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JVET-O0272

CE2-related: Simplified inverse luma mapping

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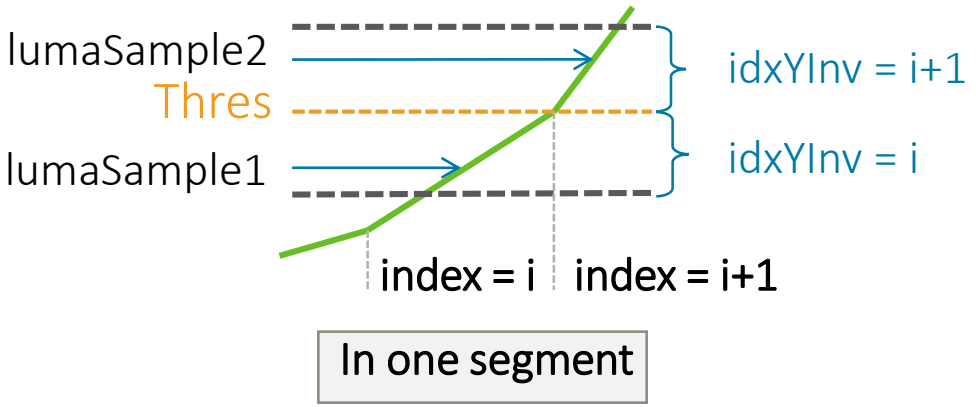
Overall Summary

- Propose to simplify the inverse mapping of LMCS
  - Divide the luma samples into 32 equal-size segments
  - Derive the interval index (idxYInv) by comparing the to-be-mapped luma sample with a threshold value in its segment
  - Only allow luma samples belonging to at most 2 different intervals in one segment
- **The worst case number of comparisons in each luma samples's inverse luma sample derivation is reduced from 15 to 1**
- No BD-rate changes



Introduction

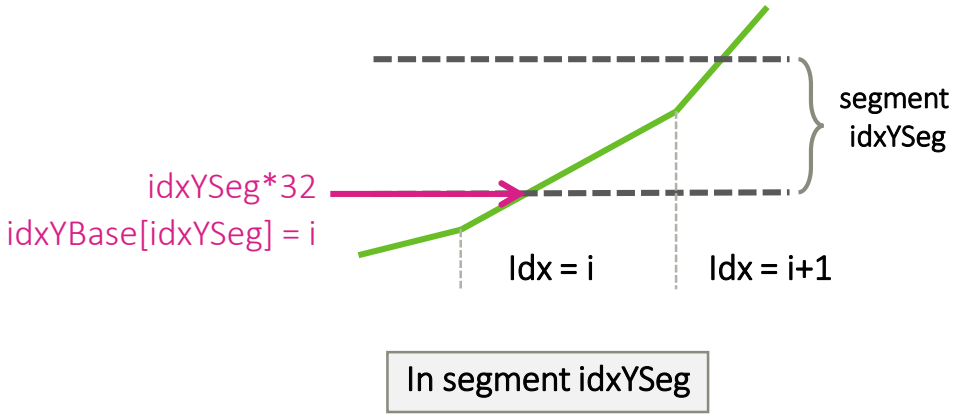
- In VTM-5.0, the inverse luma sample of lumaSample is derived as
  - invSample = InputPivot[**idxYInv**] + (InvScaleCoeff[**idxYInv**] * (lumaSample − LmcsPivot[**idxYInv**]) + (1 << 10)) >> 11
- **idxYInv** is the interval index of the to-be-mapped luma sample (lumaSample)
- In the worst case, **15 comparisons** are required to allocate the interval index (idxYInv)

VVC Draft 5

```
for( idxYInv = lmcs_min_bin_idx; idxYInv < LmcsMaxBinIdx; idxYInv++ )
{
        if( lumaSample < LmcsPivot [ idxYInv + 1 ] )
            break
}
```

