AHG8: Coding the prediction differences of the intra BC vectors

Shih-Ta Hsiang, Tzu-Der (Peter) Chuang, Shawmin Lei

Presented by Tzu-Der (Peter) Chuang
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Overall Summary

- **Problem**

  MVD tool is not effective for coding the block vector difference (BVD) in the Intra BC mode
- **Proposals**
  - Modified entropy coding by re-using the MVD binarization but improving the context modeling scheme
  - Modified BVD value range
- **Average luma BD-rate savings**
  - 1.9%, 1.4%, and 1.6% for AI-MT, RA-MT, LB-MT, respectively, under the AHG 8 CTCs

Introduction

- REXt-6.0 reuses the HEVC MVD syntax set for coding Intra BC block vector (BVD) difference
- HEVC MVD coding method:
  - Binarization: TU + Exp-Golomb (EG1)
  - Two fixed contexts for TU binIdx0 and binIdx1, shared between x/y components
  - Bypass coding for remaining EG1 bins & sign flags

Proposed Method

- Represent the absolute value of each BVD component by its most significant bit (MSB) index & its refinement
- Binarization
  - A concatenation of a prefix bin string and a suffix bin string
  - The prefix string represents the MSB index plus one, or **msb_plus_one,** of symbol *x* with

$$\text{msb\_plus\_one} = \begin{cases} \text{Floor}\,(\,\text{Log2}(\,x\,)\,) + 1, & \text{if } x > 0; \\ 0, & \text{otherwise.} \end{cases}$$

  - Prefix part representing msb_plus_one in a unary code
  - Suffix part representing refinement bins in a fixed-length binary code

Comparison of Binarization Schemes

- The binarization is the same as HEVC MVD coding, but classified into prefix part (msb_plus_one) and suffix part (refinement_bins)

<table>
<tr><th></th><th colspan="2">Proposed Method</th><th colspan="3">HEVC mvd_coidng()</th></tr>
<tr><th>| d |</th><th>msb_plus_one</th><th>refinement bins</th><th>TU prefix</th><th>EG1 prefix</th><th>EG suffix</th></tr>
<tr><td>0</td><td>0</td><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>10</td><td>-</td><td>10</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>110</td><td>0</td><td>11</td><td>0</td><td>0</td></tr>
<tr><td>3</td><td>110</td><td>1</td><td>11</td><td>0</td><td>1</td></tr>
<tr><td>4</td><td>1110</td><td>00</td><td>11</td><td>10</td><td>00</td></tr>
<tr><td>5</td><td>1110</td><td>01</td><td>11</td><td>10</td><td>01</td></tr>
<tr><td>6</td><td>1110</td><td>10</td><td>11</td><td>10</td><td>10</td></tr>
<tr><td>7</td><td>1110</td><td>11</td><td>11</td><td>10</td><td>11</td></tr>
</table>

Entropy Coding

- Prefix bin string is mostly coded in the CABAC mode
  - Each prefix bin is assigned a single context
  - Separate context sets for the two vector components
  - Use of the bypass mode for bin index > 7 and 6 for horizontal and vertical components, respectively
  - 15 total contexts (8 for horizontal and 7 for vertical components)
- Refinement bins and sign flags are coded in the bypass mode

Experimental Results

- Anchor: HM-13.0+RExt-6.0
- Condition: AHG8 CTC
- 1.9%, 1.4%, and 1.6% for SC YUV444 AI-MT, RA-MT, LB-MT, respectively, under the AHG 8 CTCs

BD-rate Y	AI-MT	AI-HT	AI-SHT	RA-MT	RA-HT	LB-MT	LB-HT
Class F	-0.9%	-0.7%	-0.5%	-0.6%	-0.5%	-0.5%	-0.3%
Class B	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
SC RGB 444	-1.6%	-1.2%	-1.0%	-1.4%	-1.2%	-1.2%	-0.9%
Animation RGB 444	0.0%	0.0%	0.0%	-0.1%	0.0%	-0.1%	0.0%
SC YUV 444	-1.9%	-1.5%	-1.2%	-1.4%	-1.2%	-1.6%	-1.3%
Animation YUV 444	-0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC(444) GBR Optional	-1.7%	-1.6%	-1.5%	-1.7%	-1.5%	-2.4%	-2.1%
SC(444) YUV Optional	-2.3%	-2.0%	-1.8%	-2.1%	-2.0%	-2.3%	-2.2%

Proposed BVD value range

- The value of BVD component is in the range of [-128, 128], inclusive, in RExt Draft 6
  - Not enforced by the HM-13.0+RExt-6.0 software

- Proposed value range
  - [-127, 127] for each component
  - Store each BVD component in one byte
  - Reduce the largest number of the coded bins by 1

Conclusion

- Proposal 1: Improved method for entropy coding the intra BC BVD
- Proposal 2: Modified BVD component value range [-127, 127]
- Recommendation
  - Proposal 1: adoption into HEVC Draft or further study in CE
  - Proposal 2: adoption into HEVC Draft