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| *Title:* | **CE 6.h: Results on Simplified Inter Mode Coding of Depth** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution reports result of JCT3V-D0069 which proposes simplified inter mode coding of depth. Instead of coding residual for all pixels in a CU (coding unit), only one residual value is encoded for each PU (prediction unit) of the CU. Proposed method is only applied to non-skip inter modes since skip mode already encodes only one residual value for the entire coding unit. To indicate whether proposed method is employed, one flag is coded for each inter-coded depth CU excluding skipped depth CU.

It is reported that there is -0.71% coding gain on synthesized view.

# Proposed Method

Enlightened by SDC (simplified depth coding) in 3D-HEVC [1], this contribution proposes simplified inter mode coding for depth, in which an alternative approach for coding residual signal is proposed. The basic idea is to encode only one residual for each PU of inter-coded depth CU (excluding skipped depth CU). For each PU, the difference between average value of original signal and average value of prediction signal is used as the residual for all pixels in the PU, and is signalled to the decoder.

Encoder will perform rate distortion optimized selection between approaches in 3D-HEVC and proposed approach when encoding residual signal for inter-coded depth CU (excluding skipped depth CU), and one flag will be encoded to indicate which approach is selected.

To avoid possible overlap between proposed method and the skip mode, proposed residual coding method is only applied when residual of any PU in a CU is non-zero. That is to say, after calculating one residual for each PU, encoder will check whether it is non-zero. If the encoder detects one zero residual, it will not choose simplified inter mode coding method.

**1. 1 Further Improvement**

To reduce the rounding error, instead of calculating residual as the difference of average value of original signal and average value of prediction signal, the residual is calculated as the average of difference of original signal and prediction signal.

Meanwhile, because proposed method only compensates DC error between original signal and prediction signal, we propose to use mean-removed SAD (MR-SAD) in motion estimation stage to minimize AC error. MR-SAD is the same as that used in illumination compensation module.

# Results

Proposed method is integrated into HTM 7.0r1 software and compared with it following common test condition [2].

**2.1 Without Further Improvement**

Result is shown in Table 1. As shown in Table 1, there is -0.53% coding gain on synthesized view. From the video PSNR/total bitrate column, it can also be seen that the total bit rate of depth is increased by 0.16%.

Table 1: performance comparison with HTM-6.0 (CTC)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video PSNR / video bitrate | video PSNR / total bitrate | synth PSNR / total bitrate | enc time | dec time |
| Balloons | 0.00% | -0.09% | 0.01% | -0.01% | 0.05% | -0.41% | 109.6% | 117.1% |
| Kendo | 0.00% | 0.09% | -0.07% | 0.01% | 0.25% | -0.46% | 104.5% | 93.8% |
| Newspaper\_CC | 0.00% | -0.12% | -0.08% | -0.03% | 0.26% | -0.16% | 114.3% | 105.7% |
| GT\_Fly | 0.00% | -0.69% | -0.96% | -0.21% | 0.04% | -0.94% | 105.6% | 78.4% |
| Poznan\_Hall2 | 0.00% | -0.29% | -0.05% | -0.08% | 0.30% | -0.92% | 96.9% | 108.8% |
| Poznan\_Street | 0.00% | -0.11% | 0.00% | -0.03% | 0.08% | -0.16% | 101.5% | 114.7% |
| Undo\_Dancer | 0.00% | -0.35% | -0.37% | -0.08% | 0.15% | -0.69% | 104.3% | 91.8% |
| 1024x768 | 0.00% | -0.04% | -0.04% | -0.01% | 0.19% | -0.34% | 109.5% | 105.5% |
| 1920x1088 | 0.00% | -0.36% | -0.34% | -0.10% | 0.14% | -0.68% | 102.1% | 98.4% |
| **average** | **0.00%** | **-0.22%** | **-0.21%** | **-0.06%** | **0.16%** | **-0.53%** | **105.2%** | **101.5%** |

**2.2 With Further Improvement**

Result is shown in Table 2. There is -0.71% coding gain on synthesized view. From the video PSNR/total bitrate column, it can also be seen that the total bit rate of depth is increased by 0.15%.

Table 2: performance comparison with HTM-6.0 (CTC)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video PSNR / video bitrate | video PSNR / total bitrate | synth PSNR / total bitrate | enc time | dec time |
| Balloons | 0.00% | -0.10% | -0.08% | -0.03% | 0.04% | -0.40% | 104.8% | 101.3% |
| Kendo | 0.00% | 0.26% | 0.01% | 0.07% | 0.23% | -0.50% | 105.6% | 97.4% |
| Newspaper\_CC | 0.00% | -0.06% | -0.12% | -0.03% | 0.25% | -0.73% | 105.3% | 102.5% |
| GT\_Fly | 0.00% | -0.98% | -1.06% | -0.25% | 0.06% | -1.10% | 104.1% | 101.6% |
| Poznan\_Hall2 | 0.00% | -0.35% | -0.03% | -0.10% | 0.25% | -1.10% | 102.9% | 101.3% |
| Poznan\_Street | 0.00% | -0.19% | -0.08% | -0.04% | 0.06% | -0.26% | 104.1% | 101.3% |
| Undo\_Dancer | 0.00% | -0.42% | -0.40% | -0.09% | 0.15% | -0.86% | 104.5% | 97.4% |
| 1024x768 | 0.00% | 0.04% | -0.06% | 0.00% | 0.17% | -0.54% | 105.2% | 100.4% |
| 1920x1088 | 0.00% | -0.49% | -0.39% | -0.12% | 0.13% | -0.83% | 103.9% | 100.4% |
| **average** | **0.00%** | **-0.26%** | **-0.25%** | **-0.07%** | **0.15%** | **-0.71%** | **104.5%** | **100.4%** |

# Conclusion

This contribution reports result of inter SDC. As can be seen, -0.71% coding gain can be achieved for synthesized view, and the encoding time and decoding time is not increased much. Therefore, we recommend adopting proposed method into 3D-HEVC.

# Reference

[1] G. Tech, K. Wegner, Y. Chen, S.Yea, “3D-HEVC Test Model 3”, Doc. JCT3V-C1005, Geneva, Swizerland, 17–23 Jan. 2013.

[2] D. Rusanovskyy, K. Müller, A. Vetro, “Common Test Conditions of 3DV Core Experiments”, Doc. JCT3V-D1100, Inchon, KR, 20–26 Apr. 2013.

# Patent rights declaration(s)

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