

JCTVC-00205

AHG8: Line-based Intra Block Copy

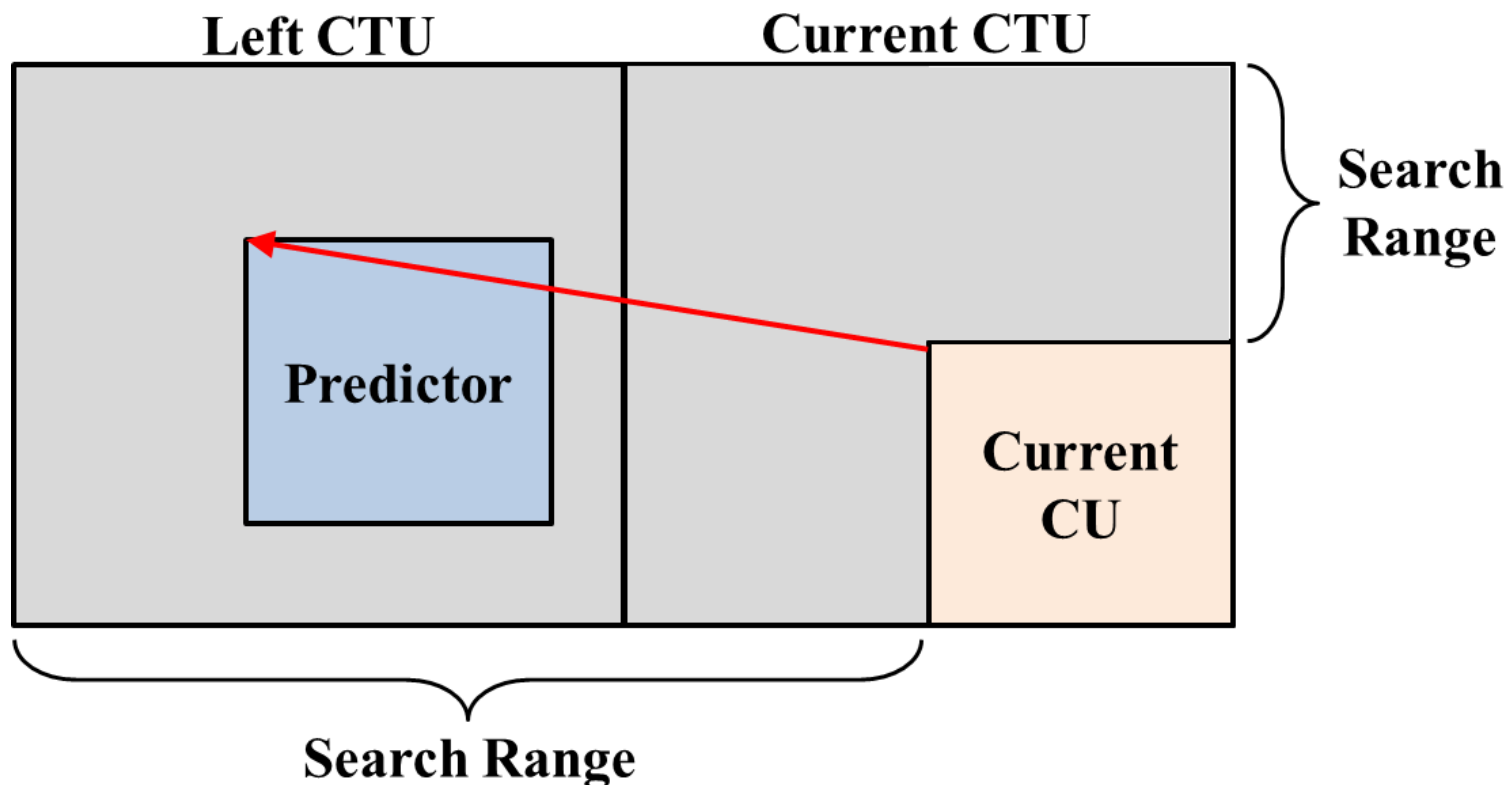
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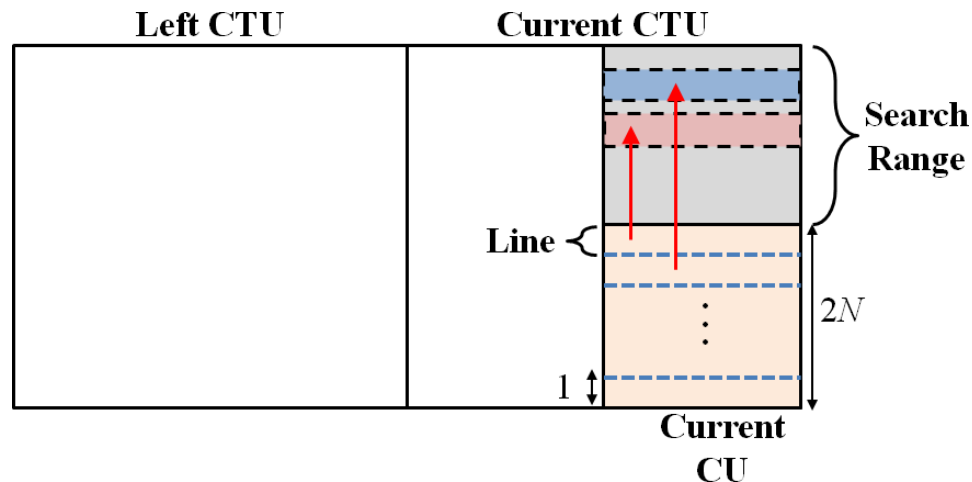
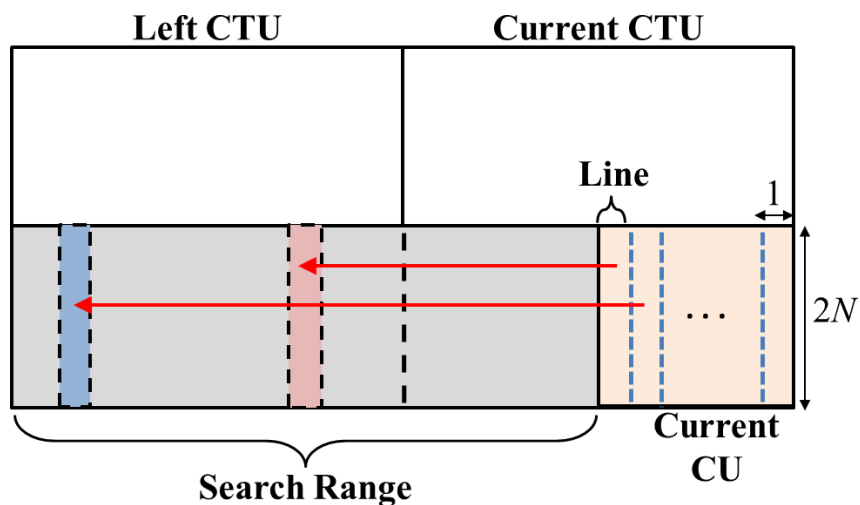
- * Relax the restriction that the basic unit for intra block copy must be $2N \times 2N$
- * Introduce additional units by dividing a CU equally into multiple partitions of size $M \times 2N$ or $2N \times M$
- * Evaluate performance for $M=1$ (line-based), 4, N
- * Y-BD-Rate savings for All Intra, MT/HT/SHT

