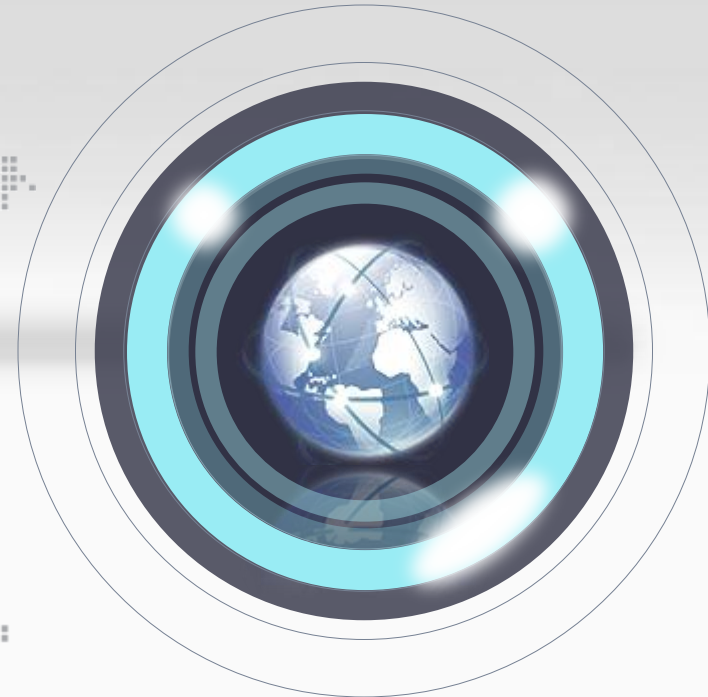


AHG5: Extension of intra block copy

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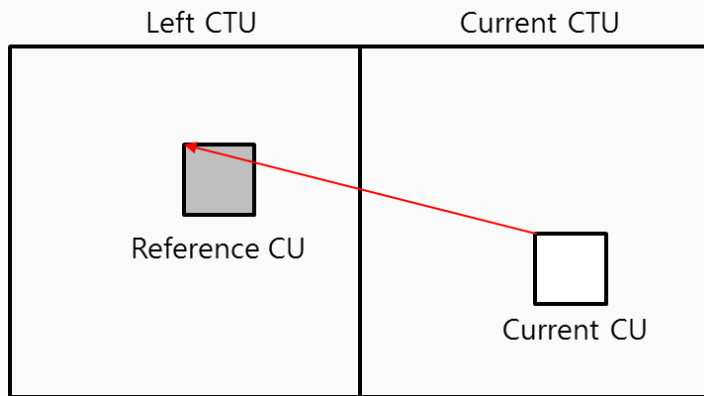
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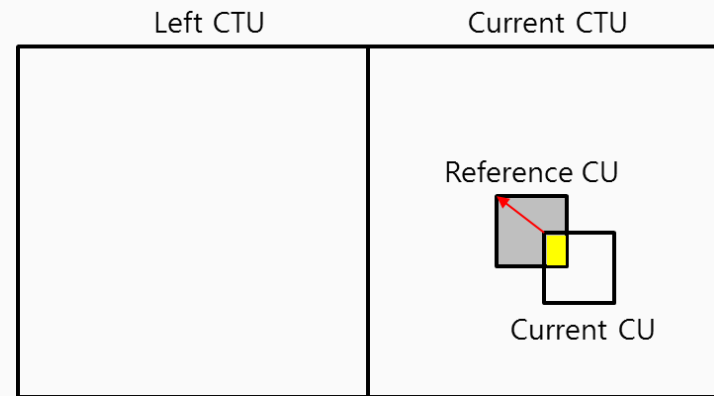
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Conclusion

- At the last meeting in Vienna, intra block copy (IBC) was adopted.
- Since the current CU should be predicted inside the same slice, **the motion vector (MV) which points at the reference CU including unavailable samples is considered as an invalid MV and not used in intra block copy.**
- An example of such invalid MVs is a MV points at the reference CU which overlaps with the current CU to be predicted, as shown below.
- The main idea of this contribution is **to make those MVs valid by generating (padding) unavailable samples in the overlapped region.**



IBC with a valid MV

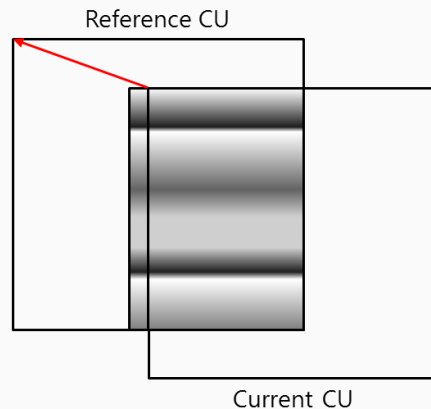


IBC with an invalid MV

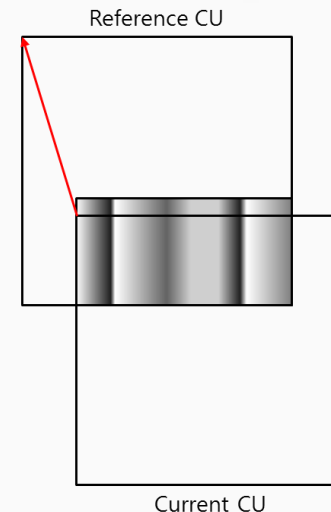
Algorithm Description (1/2)



- When the reference CU overlaps with the current CU to be predicted, **unavailable samples in the overlapped region are generated by copying the samples from either horizontal or vertical directions depending on the MV.**
 - The proposed method is invoked when $-W < MV_x \leq 0$ and $-H < MV_y \leq 0$, where W and H are width and height of the current CU, MV_x and MV_y are horizontal and vertical components of the $MV = (MV_x, MV_y)$, respectively.
 - The samples are copied from the rightmost column of the left CU when $|MV_y| \leq |MV_x|$, otherwise from the bottommost row of the above CU, as shown below.



