

On Sample Adaptive Band Value

JCTVC-R0087

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HEVC: SAO Band Offset

■ Filtering principle:

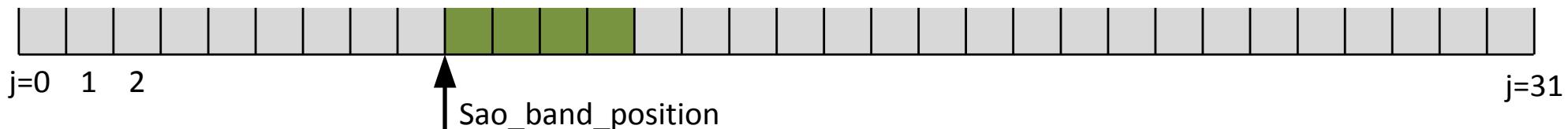
- For all P_i of a band j :
- $P'_i = P_i + O_j$

■ O_j transmitted for all j

- Unary code

■ 4 consecutive bands:

- Signaling by the Sao_band_position



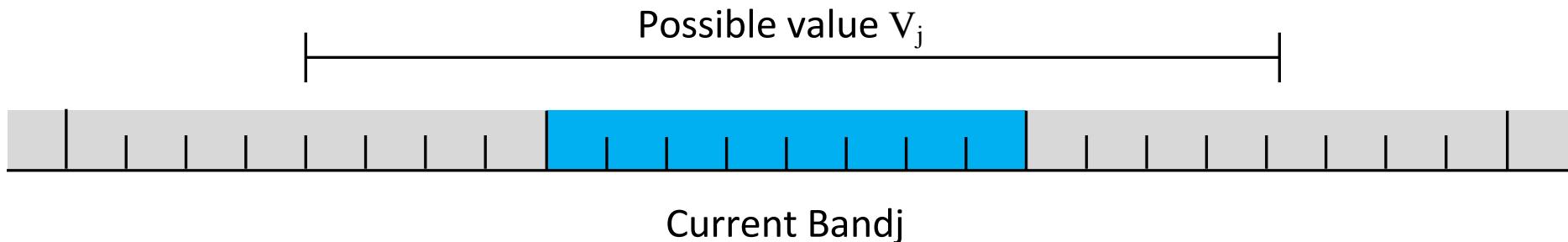
Proposal: SAO Band Value

■ Filtering principle:

- For all P_i of a band j :
- $P'_i = V_j$

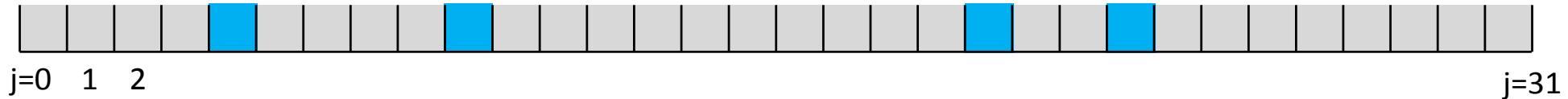
■ V_j transmitted for all j

- 4 bits
- V_j inside the current band and the half of the neighboring bands



Proposal: SAO Band Value

- 4 independent bands:
 - 4 SAO_band_value transmitted



- Band Value is competing to Band Offset and Edge offset at encoder side.

Experimental results

■ Anchor: SCM1.0:

■ Full frame

- Same results for 2CTBs

■ BDR 1080p text & Graphics:

- -2,5%

■ BDR Average:

- -1%

Canon

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-2,1%	-2,5%	-2,4%
RGB, text & graphics with motion, 720p	-0,8%	-1,3%	-1,0%
RGB, mixed content, 1440p	-0,2%	-0,2%	-0,3%
RGB, mixed content, 1080p	-0,8%	-0,6%	-0,8%
RGB, Animation, 720p	0,0%	0,0%	0,0%
RGB, camera captured, 1080p	0,0%	0,0%	0,0%
YUV, text & graphics with motion, 1080p	-3,0%	-2,2%	-1,9%
YUV, text & graphics with motion, 720p	-1,1%	-0,2%	-0,5%
YUV, mixed content, 1440p	-0,5%	-0,3%	-0,2%
YUV, mixed content, 1080p	-1,1%	0,0%	-0,1%
YUV, Animation, 720p	0,0%	0,0%	0,0%
YUV, camera captured, 1080p	0,0%	0,0%	0,0%
Enc Time[%]		101%	
Dec Time[%]		98%	

	Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-2,2%	-3,3%	-3,2%	-2,3%	-3,1%	-3,0%
RGB, text & graphics with motion, 720p	-1,1%	-1,9%	-1,8%	-1,3%	-1,6%	-1,6%
RGB, mixed content, 1440p	-0,4%	-0,4%	-0,6%	-0,4%	-0,4%	-0,6%
RGB, mixed content, 1080p	-1,0%	-0,7%	-1,1%	-1,3%	-0,6%	-1,2%
RGB, Animation, 720p	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%
RGB, camera captured, 1080p	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
YUV, text & graphics with motion, 1080p	-2,8%	-2,0%	-2,2%	-2,5%	-1,7%	-1,9%
YUV, text & graphics with motion, 720p	-1,2%	-0,3%	-0,5%	-1,3%	-0,3%	-1,0%
YUV, mixed content, 1440p	-0,6%	-0,5%	-0,3%	-0,8%	-0,7%	-0,4%
YUV, mixed content, 1080p	-1,1%	-0,3%	-0,2%	-1,0%	-0,7%	-0,3%
YUV, Animation, 720p	0,0%	0,0%	0,0%	0,0%	-0,4%	-0,1%
YUV, camera captured, 1080p	0,0%	0,1%	0,0%	0,0%	0,1%	-0,1%
Enc Time[%]		100%			100%	
Dec Time[%]		105%			105%	

Visual results: SCM1.0

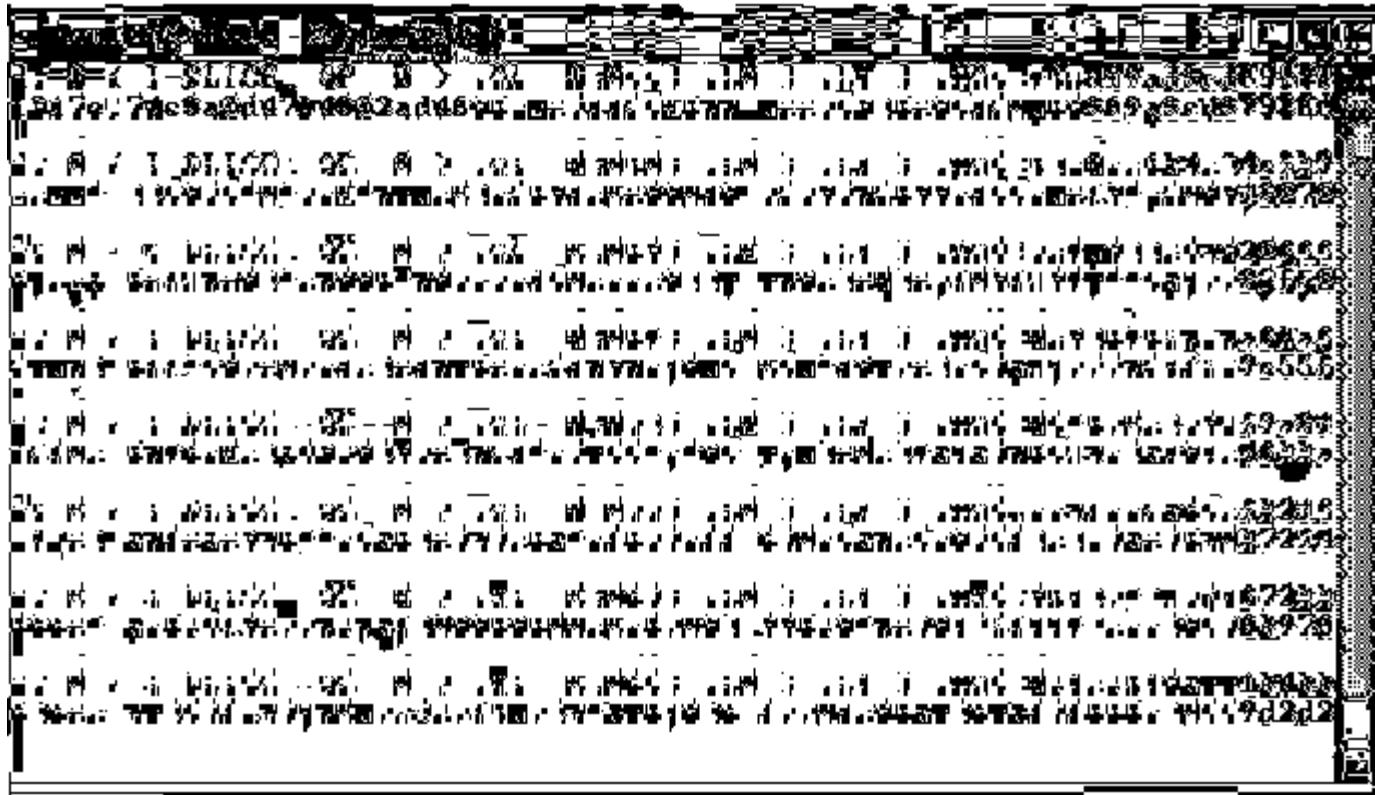
■ Binary difference:



