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| *Title:* | **Prediction modes and mode coding for large size Intra block** | | | |
| *Status:* | Input Document to JCT-VC | | | |
| *Purpose:* | Proposal | | | |
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# Abstract

This contribution proposes two methods for intra mode coding for large size Intra PU (64x64 and above). In method 1, four prediction modes are used for intra prediction for large size Intra PU without using probable modes (MPMs). The four modes are represented by fixed length code words. By integrating method 1 in HM6.0, experimental results report average 6% encoding complexity reduction with negligible BD-rate variation for All Intra HE10 and average 7% encoding complexity reduction with negligible BD-rate variation for All Intra Main. In method 2, one prediction mode is used for intra prediction for large size Intra PU. As a result, the entropy coding for large size Intra PU prediction mode is skipped. By integrating method 2 in HM6.0, experimental results report average 9% and 10% encoding complexity reduction with very small average BD-rate variation for All Intra HE10 and All Intra Main.

1. Introduction

In HM6, the PU size can be 64x64, 32x32, 16x16, 8x8 and 4x4. For all PUs, 35 prediction modes can be selected. Among the 35 modes, 33 are directional prediction modes as illustrated in Fig.1. In order to achieve better compression efficiency, a most-probable-modes (MPM) based scheme is used to encode the mode syntax. Simply speaking, shorter code words are used to encode the three MPMs and longer fixed length code words are used to encode the remaining mode.

For 64x64 PU, all the 4096 pixels have to follow same prediction mode even though the 64x64 PU has to be divided into at least four 32x32 TUs. With this constraint, there are redundancies to use 35 modes to represent 64x64 intra PU.



Figure 1. Illustration of directional Intra Prediction

# Proposed Methods

## Proposed method 1

In method 1, four candidate modes are selected in the current HEVC for 64x64 Intra PU. The four candidates include PLANAR, DC, Vertical and Horizontal. For all 64x64 Intra PUs, the intra mode is coded by 2-bin fixed length bypass coding. In this method, the MPM coding is skipped. With only four modes, the best mode from HAD is selected to calculate the final R-D cost instead of the best 3 modes in HM6.0

Table 1 – Binarization of the Intra prediction modes for 64x64 Intra PU

|  |  |
| --- | --- |
| **Intra prediction mode** | **Bin String** |
| PLANAR | 00 |
| DC | 01 |
| Horizontal | 10 |
| Vertical | 11 |

## Proposed method 2

In method 2, only one candidate mode can be selected in the current HEVC for 64x64 Intra PU. The one candidate can be PLANAR or DC. With only one candidate, the intra mode is inferred for all 64x64 PUs in the decoder. For the Chroma coding, only DM is used for All Intra Main. Therefore, no entropy coding is needed for the intra mode coding of 64x64 PU for All Intra Main. For All Intra HE10, only DM and LM are used. One bin is used to specify the Chroma intra mode , where 0 is used for DM and 1 is used for LM in current implementation.

# Experimental Results

Simulations were conducted following common test conditions defined in JCTVC-H1100 [1]. Anchor data was generated using HM6.0 software [2].

## Proposed method 1

The results for the proposed method 1 are reported in table 2. Detailed results are in “JCTVC-I0227\_Luma4mode.xlsm”.

Table 2 Results for proposed method 1.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.4% | 0.4% | 0.0% | 0.5% | 0.6% |
| Class B | 0.0% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Class C | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class D | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class E | 0.1% | 0.0% | -0.2% | 0.1% | -0.1% | 0.0% |
| **Overall** | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% |
|  | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% |
| Class F | 0.0% | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% |
| Enc Time[%] | 93% | | | 94% | | |
| Dec Time[%] | 100% | | | 100% | | |

## Proposed method 2

The results for the proposed method 2 are reported in table 3 and 4. Detailed results for using Planar and DC single mode are in “JCTVC JCTVC-I0227\_Luma1PL\_Chroma\_DMLM.xlsm” and “JCTVC-I0227\_Luma1DC\_Chroma\_DMLM.xlsm”, respectively.

Table 3 Results for proposed method 2 with Planar mode.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | 0.1% | 1.2% | 1.1% | 0.0% | 0.8% | 1.2% |
| Class B | 0.0% | 0.2% | 0.2% | 0.0% | 0.1% | 0.0% |
| Class C | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% |
| Class D | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class E | 0.2% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| **Overall** | 0.0% | 0.3% | 0.3% | 0.0% | 0.2% | 0.2% |
|  | 0.0% | 0.3% | 0.3% | 0.0% | 0.2% | 0.3% |
| Class F | 0.0% | 0.2% | 0.1% | 0.1% | 0.0% | -0.1% |
| Enc Time[%] | 90% | | | 91% | | |
| Dec Time[%] | 100% | | | 100% | | |

Table 4 Results for proposed method 2 with DC mode.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra Main** | | | **All Intra HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | 0.0% | 0.9% | 0.8% | 0.0% | 0.8% | 1.2% |
| Class B | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| Class C | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class D | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class E | 0.2% | -0.3% | -0.3% | 0.2% | -0.4% | -0.3% |
| **Overall** | 0.1% | 0.2% | 0.1% | 0.1% | 0.1% | 0.2% |
|  | 0.1% | 0.2% | 0.1% | 0.1% | 0.1% | 0.2% |
| Class F | 0.0% | 0.1% | 0.0% | 0.1% | 0.0% | -0.1% |
| Enc Time[%] | 90% | | | 91% | | |
| Dec Time[%] | 100% | | | 100% | | |

# Conclusions

This contribution reports the methods and results for the proposed intra prediction mode coding. Experimental results reportedly show the proposed method 1 obtains the average 6% and 7% encoding complexity reduction for All Intra HE10 for All Intra Main settings with negligible BD rate variation, respectively. Decoding runtime difference is negligible. Experimental results reportedly show the proposed method 2 obtains the average 9% and 10% encoding time reduction with very small average BD-rate change for All Intra HE10 for All Intra Main settings, respectively. Decoding runtime difference is negligible. These two methods provide two different designs to simplify the intra mode coding for 64x64 Intra PU. It is recommended to include one of these two proposed methods in HM.

# Patent rights declaration(s)

**MediaTek Inc. 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).**

# References

1. Frank Bossen, “Common test conditions and software reference configurations”, JCTVC-H1100, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T VCEG and ISO/IEC MPEG, San Jose, USA, Feb 2012.
2. HM 6.0 Software, <http://hevc.kw.bbc.co.uk/trac/browser/tags/HM-6.0>.