	Class F	SC RGB 444	SC YUV 444	Enc.	Dec.
$M=1$	3.0/2.7/2.4	10.6/10.7/10.6	7.5/8.3/8.9	114%	97%
$M=4$	2.2/1.9/1.5	7.0 / 6.4 / 6.0	6.8/6.4/6.1	113%	94%
$M=N$	2.5/2.2/1.9	7.0 / 6.4 / 5.9	6.7/6.4/6.1	114%	94%

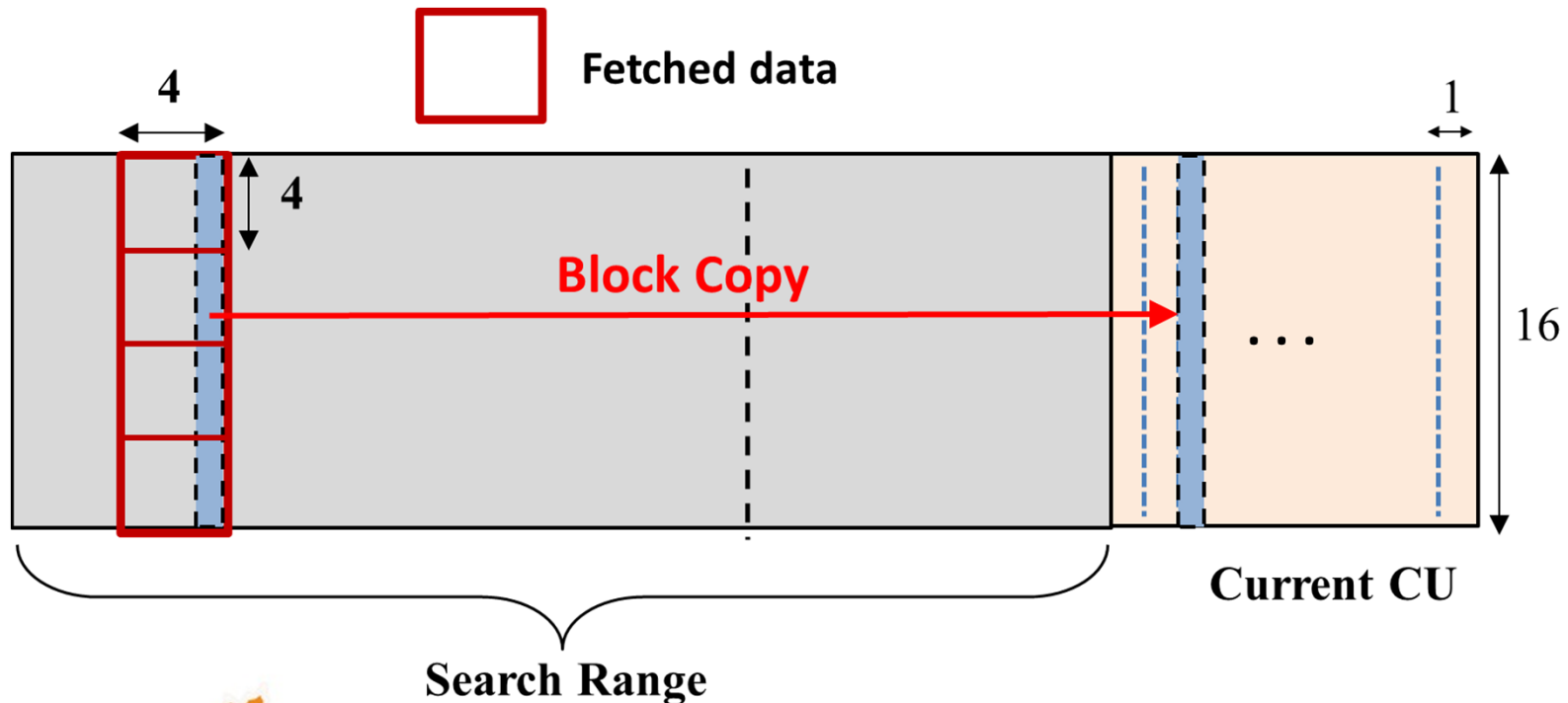
- * Searching the best match of a current CU (size $2N \times 2N$) within the area covering the left CTU and part of the current CTU



- * Divide a CU into lines of size $1 \times 2N$ or $2N \times 1$