Copied from left when $|MV_y| \leq |MV_x|$



Copied from above when $|MV_y| > |MV_x|$



- The proposed method is combined with the **MV prediction from the left CU**.
- When the left CU is available and coded in IBC mode ($intra_bc_flag = 1$), the MV from the left CU is used as a MV predictor for the current CU.
- This simplest MV prediction method provides the additive coding gain on top of the proposed extension method.



- Anchor: HM12.0-RExt4.1 (AHG8, lossy coding anchor)
- Tested results: Generation of unavailable samples in the overlapped region
- The coding gain for SC YUV 444 is -0.8% in AI-MT, -0.6% in RA-MT, and -1.1% in LB-MT, respectively.

BD-rate Y	AI-MT	AI-HT	AI-SHT	RA-MT	RA-HT	LB-MT	LB-HT
Class F	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%	-0.1%	-0.1%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC RGB 444	-0.9%	-0.9%	-0.9%	-0.6%	-0.8%	-0.7%	-0.6%
Animation RGB	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC YUV 444	-0.8%	-0.9%	-0.9%	-0.6%	-0.6%	-1.1%	-0.9%
Animation YUV	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC(444) GBR	-3.0%	-3.2%	-3.1%	-2.1%	-2.3%	1.0%	0.2%
SC(444) YUV	-1.7%	-1.7%	-1.7%	-2.0%	-1.9%	-2.5%	-1.9%
Enc Time[%]	102%	102%	101%	101%	101%	101%	101%
Dec Time[%]	96%	96%	96%	102%	102%	105%	105%

Test Results (2/4)



- Anchor: HM12.0-RExt4.1 (AHG8, lossless coding anchor)
- Tested results: Generation of unavailable samples in the overlapped region
- The bit-rate saving for SC YUV 444 is 0.5% in AI-Main, 0.4% in RA-Main, and 0.3% in LB-Main, respectively.

Bit-rate saving (Average)	AI-Main	RA-Main	LB-Main
Class F	0.1%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%
SC RGB 444	0.6%	0.3%	0.2%
Animation RGB	0.0%	0.0%	0.0%
SC YUV 444	0.5%	0.4%	0.3%
Animation YUV	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%
SC(444) GBR	1.1%	0.8%	0.3%
SC(444) YUV	1.3%	1.4%	-0.1%
Enc Time[%]	101%	100%	100%
Dec Time[%]	98%	99%	100%

Test Results (3/4)



- Anchor: HM12.0-RExt4.1 (AHG8, lossy coding anchor)
- Tested results: Generation of unavailable samples in the overlapped region combined with MV prediction from left CU
- The coding gain for SC YUV 444 is -2.5% in AI-MT, -1.8% in RA-MT, and -2.0% in LB-MT, respectively.

BD-rate Y	AI-MT	AI-HT	AI-SHT	RA-MT	RA-HT	LB-MT	LB-HT
Class F	-1.1%	-0.8%	-0.6%	-0.8%	-0.6%	-0.7%	-0.5%
Class B	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC RGB 444	-1.9%	-1.7%	-1.5%	-1.4%	-1.3%	-1.3%	-1.2%
Animation RGB	-0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%
SC YUV 444	-2.5%	-2.1%	-1.8%	-1.8%	-1.5%	-2.0%	-2.0%
Animation YUV	-0.1%	-0.1%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC(444) GBR	-6.3%	-6.3%	-5.9%	-5.1%	-5.0%	-2.4%	-3.4%
SC(444) YUV	-4.9%	-4.3%	-3.8%	-5.0%	-4.4%	-4.9%	-3.9%
Enc Time[%]	103%	102%	102%	101%	101%	101%	101%
Dec Time[%]	97%	96%	96%	102%	101%	102%	103%



- Anchor: HM12.0-RExt4.1 (AHG8, lossless coding anchor)
- Tested results: Generation of unavailable samples in the overlapped region combined with MV prediction from left CU
- The bit-rate saving for SC YUV 444 is 0.8% in AI-Main, 0.7% in RA-Main, and 0.6% in LB-Main, respectively.

Bit-rate saving (Average)	AI-Main	RA-Main	LB-Main
Class F	0.4%	0.3%	0.3%
Class B	0.0%	0.0%	0.0%
SC RGB 444	0.9%	0.7%	0.4%
Animation RGB	0.0%	0.0%	0.0%
SC YUV 444	0.8%	0.7%	0.6%
Animation YUV	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%
SC(444) GBR	1.8%	1.5%	0.7%
SC(444) YUV	2.5%	2.5%	0.8%
Enc Time[%]	101%	100%	101%
Dec Time[%]	99%	100%	101%



- In this contribution, the extension of intra block copy is proposed.
- The proposed extension includes the reference sample generation and MV prediction from left CU.
- The combined coding gain for lossy coding is -2.5% in AI-MT, -1.8% in RA-MT, and -2.0% in LDB-MT for SC YUV 444, respectively.
- It is suggested that the proposed method is adopted into the next version of the HEVC Range Extensions text and reference software.

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THANK YOU

