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| *Title:* | **Improvement of Adaptive Intra Smoothing by switching interpolation filters** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This document a method is described to improve the performance of Adaptive Intra Smoothing algorithms. In this method, a set of new 4-tap interpolation filters is proposed to be used in the Intra prediction process instead of the linear interpolation when Intra smoothing is set to off. The method in tested on hybrid Intra smoothing [1] and showed, on average, 0.3% and 0.4% improvements over their results [2] for HE and LC settings, respectively.

# Algorithm description

Almost all existing AIS techniques adaptively switch between a numbers of available low-pass filters [1, 2] which are used to filter the full-pel locations of the reconstructed boundaries of the block to be predicted. However, in this document we propose to also switch between interpolation filters for non-integer locations. Current TMuC software uses a linear interpolation for all non-integer locations regardless of the AIS flag. In our proposal, when AIS flag is on, the same low-pass filters (as in JCTVC-D282) are used for the integer-pel, and the default linear interpolation is used for the non-integer locations. On the other hand, when AIS flag is off, the set of 4-tap filters are used for fractional-pel locations. No filtering is applied to the full-pel locations as before.

It should be also noted that, for both cases of AIS on or off, one can design a set of 4-tap filters for all locations (full and fractional pel locations) and just switch between them according to the AIS flag such that the overall effect of the filters becomes equivalent to the method described above. In other words, for a more simplified implementation, instead of having two branches, one with a 3-tap filter for the full-pel locations and a linear interpolation and the other with no full-pel filtering and a set of 4-tap interpolation filters, one can envisage a single branch with two (or perhaps more) sets of switching 4-tap filters with the same performance.

We implemented this technique in the hybrid AIS source code we received from Qualcomm. In addition to the switching between AIS filters (for full-pel locations) as described in JCTVC-D282, we also allowed switching between interpolation methods as described above according to the AIS flag for that block. Results are shown in and for the cases of FIS and HIS, respectively. As it can be seen from the results, the average BD-rates of high efficiency (HE) and low complexity (LC) settings improved by 0.3% and 0.4% , respectively (for both FIS and HIS), without any significant increase in the encoding or decoding times.

Table 3. Results of FIS with switching interpolation method.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Intra | | | Intra LoCo | | |
| Y BD-rate | U BD-rate | V BD-rate | Y BD-rate | U BD-rate | V BD-rate |
| Class A | -0.5 | -0.6 | -0.7 | -1.3 | -0.8 | -0.8 |
| Class B | -0.7 | -0.5 | -0.6 | -1.3 | -0.7 | -0.6 |
| Class C | -0.4 | -0.4 | -0.4 | -0.6 | -0.5 | -0.6 |
| Class D | -0.5 | -0.6 | -0.6 | -0.8 | -0.6 | -0.6 |
| Class E | -0.8 | -0.8 | -1.0 | -1.8 | -0.9 | -0.8 |
| All | -0.6 | -0.6 | -0.6 | -1.1 | -0.7 | -0.7 |
| Enc Time[%] | 103% | | | 102% | | |
| Dec Time[%] | 100% | | | 101% | | |

Table 5. Results of HIS with switching interpolation method.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Intra | | | Intra LoCo | | |
| Y BD-rate | U BD-rate | V BD-rate | Y BD-rate | U BD-rate | V BD-rate |
| Class A | -0.7 | -0.7 | -0.9 | -1.6 | -0.8 | -0.9 |
| Class B | -0.9 | -0.9 | -0.9 | -1.4 | -0.8 | -1.0 |
| Class C | -0.6 | -0.6 | -0.7 | -0.9 | -0.6 | -0.7 |
| Class D | -0.6 | -0.7 | -0.6 | -0.8 | -0.6 | -0.6 |
| Class E | -1.2 | -1.2 | -1.2 | -2.0 | -1.2 | -1.0 |
| All | -0.8 | -0.8 | -0.9 | -1.3 | -0.8 | -0.8 |
| Enc Time[%] | 104% | | | 108% | | |
| Dec Time[%] | 101% | | | 102% | | |

# References

1. [Y. Zheng](mailto:zhengy@qualcomm.com), [M. Coban](mailto:mcoban@qualcomm.com), and [M. Karczewicz](mailto:martak@qualcomm.com), “CE13: Mode Dependent Hybrid Intra Smoothing”, Doc. JCTVC-D282, Daegu, Korea Jul 2010.
2. K. Sato, “CE13: Cross-Check Result of 3.2d”, Doc. JCTVC-D305, Daegu, Korea Jul 2010.

1. [B. Bross](mailto:benjamin.bross@hhi.fraunhofer.de), D. Marpe , H. Schwarz , T. Wiegand, “ CE13: Intra Smoothing Test Report”, Doc. JCTVC-D313, Daegu, Korea Jul 2010.
2. Frank Bossen, “Common test conditions and software reference configurations”, JCTVC-C500, Guangzhou, October 2010.

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