Mode Dependent Intra Residual Coding

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Motivation

- Mode-dependent intra residual transform
  - Several tools being tested within CE7
    - Transforms
      - DCT/KLT
      - DCT/DST
    - Mode mapping
    - Coefficient scanning
  - Propose a combination of these aspects
    - Simplification and Low computational complexity
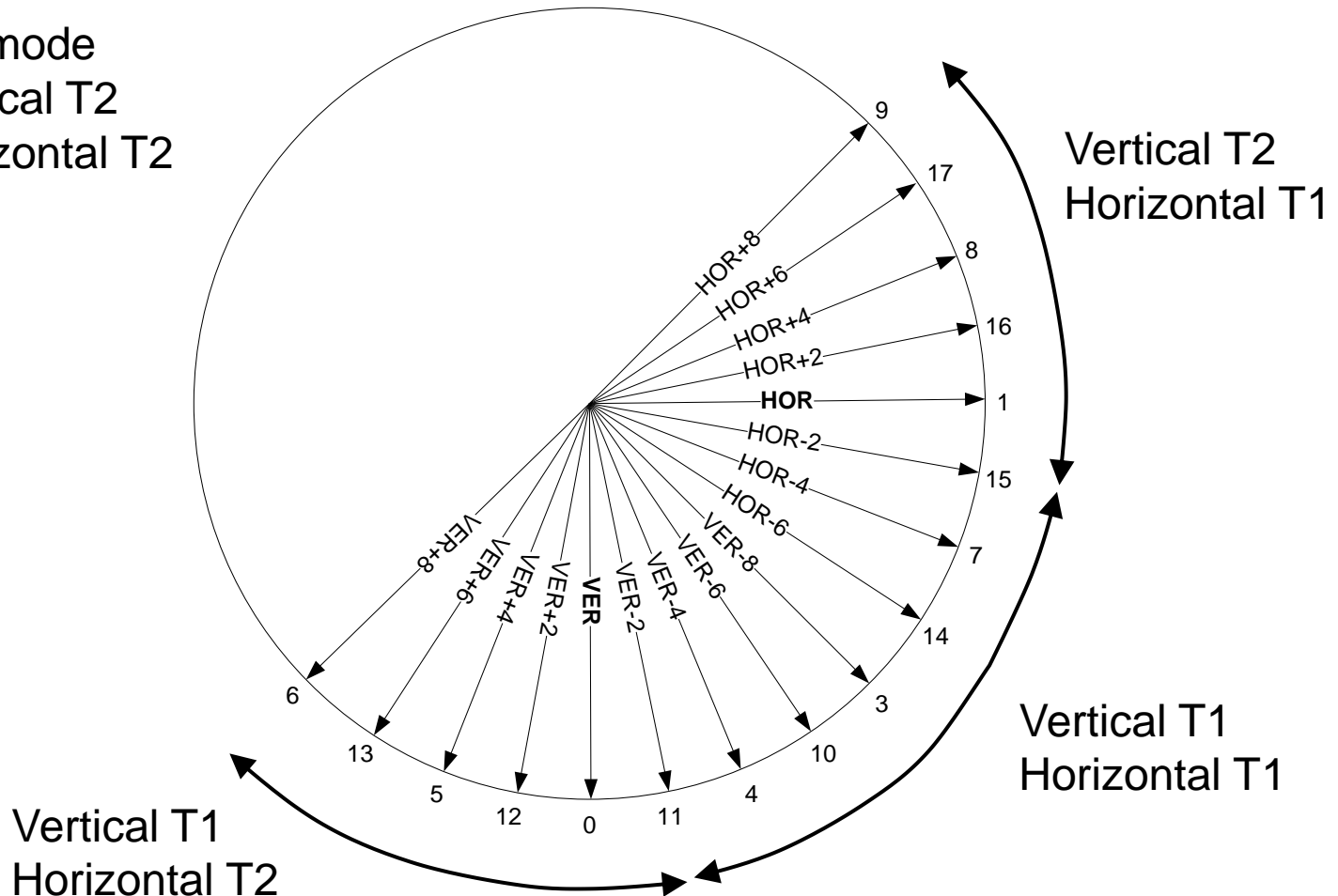   - Maintain good BD-rate performance

Transforms

- Two possible transforms
  - T1: DST (odd type III).
  - T2: DCT
- Four possible combinations for 2-D transforms

TransformIdx	Vertical 1D Transform	Horizontal 1D Transform
0	T1	T2
1	T2	T1
2	T2	T2
3	T1	T1

- Used only for 4×4, 8×8, and 16×16 blocks.

Mode Mapping

DC mode
Vertical T2
Horizontal T2

Vertical T2
Horizontal T1

Vertical T1
Horizontal T1

Vertical T1
Horizontal T2

Coefficient Scanning

- Only 3 scans are used
  - Zigzag, horizontal, vertical
  - Horizontal and vertical scans are transposed versions of each other
    - Statistics sharing between horizontal and vertical scans.
- HE: Fixed scans
- LC: Adaptive scans
  - Conditional exchange of scanning position if a nonzero coefficient is encountered.

Results

Config	BD-rate			Encoding Time	Decoding Time
	Y	U	V		
Intra	-2.1	-2.5	-2.5	106%	105%
Intra LoCo Adaptation	-2.6	-2.7	-2.7	116%	114%
Intra Loco fixed	-2.7	-2.6	-2.6	105%	107%
RA	-0.9	-0.8	-0.7	101%	102%
RA LoCo	-0.8	-0.7	-0.8	101%	104%
LD	-0.2	-0.7	-0.6	101%	101%
LD LoCo	-0.2	-0.3	-0.4	102%	103%

Fixed vs Adaptation for Intra LoCo configuration

	BD-rate			Encode Time	Decode Time
	Y	U	V		
Adaptive	-2.6	-2.7	-2.7	116%	114%
Fixed	-2.7	-2.6	-2.6	105%	107%
Fixed with VLC fix	-4.6	-4.1	-4.1		
Adaptive with VLC fix	-5.3	-4.6	-4.6		

The luma BD-rate gains for the last 2 rows should be revised downwards by 1.6% since VLC fix gains 1.6%.

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Conclusion

- Mode dependent coding of intra prediction residual shows good BD-rate improvement with small increase in complexity.

- Propose adoption into the next HEVC Test Model.