|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  4th Meeting: Daegu, KR, 20-28 January, 2011 | Document: JCTVC-D300  WG11 Number: m19066 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **Improved Intra prediction for positive directions in UDI** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Yongbing Lin, HiSilicon,  Changcai Lai, HiSilicon,  Jianhua Zheng, HiSilicon,  Lingzhi Liu, HiSilicon | Tel: Email: | +86-10-82836279 yblin@huawei.com laichangcai@huawei.com  zhengjianhua@huawei.com  lzliu@huawei.com |
| Source: | HiSilicon Technologies Co., Ltd. | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

This document presents an improved Intra prediction for positive directions in UDI. Both the reference pixels from main and side arrays can be further exploited to improve prediction accuracy. The prediction value of a particular point is linearly interpolated from the two reference points. Simulation results show 0.3% and 0.4% of bit-rate reduction over HM0.9 anchors for both Intra and Intra LoCo configurations with almost the same encoding and decoding time.

# Introduction

UDI Intra prediction uses main and side arrays as prediction references. When Intra prediction direction is positive, as shown in Figure 1, the reference pixels from the main array are used for prediction [1][2].

It is observed that the main and side arrays are available for each positive direction, which means both the arrays can be used to further improve the prediction accuracy. An improved Intra prediction is proposed based on a linear interpolation method using the corresponding reference pixels from both main and side arrays.

Another observation is that two positive directions, i.e. Intra prediction mode 6 and mode 9 shown in Figure 1, have the same texture direction of 45 degrees. The following section describes the proposed implementation based on the texture direction of mode 6 (or mode 9).



Fig. 1. Positive directions in UDI

(Both prediction mode 6 and mode 9 have the same texture direction. )

# Improved Intra prediction for positive directions

Taking mode 6 as an example, as shown in Figure 2, the pixel P(*x*, *y*) in current block has two corresponding reference pixels from main and side arrays according to the texture direction of mode 6, where *ref*1 denotes the reference pixel from main array, and *ref*2 denotes the other reference pixel from side array. Both reference pixels are located in integer position due to the corresponding texture direction of 45 degrees.

The prediction value of P is calculated by using equation (1) through a linear interpolation method.

P’(*x*, *y*) = (*ref*1\**d*2 + *ref*2\**d*1)/(*d*1+*d*2) (1)

Where, P’ is the prediction value of the pixel P, *d*1 and *d*2 are spatial distances from P to *ref*1 and *ref*2 pixels, respectively. To avoid the square root operation for distance calculation, *d*1 and *d*2 are simplified by their projections on the vertical or horizontal axis. For vertical projection, then we get,

*d*1 = *y*+1

*d*2 = *x*+1

The division operation in equation (1) is implemented by a look-up-table.



Fig. 2 Linear interpolation for Intra prediction mode 6

# Test conditions and Results

The proposal has been integrated into HM0.9. Currently, only the existing Intra prediction mode 6 has been replaced with the proposed prediction method when above and left neighbor blocks are available.

The following platform and compiler have been used.

|  |  |
| --- | --- |
| **Platform** | **Compiler** |
| Windows Server 2003 64 bits  Intel Xeon X7560 @2.27GHz | VS2005 |

We have run Intra and Intra LoCo cases using the same computer in order to obtain coherent encoding and decoding time. Common testing conditions are used for simulation [3]. The following table summarizes the simulation results. The complete results is listed in the attached excel file.



The test results show that 0.3% and 0.4% bit-rate reduction for Intra and Intra LoCo configurations are achieved with negligible increase of encoding and decoding time. It is noticed that only the Intra prediction for mode 6 has been modified in current implementation.

# Conclusion

This proposal presents an improved Intra prediction for positive directions in UDI. Prediction value is generated by linearly interpolating the two reference pixels from both main and side arrays. Test results show 0.3% and 0.4% bit-rate reduction over HM0.9 anchor for Intra and Intra LoCo configurations respectively with almost the same encoding and decoding time.

# References

1. Jung-Hye Min, Sunil Lee, Il-Koo Kim, etc., “Unification of the Directional Intra Prediction Methods in TMuC”, Doc. JCTVC-B100, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, Geneva, Switzerland, July 2010.
2. Frank Bossen, TK Tan, Junya Takiue. “Simplified angular Intra prediction”, Doc. JCTVC-B093, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, Geneva, Switzerland, July 2010.
3. F. Bossen., “Common conditions and software reference configurations”, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, JCTVC-C500, 3rd Meeting: Guangzhou, CN, Oct., 2010.

# Patent rights declaration(s)

**Huawei Technologies Co., Ltd and HiSilicon Technologies Co., Ltd. may have IPR 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).**