Decoded = Original



Decoded ≠ Original



Sc_consol
AI QP 22

```
system32\cmd.exe - RunCode2.bat
d: 0 < I-SLICE, QP 0 > {DT 0.855} [LL 1] [MD5:96e419abfc169fb91317e74c8a9d47b4882ad4686aed71f58644,bd276326d851f9b68869a8c4879266aae97258759797c094eb02cf631a0b088010,7f7374f633:195:chdf39af0881b0708e6dc4d829a48869487e7c150:acc822e+49a2d0247f03f39e95b17782fe08eac6,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55fFeb42,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55f4: 0 < I-SLICE, QP 0 > {DT 0.061} [LL 0] [LL 1] [MD5:62a9eab4ba24fcfb9eae97258759797c094eb02cf631a0b088010,7f7374f633:195:chdf39af0881b0708e6dc4d829a48869487e7c150:acc822e+49a2d0247f03f39e95b17782fe08eac6,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55fFeb42,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55f4: 0 < I-SLICE, QP 0 > {DT 0.063} [LL 0] [LL 1] [MD5:7a9b22a548286668eac6,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55fFeb42,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55f4: 0 < I-SLICE, QP 0 > {DT 0.069} [LL 0] [LL 1] [MD5:0a32d9bf4a4fbfa6Feb42,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55fFeb42,6ff9587d07c1a2d4e6dcacf1434:18b5,05b918e7d2c53b17774f1fe9c55f4: 0 < I-SLICE, QP 0 > {DT 0.073} [LL 0] [LL 1] [MD5:059670a273c59a811ff0a_6498c02b53a8237d24f19c7e559c985,ech2d0a29h1b34654c2b181a46bbaa12d2,hd4fd34699c5362d343a6b7cf673cf,630c53a5c979f2a2e3bd3640872494: 0 < I-SLICE, QP 0 > {DT 0.077} [LL 0] [LL 1] [MD5:c4fcfcf85afbf216a12d2,hd4fd34699c5362d343a6b7cf673cf,630c53a5c979f2a2e3bd3640872494: 0 < I-SLICE, QP 0 > {DT 0.083} [LL 0] [LL 1] [MD5:3612792e781672bb688d9,hd5e65f3d774e4bf28886860a0c57082,336e894d3812f1192acc2853639764: 0 < I-SLICE, QP 0 > {DT 0.085} [LL 0] [LL 1] [MD5:0e1ae618beef14bb828da_4e253fe43140b7c3a7f6b7249be61828,7F701aB6be28ebf3F666c20559d242
```

Visual results: SAO Band value

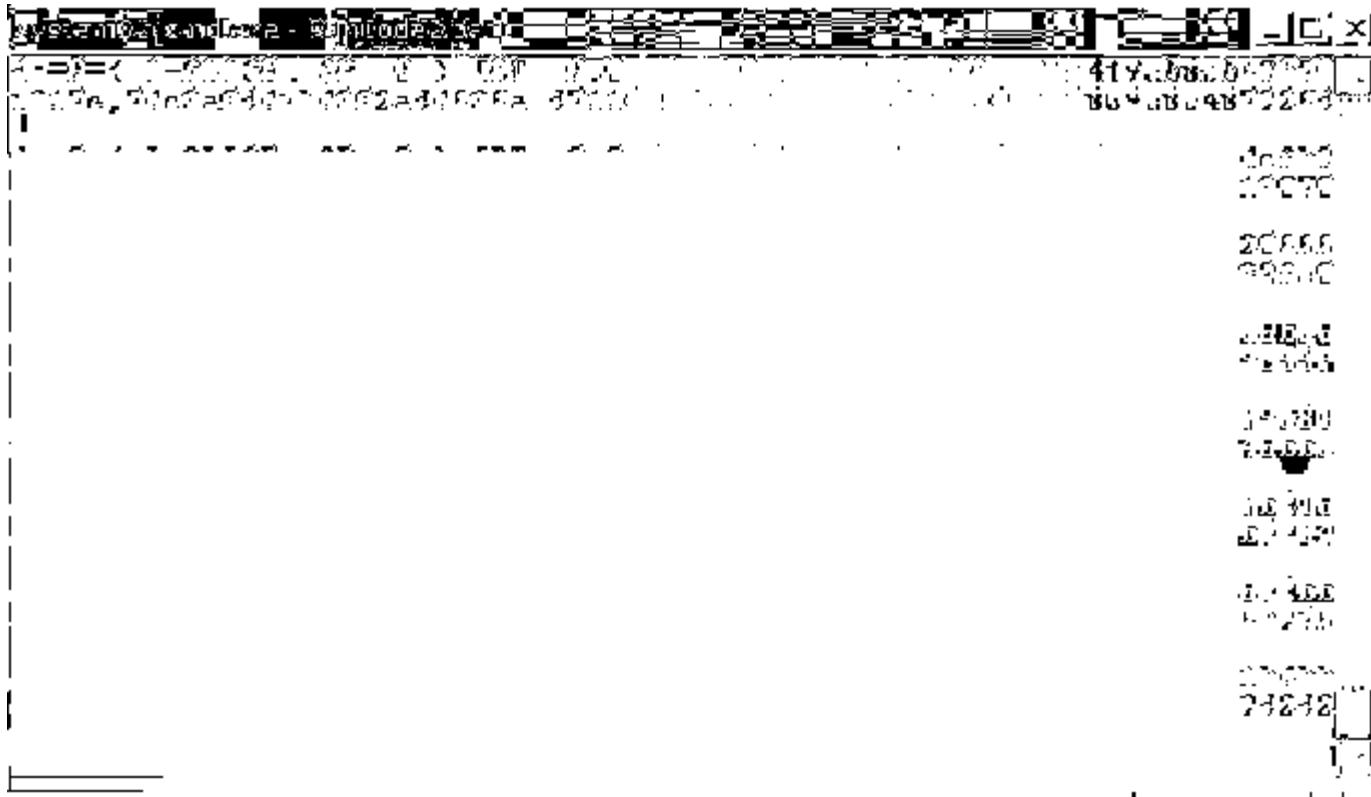
■ Binary difference:



