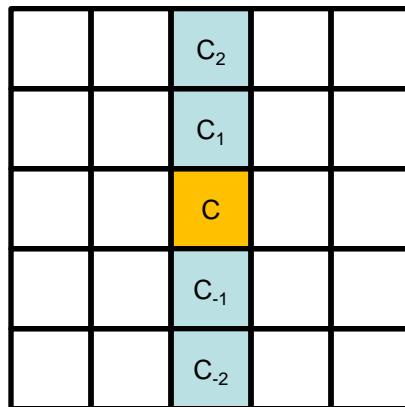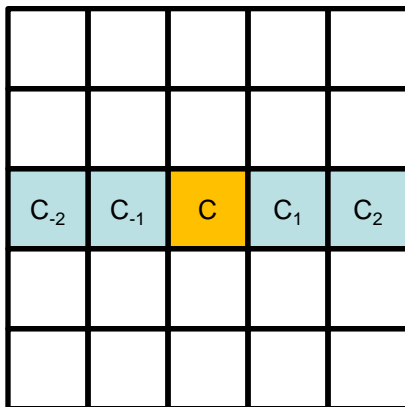
# BD Rate Results versus SHM-2.0

| | AI HEVC 2x | | | AI HEVC 1.5x | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Y | U | V | Y | U | V | | | |
| Class A | -1.0% | -1.4% | -1.5% | | | | | | |
| Class B | -0.2% | -0.4% | -0.4% | -0.2% | -0.4% | -0.4% | | | |
| **Overall (Test vs Ref)** | -0.4% | -0.7% | -0.7% | -0.2% | -0.4% | -0.4% | | | |
| Enc Time[%] | | 101.2% | | | 101.1% | | | | |
| Dec Time[%] | | 105.2% | | | 105.1% | | | | |
| | RA HEVC 2x | | | RA HEVC 1.5x | | | RA HEVC SNR | | |
| | Y | U | V | Y | U | V | Y | U | V |
| Class A | -1.1% | -0.8% | -1.2% | | | | -2.3% | -1.6% | -2.0% |
| Class B | -0.3% | -0.4% | -0.4% | -0.2% | -0.4% | -0.4% | -0.9% | -0.8% | -0.6% |
| **Overall (Test vs Ref)** | -0.5% | -0.5% | -0.6% | -0.2% | -0.4% | -0.4% | -1.3% | -1.0% | -1.0% |
| Enc Time[%] | | 99.9% | | | 99.7% | | | 99.8% | |
| Dec Time[%] | | 106.2% | | | 103.4% | | | 110.0% | |
| | LD-B HEVC 2x | | | LD-B HEVC 1.5x | | | LD-B HEVC SNR | | |
| | Y | U | V | Y | U | V | Y | U | V |
| Class A | -1.0% | -0.9% | -1.3% | | | | -2.0% | -1.6% | -2.1% |
| Class B | -0.4% | -0.7% | -0.6% | -0.3% | -0.8% | -1.0% | -0.8% | -1.1% | -1.1% |
| **Overall (Test vs Ref)** | -0.5% | -0.8% | -0.8% | -0.3% | -0.8% | -1.0% | -1.1% | -1.2% | -1.4% |
| Enc Time[%] | | 99.8% | | | 100.3% | | | 100.6% | |
| Dec Time[%] | | 110.2% | | | 108.2% | | | 111.3% | |

\* Thank Samsung for the cross check (JCTVC-N0307)

# BD Rate Comparison with SCE3.3 (JCTVC-N0140)

| | SCE3.3 (N0140) | | | Proposal | | |
|---|---|---|---|---|---|---|
| | Y | U | V | Y | U | V |
| AI HEVC 2x | -0.4% | -0.6% | -0.6% | -0.4% | -0.4% | -0.4% |
| AI HEVC 1.5x | -0.2% | -0.4% | -0.5% | -0.2% | -0.2% | -0.2% |
| RA HEVC 2x | -0.5% | -0.3% | -0.4% | -0.5% | -0.5% | -0.5% |
| RA HEVC 1.5x | -0.3% | -0.4% | -0.3% | -0.2% | -0.2% | -0.2% |
| RA HEVC SNR | -1.4% | -1.1% | -1.0% | -1.3% | -1.3% | -1.3% |
| LD-B HEVC 2x | -0.5% | -0.3% | -0.3% | -0.5% | -0.5% | -0.5% |
| LD-B HEVC 1.5x | -0.4% | -0.4% | -0.4% | -0.3% | -0.3% | -0.3% |
| LD-B HEVC SNR | -1.2% | -1.1% | -1.1% | -1.1% | -1.1% | -1.1% |
| **Average** | **-0.6%** | **-0.6%** | **-0.6%** | **-0.6%** | **-0.6%** | **-0.6%** |

\* Thank Samsung for the cross check (JCTVC-N0307)

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# Conclusion

- Proposed to simplify the inter-layer SAO in SCE 3.3 (JCTVC-N0140) for reduced complexity

- Overall average YUV BD rate improvements

| EL+BL | AI 2x | AI 1.5X | RA 2x | RA 1.5x | RA SNR | LD-B 2x | LD-B 1.5x | LD-B SNR |
|---|---|---|---|---|---|---|---|---|
| Class A | -1.1% | | -1.0% | | -2.2% | -1.0% | | -2.0% |
| Class B | -0.2% | -0.2% | -0.3% | -0.3% | -0.9% | -0.4% | -0.4% | -0.9% |
| **Overall (Test vs Ref)** | -0.5% | -0.2% | -0.5% | -0.3% | -1.3% | -0.6% | -0.4% | -1.2% |
| **Overall (Test vs single layer)** | 12.7% | 10.2% | 20.9% | 18.2% | 15.9% | 29.5% | 26.0% | 24.9% |
| **EL only (Test vs Ref)** | -0.9% | -0.1% | -0.9% | -0.3% | -2.0% | -1.0% | -0.3% | -1.7% |

- No performance loss compared with the inter-layer SAO in SCE 3.3

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