

ANG16/NON-CE5: A CLEAN-UP FOR DE-BLOCKING IN THE AFFINE AND TPM MODE (JVET-P0043)



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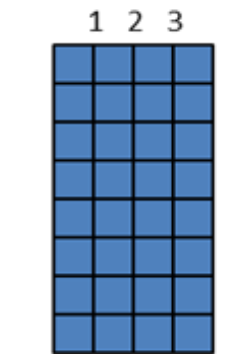
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Problem Statement

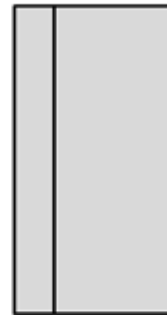
- The affine mode and the triangle merge mode (TPM) are two new modes added to the VVC.
- It is asserted that the current de-blocking design is not consistent for the affine mode and TPM mode in some of corner cases.
 - In the affine mode, two 4x4 subblock edges can be treated differently even if they have the exactly same conditions (i.e. having no non-zero coefficients and the same amount of large enough MV differences that can trigger de-blocking along the edge).
 - In the TPM mode, an inner TU edge with no non-zero coefficients can still be de-blocked if the edge is located along the diagonal TPM boundary and the triangle block MV difference is large enough to trigger de-blocking.

De-blocking Filtering Example in Affine Mode

- In this example
 - The CU size is 16x32.
 - The CU is coded in affine mode. Therefore, there are three inner sub-block boundaries marked 1, 2, 3 in the figure above.
 - The CU uses quad SBT, therefore, sub-block boundary 1 is a TU boundary. However, there are no non-zero coefficients in the current component.
 - The sub-block MV difference is large enough along the sub-block boundaries to trigger de-blocking.
- Sub-block edge 1 & 3 have the same edge conditions
 - No non-zero transform coefficients (residual) along the edge.
 - MV difference along the edge is large enough to trigger de-blocking.
- Design inconsistency: sub-block edge 1 is de-blocked but sub-block edge 3 is not.

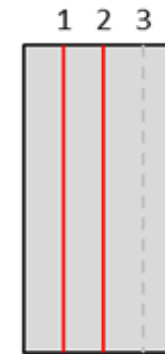


Affine 4x4 Vectors



Transform Units
Quad SBT

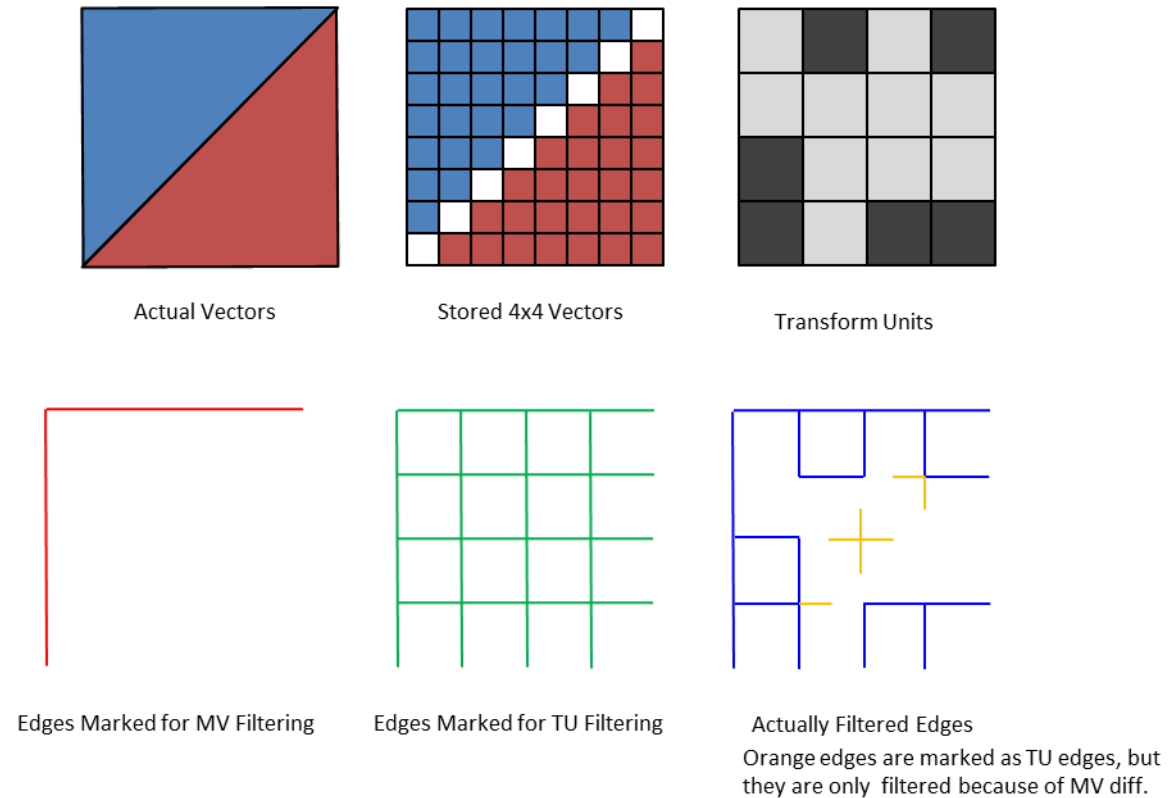
No coefficients in current component (Y, Cb, or Cr)



