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Question: Q.6/SG16 (VCEG)

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Title: A simplified 1/3 pixel prediction method

Purpose: Proposal/discussion

1 Introduction

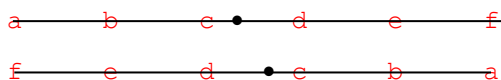
In the investigation of coding performance and complexity it has been requested to test different prediction accuracies as well as filter tap sizes. This document describes a test with 1/3 pixel accuracy and appropriate filters.

An additional goal of this document is to present a fractional pixel interpolation where filtering is performed in one dimension only - for complexity reduction.

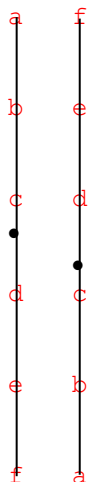
2 1/3 pixel conversion

The figures below illustrate how filtering is done. Red characters indicate integer pixel positions and filter taps. • indicate fractional pixel position to be calculated. Lines through a • indicate direction of filtering.

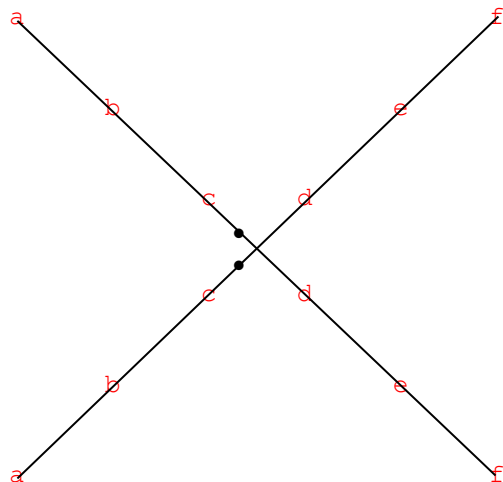
2.1 Horizontal filtering



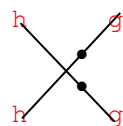
2.2 Vertical filtering



2.3 Diagonal filtering I



2.4 Diagonal filtering II (reduced filtering - funny position)



2.5 Filter taps used

	a	b	c	d	e	f	g	h
6 taps	(2	-9	52	25	-8	2)/64		
4 taps I	(0	-3	25	12	-2	0)/32		
4 taps II	(0	-1	12	6	-1	0)/16		
2 taps							(21	11)/32

VCEG-M34 shows the objective simulation results. With 4 tap filtering, "4 taps I" is used.

3 IPR

"The contributor are not aware of any issued, pending, or planned patents associated with the technical content of this proposal."

4 Concluding remarks

It has been observed that there is a connection between prediction accuracy and filter length. Hence the combination of **1/3 pixel and 4 taps** seems to be a good combination. **1/4 pixel and 6 taps** seems to be a similarly good combination.

4.1 Choice of 4 tap filter

"4 taps I" is used as a preferred 4 taps filter. However, "4 taps II" gives only marginal loss on coding efficiency. If "4 taps II" is considered to result in lower complexity it could be an overall better solution.

4.2 Funny position

After the introduction of deblocking filter, the subjective benefit of funny position is reduced. Still my personal preference is to keep it, but the differences is so small that complexity considerations should be used to decide the procedure. The options are:

- As described above with two positions with 2-tap filter. Does the two tap filter represent a complexity reduction?
- All interior positions with two tap filters. Does this represent even lower complexity?
- Use the same filter length (preferably 4 taps) for all positions. Does the use of the same filter taps for all positions represent a simplification?

4.3 Complexity

The described approach represent the following simplifications compared to TML 5.9:

- Upconversion filtering is performed in one direction only. For the decoder this represents a considerable simplification. Compared to two dimensional upconversion the saving of filtering operations is in the order of (50-60) % (see diagonal filtering above)
- On the **encoder** side use of 1/3 pixel resolution needs two motion search steps (1 pixel and 1/3 pixel), whereas 1/4 pixel resolution needs three steps (1pixel, 1/2 pixel and 1/4 pixel)

4.4 Recommendation

It is proposed to consider this definition of 1/3 pixel resolution prediction for a low complexity profile of H.26L