Proposed Method

- Divide [0, 1023] into 32 segments with equal size (size = 32)
- An array idxYBase is derived for each segment, representing the base idexYInv in each segment
  - The idxYBase[idxYSe] is the idxYInv of the luma sample idxYSeg*32



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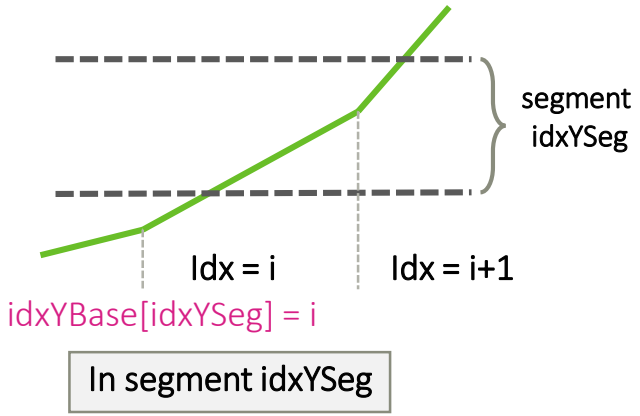
- The idxYInv of luma sample lumaSample is derived as
  - idxYSeg = lumaSample >> 5

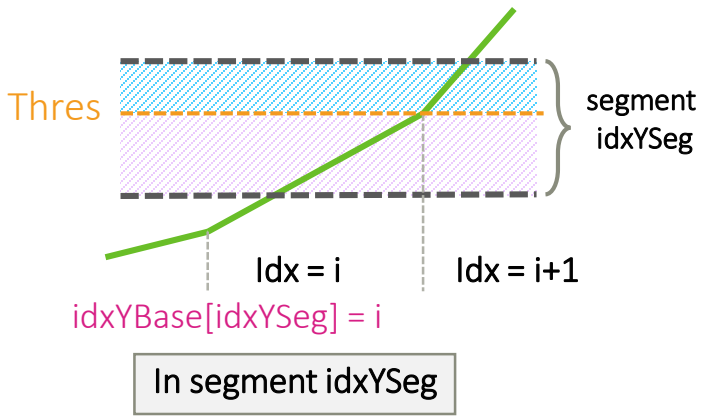


Proposed Method

- Divide [0, 1023] into 32 segments with equal size (size = 32)
- An array idxYBase is derived for each segment, representing the base idexYInv in each segment
  - The idxYBase[idxYSe] is the idxYInv of the luma sample idxYSeg*32
- The idxYInv of luma sample lumaSample is derived as
  - idxYSeg = lumaSample >> 5

