



SAO software cleanup and non-normative encoder-only bug-fixes

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Overall Summary

- Three non-normative encoder-only bug-fixes
 - Pure encoder-only software bug-fixes
 - Negligible BD-rate change
- New SAO software implementation
 - Implemented on top of HM-11.0.
 - Remove legacies in HM (picture quadtree, fine granularity slices, adaptation parameter set)
 - Reduce the number of code lines by half (from 4000 to 2000)
 - Better code quality and readability
 - No run time increase
 - Also implemented on top of RExt, SHVC, and 3D-HEVC reference software packages

Non-normative Encoder-only Bug-fixes

- Merge flag assignment fix
 - Problem: When slice_sao_luma_flag is equal to 0 and slice_sao_chroma_flag is equal to 1, merge flags are not assigned correctly during RDO.
- Rate calculation fix
 - Problem: Regardless of what slice_sao_luma_flag and slice_sao_chroma_flag are, SAO type index rate is always counted during RDO.
- Boundary condition fix for 0-degree EO
 - Problem: When the CTU is at the bottom boundary of a picture, the bottom sample lines of the CTU are unnecessarily skipped for 0-degree EO statistics collection.

Non-normative Encoder-only Bug-fixes

- Anchor:
 - HM-11.0
- Test:
 - HM-11.0 with non-normative encoder-only bug-fixes
- Results:
 - Negligible BD-rate change
 - No run time increase

	All Intra Main			All Intra Main10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Random Access Main			Random Access Main10		
	Y	U	V	Y	U	V
Class A	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
Class E						
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	101%			100%		

	Low delay B Main			Low delay B Main10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	-0.4%	0.0%	0.0%	-0.1%
Class C	0.0%	0.0%	-0.1%	0.0%	0.1%	0.1%
Class D	0.0%	0.2%	0.1%	0.0%	0.2%	0.1%
Class E	0.0%	-0.1%	0.0%	0.0%	0.1%	0.1%
Overall	0.0%	0.0%	-0.1%	0.0%	0.1%	0.0%
	0.0%	0.0%	-0.1%	0.0%	0.1%	0.0%
Class F	0.0%	0.4%	-0.3%	0.0%	0.3%	0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay P Main			Low delay P Main10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-0.2%	-0.1%	0.0%	0.2%	-0.1%
Class C	0.0%	-0.4%	0.2%	0.0%	-0.1%	-0.2%
Class D	0.0%	-0.2%	0.0%	0.0%	0.4%	-0.2%
Class E	0.0%	0.2%	0.3%	0.0%	0.0%	0.0%
Overall	0.0%	-0.2%	0.1%	0.0%	0.1%	-0.1%
	0.0%	-0.2%	0.2%	0.0%	0.1%	-0.1%
Class F	0.1%	-0.2%	0.3%	0.0%	-0.1%	0.0%
Enc Time[%]	99%			100%		
Dec Time[%]	98%			100%		

New SAO Software Implementation

- Implemented on top of HM-11.0.
- Include the three non-normative encoder-only bug-fixes
- Remove legacies related to SAO
 - SAO picture quadtree
 - APS
 - Fine granularity slice
- Reduce the number of code lines by half
 - From around 4000 lines to 2000 lines
- No run time increase

New SAO software implementation

- Anchor:
 - HM-11.0 with non-normative encoder-only bug-fixes
- Test:
 - New SAO software implementation
- Results:
 - Bitstreams and decoded yuv results are fully matched between anchor and test.
 - No run time increase

	All Intra Main			All Intra Main10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	99%			99%		
Dec Time[%]	101%			101%		

	Random Access Main			Random Access Main10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E						
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			100%		

	Low delay B Main			Low delay B Main10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

	Low delay P Main			Low delay P Main10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	101%			99%		

New SAO software implementation

- The corresponding modifications for HEVC extensions are also provided for
 - RExt: HM-10.1+RExt-3.0
 - SHVC: SHM-2.0
 - 3D-HEVC: HTM-DEV-0.3-dev2 (Rev. 538)

Conclusions

- Three non-normative encoder-only bug-fixes are proposed
 - Pure encoder-only software bug-fixes
 - Negligible BD-rate change
- New SAO implementation is proposed for HM software
 - No run time increase
 - Reduce the number of code lines by half (4000 => 2000)
 - Better code quality and readability
- Corresponding modifications for RExt, SHVC, and 3D-HEVC are also provided