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| *Title:* | **CE6.h related: Modified Index Assignment of Depth Intra Modes in Simplified Depth Coding** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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| *Source:* | LG Electronics | | |

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# Abstract

This contribution proposes to swap binary index of DC mode and Planar mode in SDC mode. In SDC mode, shortest index is assigned to DC mode while longest index is assigned to Planar mode. However, Planar mode is the most probable mode according to the statistics result. This contribution proposes to assign shortest index to Planar mode in order to reduce the bits spent on index.

It is reported that there is -0.1% overall gain for 3 sequences in CTC. There is no overall coding gain in all intra case, however, proposed method can improve the coding efficiency of depth consistently for all sequences and there is -0.9%, -0.8% and -0.6% coding gain on depth 0, depth 1 and depth 2 respectively.

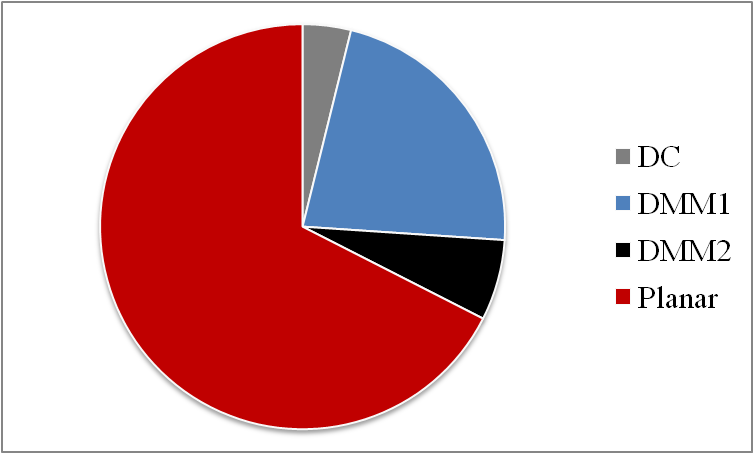
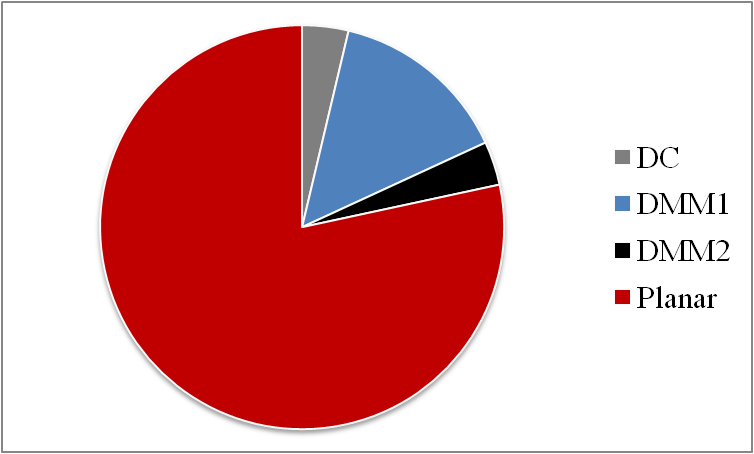
# Background

SDC includes four coding modes: DC, DMM1, DMM2 and Planar. Binary index of these four modes is shown in Table 1 [1]. As can be seen, shortest index is assigned to DC mode and longest index is assigned to Planar mode. This is reasonable when DC mode is the most probable mode and Planar is the least probable mode. However, as shown in the following statistics results, Planar mode is the most probable mode while DC mode is one of the least most probable modes.

**Table 1 – Binary Index of Different Modes**

|  |  |
| --- | --- |
| Associated Intra Prediction Mode | **Binary Index** |
| Intra\_DC | 1 |
| Intra\_DepthPartition( 35 ) | 01 |
| Intra\_DepthPartition( 41 ) | 001 |
| Intra\_Planar | 000 |

Fig.1 shows average probability distribution of the four modes in SDC over all test sequences, both for CTC and all intra case. Software HTM-5.0.1 is used to generate bit stream. As shown in Fig.1, Planar mode is the most probable mode (with probability of more than 60% for CTC and more than 70% for all intra case), DMM1 is the second most probable mode, while DMM2 and DC are the least probable modes and they are with similar probability. Therefore, assigning longest index to Planar mode and shortest index to DC mode is unreasonable.



a) Results from CTC, b) Results from all intra test condition

Fig.1. Probability distribution of four modes in SDC.

# Proposed Method

To tackle the abovementioned problem, this contribution proposes to simply swap the binary index of DC mode and Planar mode, as shown in Table 2.