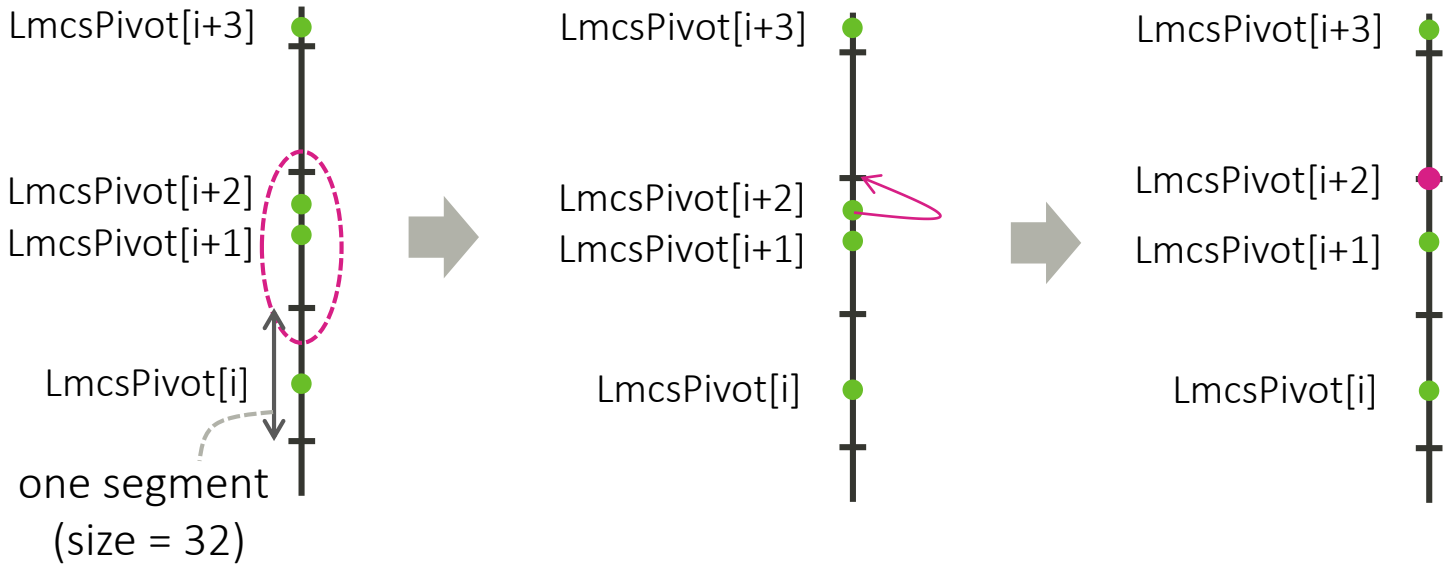
```
if ( lumaSample < LmcsPivot[ lmcs_min_bin_idx + 1 ] )
        idxYInv = lmcs_min_bin_idx
else if ( lumaSample >= LmcsPivot[ LmcsMaxBinIdx ] )
        idxYInv = LmcsMaxBinIdx
else {
        if (lumaSample >= LmcsPivot[ idxYBase[idxYSeg]+1 ])
                idxYInv = idxYBase [idxYSeg] +1
        Otherwise,
                idxYInv = idxYBase [idxYSeg]
}
```

Only one comparison is required



Proposed Method

- An encoder normative constraint is applied to make sure that all of the luma samples in one segment belong to at most two different intervals
- At encoder side, if “more than two intervals belongs to the same segment” is detected, the LmcsPivot will be adjusted



Results

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	100%	99%
Class A2	0.00%	0.00%	0.00%	99%	100%
Class B	0.00%	0.00%	0.00%	100%	100%
Class C	0.00%	0.00%	0.00%	100%	99%
Class E	0.00%	0.00%	0.00%	101%	103%
Overall	**0.00%**	**0.00%**	**0.00%**	**100%**	**100%**
Class D	0.00%	0.00%	0.00%	100%	100%
Class F	0.00%	0.00%	0.00%	101%	100%

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	100%	99%
Class A2	0.00%	0.00%	0.00%	100%	99%
Class B	0.00%	0.00%	0.00%	100%	98%
Class C	0.00%	0.00%	0.00%	100%	98%
Overall	0.00%	0.00%	0.00%	100%	99%
Class D	0.00%	0.00%	0.00%	100%	100%
Class F	0.00%	0.00%	0.00%	100%	98%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class B	0.00%	0.00%	0.00%	100%	100%
Class C	0.00%	0.00%	0.00%	100%	100%
Class E	0.00%	0.00%	0.00%	100%	99%
Overall	0.00%	0.00%	0.00%	100%	100%
Class D	0.00%	0.00%	0.00%	98%	99%
Class F	0.00%	0.00%	0.00%	98%	97%

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Conclusion

- The inverse mapping process is simplified
  - Divide [0, 1023] into 32 equal-size segments, and assign one threshold to each segment
  - Compare the to-be-mapped luma sample with the threshold in its segment, and then derive the interval index (idxYInv)
  - All of the luma samples in one segment should belong to at most two different intervals
- **The worst case number of comparisons for each luma sample is reduced from 15 to 1**
- No BD-rate changes
- Thank ByteDance for cross-checking!

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Thank you!