Decoded = Original



Decoded ≠ Original



Sc_consol
AI QP 22

```
system32\cmd.exe - RunCode2.bat
l: 0 < I-SLICE, QP 0 > [DT 0.855] [L0 ] [L1 ] [MDS:96e419abfc169fb9]
d: 317e,24c8a0d47b4882ad4686aed71f58644,bdd76326d851f9b68869a8c487926d
eae9?,2258759897c094eha02cf631a0b88801b,7f7374f633195chdf39af88318070
d: 0 < I-SLICE, QP 0 > [DT 0.060] [L0 ] [L1 ] [MDS:2a4eacab4a24fcfb9
8eae9?,2258759897c094eha02cf631a0b88801b,7f7374f633195chdf39af88318070
d: 0 < I-SLICE, QP 0 > [DT 0.063] [L0 ] [L1 ] [MDS:7a9b22a54828666
8eae9?,2258759897c094eha02cf631a0b88801b,7f7374f633195chdf39af88318070
d: 0 < I-SLICE, QP 0 > [DT 0.069] [L0 ] [L1 ] [MDS:0a3239fa4a4fb46
feh42,6ff95870b7c1a2d146edcaf1434c18b5,05b918e7d2c53b1e7774f1fe9c55f
d: 0 < I-SLICE, QP 0 > [DT 0.072] [L0 ] [L1 ] [MDS:0a3239fa4a4fb46
feh42,6ff95870b7c1a2d146edcaf1434c18b5,05b918e7d2c53b1e7774f1fe9c55f
d: 0 < I-SLICE, QP 0 > [DT 0.077] [L0 ] [L1 ] [MDS:c4fccf]85afb216
a12d2,be5f4fd34699c5362d343a6bc7f673cf,830c5fa5c97f2a23d36405724
d: 0 < I-SLICE, QP 0 > [DT 0.083] [L0 ] [L1 ] [MDS:3612792e781672bb
6889d,be5c6f3d774e4bf28886860a0c657082,336e894d3812ff1192acc28536976
d: 0 < I-SLICE, QP 0 > [DT 0.085] [L0 ] [L1 ] [MDS:0e1ae618hee14bb
828da,4e253fe43140b7c3a7f6b7249be61828,7f701a86be28ebf3f666c28559d2d2
```

Visual results: SCM1.0

■ Binary difference:



Decoded = Original



Decoded ≠ Original

dependent slice segments. The right side of the figure shows in the first tile one slice in the second tile.

rectangular. A tile always contains an integer number of slices in more than one slice. Similarly, a slice may consist of

conditions shall be fulfilled for each slice and tile:

slice belong to the same tile.

Sc_desktop
AI QP 22

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slice belong to the same tile.

Visual results: SAO Band value

■ Binary difference:



Decoded = Original



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dependent slice segments. The right side of the figure shows slices in the first tile and one slice in the second tile.

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Conclusion

- Simple modification of SAO Band Offset.
- Interesting results on top of SCM1.0 full frame for AI, RA, LDB
 - BDR 1080p text & Graphics:-2,5%
 - BDR Average: -1%
- Recommend to adopt SAO Band Value for Screen Content Coding.