Filtered Sub-Block Edges

De-blocking Filtering Example in TPM Mode

- In this example
 - The TU size is smaller than the CU size.
 - The grey TUs have no non-zero coefficients while the black TUs have non-zero coefficients.
 - The stored 4x4 sub-block MVs along the diagonal boundary is large enough to trigger de-blocking.
 - The blue edges are filtered because they are either PU edges (w/ large enough MV differences) or TU edges with non-zero coefficients.
 - The orange edges are TU edges that are only filtered because of the artificial triangle MV differences along the diagonal boundaries despite non-zero coefficients along those edges.
- These artificial triangle block MV differences don't line up with the actual diagonal MV edge anyway, so we believe this is not only inconsistent, but most likely unintentional.



Proposed Solution

- It is proposed to modify the de-blocking decision process as follows:
 - 1) Use CBFs to make decision only for TU edges.
 - 2) Using MV differences to make decisions only for MV edges.
 - 3) If an edge is both a TU edge and an MV edge, de-blocking is on if either (1) or (2) is true.

Note: here an MV edge here is defined as a PU edge or a sub-block edge which is aligned with the filtering grid.

Code Changes relative to VTM6.0

- In xSetEdgefilterMultiple()

```
for( int ui = 0; ui < uiNumElem; ui++ )
{
    m_aapbEdgeFilter[edgeDir][uiBsIdx] = bValue;

    #if JVET_P0043_DEBLOCKING_CLEANUP
        if (m_aapucBS[edgeDir][uiBsIdx] && bValue) {
            m_aapucBS[edgeDir][uiBsIdx] = 3; // both the TU and PU edge
        }
        else
    #endif
        if (!EdgeIdx) {
            m_aapucBS[edgeDir][uiBsIdx] = bValue;
        }
        uiBsIdx += uiAdd;
    }
```



- In xGetBoundaryStrengthSingle ()

```
if ( !cu.Y().valid() )
{
    return tmpBs;
}

// and now the pred

#if JVET_P0043_DEBLOCKING_CLEANUP
    if (m_aapucBS[edgeDir][rasterIdx] != 0 && m_aapucBS[edgeDir][rasterIdx] != 3) return 0;
#endif

const Position& lumaPosQ = Position{ localPos.x, localPos.y };
```



Experimental Results

- No impact on AI, the corner cases rarely happen in the CTC sequences of RA and LD_B.

	Random Access Main 10				
	Over VTM6.0			EncT	DecT
	Y	U	V		
Class A1	0.00%	-0.01%	0.02%	99%	96%
Class A2	0.01%	0.03%	0.02%	94%	96%
Class B	0.00%	0.01%	-0.04%	95%	87%
Class C	0.00%	0.00%	0.00%	96%	82%
Class E					
Overall	0.00%	0.01%	-0.01%	96%	89%
Class D	0.00%	0.00%	0.00%	89%	78%
Class F (optional)	0.00%	0.00%	0.00%	103%	102%

	Low delay B Main10				
	Over VTM6.0			EncT	DecT
	Y	U	V		
Class A1					
Class A2					
Class B	0.00%	0.04%	-0.18%	90%	99%
Class C	0.02%	0.05%	-0.03%	92%	85%
Class E	-0.03%	0.33%	-0.10%	82%	76%
Overall	0.00%	0.12%	-0.11%	89%	88%
Class D	0.06%	0.44%	-0.07%	74%	63%
Class F (optional)	0.08%	-0.07%	0.28%	101%	95%

Thanks to Bytedance for cross-checking.

Recommendation

- It is recommended to fix the design inconsistency in the de-blocking of affine and TPM mode.