 - $1 \times 2N$ (Column Mode): 1-D horizontal vector
 - $2N \times 1$ (Row Mode): 1-D vertical vector
- * Search area limited to the reconstructed region (gray)
- * One flag at CU level to signal its use, one for its mode



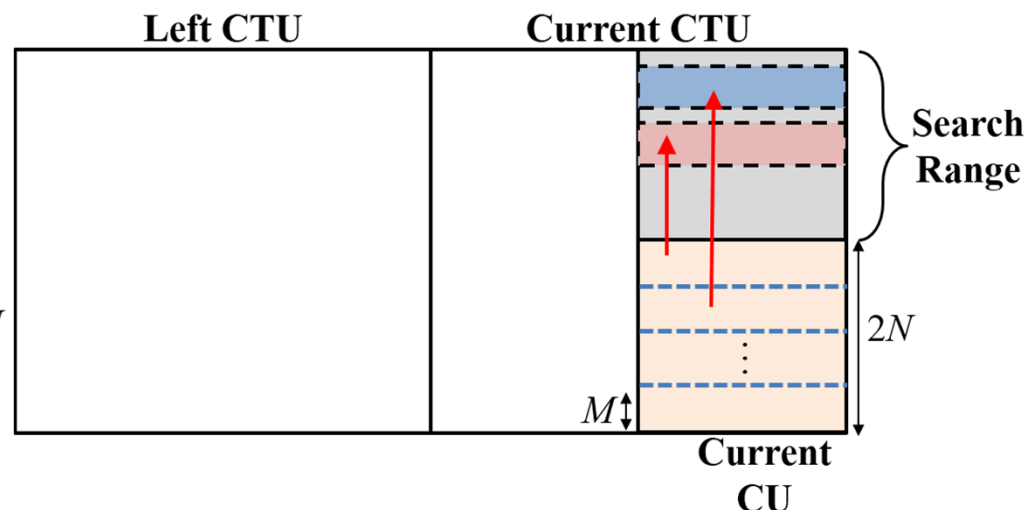
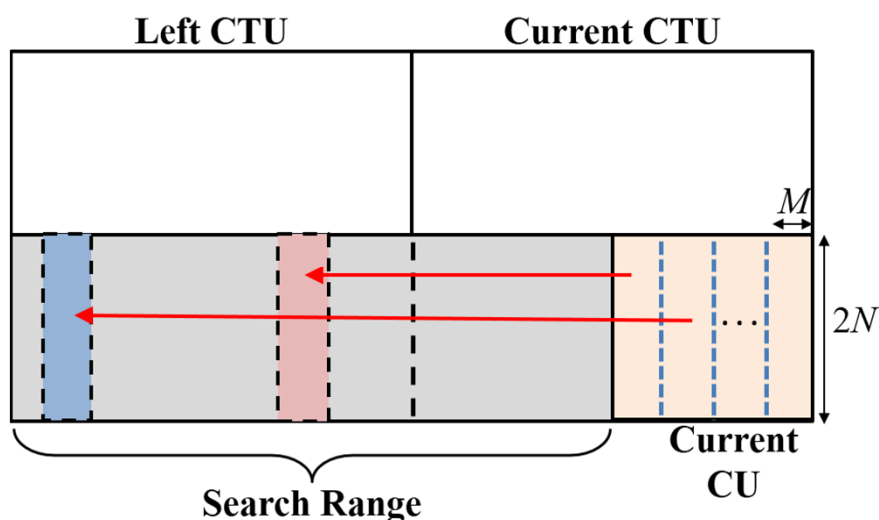
- * In some designs, fetching a column of pixels may be no different from fetching a column of blocks
- * Line-based fetching would imply higher memory access bandwidth