**Table 2 – Modified Binary Index of Different Modes**

|  |  |
| --- | --- |
| Associated Intra Prediction Mode | **Binary Index** |
| Intra\_ Planar | 1 |
| Intra\_DepthPartition( 35 ) | 01 |
| Intra\_DepthPartition( 41 ) | 001 |
| Intra\_ DC | 000 |

# Results

Proposed method is integrated into HTM 5.0.1 software and compared with it. Simulation results are tested following the configuration and common test condition defined in [2].

Table 3 shows the performance of proposed method in CTC case. As can be seen, there is -0.1% and -0.1% gain on synthesized view and coded and synthesized view on 3 sequences.

Table 3: performance comparison with HTM-5.0.1 (CTC)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video only | synthesized only | coded & synthesized |
| Balloons | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Kendo | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Newspapercc | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% |
| GhostTownFly | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% |
| PoznanHall2 | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% |
| PoznanStreet | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| UndoDancer | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1024x768 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1920x1088 | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% |
| **average** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** |

Table 4 shows the performance of proposed method in all intra case. There is no influence on overall coding performance. However, as can be seen in Table 5, there is performance improvement on depth coding for all sequences, and the average coding gain is -0.9%, -0.8% and -0.6% on depth 0, depth 1 and depth 2 respectively.

Table 4: performance comparison with HTM-5.0.1 (all intra)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video only | synthesized only | coded & synthesized |
| Balloons | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Kendo | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Newspapercc | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| GhostTownFly | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| PoznanHall2 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| PoznanStreet | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| UndoDancer | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1024x768 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1920x1088 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **average** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** |

Table 5: performance comparison of depth coding with HTM-5.0.1 (all intra)

|  |  |  |  |
| --- | --- | --- | --- |
|  | depth 0 | depth 1 | depth 2 |
| Balloons | -0.7% | -1.1% | -1.1% |
| Kendo | -0.7% | -1.0% | -0.3% |
| Newspapercc | -0.9% | -0.3% | -0.4% |
| GhostTownFly | -0.6% | -0.3% | 0.0% |
| PoznanHall2 | -1.9% | -2.0% | -1.3% |
| PoznanStreet | -0.8% | -0.8% | -1.4% |
| UndoDancer | -0.5% | -0.1% | -0.1% |
| **average** | **-0.9%** | **-0.8%** | **-0.6%** |

# Reference

[1] G. Tech, Y. Chen, S. Yea, “3D-HEVC Test Model 2”, Doc. JCT3V-B1005\_d0, Shanghai, China, Oct. 2012.

[2] D. Rusanovskyy, K. Müller, A. Vetro, “Common Test Conditions of 3DV Core Experiments”, Doc. JCT3V-B1100, Shanghai, China, Oct. 2012.

# Patent rights declaration(s)

**LG Electronics / LG Electronics (China) R&D Center may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**

Working Draft:

**sdc\_pred\_mode** shall be one of the values shown in Table G‑3. sdc\_pred\_mode specifies the intra prediction mode used for simplified depth coding.

~~Table G‑3 – Interpretation of sdc\_pred\_mode~~

|  |  |
| --- | --- |
| **~~sdc\_pred\_mode~~** | ~~Associated Intra Prediction Mode~~ |
| ~~0~~ | ~~Intra\_DC~~ |
| ~~1~~ | ~~Intra\_DepthPartition( 35 )~~ |
| ~~2~~ | ~~Intra\_DepthPartition( 41 )~~ |
| ~~3~~ | ~~Intra\_Planar~~ |

Table G‑3 – Interpretation of sdc\_pred\_mode

|  |  |
| --- | --- |
| **sdc\_pred\_mode** | Associated Intra Prediction Mode |
| 0 | Intra\_ Planar |
| 1 | Intra\_DepthPartition( 35 ) |
| 2 | Intra\_DepthPartition( 41 ) |
| 3 | Intra\_ DC |

* If sdc\_flag[ xB ][ yB ] is equal to 1, IntraPredMode[ xB ][ yB ] is derived as follows.
  + If sdc\_pred\_mode[ xB ][ yB ] is equal to 0, IntraPredMode[ xB ][ yB ] is set equal to 0.
  + Otherwise, if sdc\_pred\_mode[ xB ][ yB ] is equal to 1, IntraPredMode[ xB ][ yB ] is set equal to 35.
  + Otherwise, if sdc\_pred\_mode[ xB ][ yB ] is equal to 2, IntraPredMode[ xB ][ yB ] is set equal to 41.
  + Otherwise, if sdc\_pred\_mode [ xB ][ yB ] is equal to 3, IntraPredMode[ xB ][ yB ] is set equal to 1.