Mx2N/2NxM Intra Block Copy

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- * Generalization to Mx2N or 2NxM for bandwidth-performance trade-off, with
- * M=4 (4 columns or rows of pixels)
- * M=N (same as Nx2N/2NxN PU's)



- * HM-12.0+RExt-4.1 (Anchor) & RCE3 test conditions
- * One additional unit $M=1, 4, N$ at a time, besides $2N \times 2N$
- * Line-based ($M=1$) is most advantageous in PCB_layout,...
- * $M=4$ and $M=N$ perform almost identically

	All Intra HE Main-tier			All Intra HE High-tier			All Intra HE Super-High-tier		
	M=1	M=4	M=N	M=1	M=4	M=N	M=1	M=4	M=N
Class F	-3.0	-2.2	-2.5	-2.7	-1.9	-2.2	-2.4	-1.5	-1.9
Class B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC RGB 444	-10.6	-7.0	-7.0	-10.7	-6.4	-6.4	-10.6	-6.0	-5.9
Animation RGB 444	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.0
SC YUV 444	-7.5	-6.8	-6.7	-8.3	-6.4	-6.4	-8.9	-6.1	-6.1
Animation YUV 444	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
RangeExt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC(444) GBR Optional	-13.5	-7.7	-7.7	-14.1	-7.6	-7.6	-14.6	-7.5	-7.5
SC(444) YUV Optional	-13.4	-8.6	-8.5	-15.0	-8.6	-8.4	-16.8	-8.7	-8.6
Enc Time[%]	114%	112%	113%	114%	113%	114%	114%	113%	114%
Dec Time[%]	97%	94%	94%	97%	94%	94%	97%	94%	94%

U-BD-Rate Comparison

	All Intra HE Main-tier			All Intra HE High-tier			All Intra HE Super-High-tier		
	M=1	M=4	M=N	M=1	M=4	M=N	M=1	M=4	M=N
Class F	-2.6	-2.1	-2.5	-2.4	-1.8	-2.2	-2.1	-1.5	-1.9
Class B	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
SC RGB 444	-10.4	-6.9	-6.9	-10.5	-6.4	-6.4	-10.3	-6.0	-5.9
Animation RGB 444	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.0
SC YUV 444	-5.0	-4.8	-4.8	-5.5	-4.6	-4.5	-6.0	-4.2	-4.2
Animation YUV 444	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	-0.1
RangeExt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC(444) GBR Optional	-13.5	-7.9	-7.7	-14.0	-7.6	-7.5	-14.5	-7.5	-7.4
SC(444) YUV Optional	-13.1	-8.5	-8.3	-14.6	-8.5	-8.3	-16.3	-8.6	-8.5
Enc Time[%]	114%	112%	113%	114%	113%	114%	114%	113%	114%
Dec Time[%]	97%	94%	94%	97%	94%	94%	97%	94%	94%

V-BD-Rate Comparison

	All Intra HE Main-tier			All Intra HE High-tier			All Intra HE Super-High-tier		
	M=1	M=4	M=N	M=1	M=4	M=N	M=1	M=4	M=N
Class F	-2.5	-2.1	-2.6	-2.4	-1.8	-2.2	-2.4	-1.5	-1.9
Class B	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
SC RGB 444	-10.6	-7.0	-7.0	-10.6	-6.4	-6.4	-10.6	-6.0	-5.9
Animation RGB 444	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.0
SC YUV 444	-5.2	-4.9	-4.8	-5.7	-4.6	-4.5	-8.9	-4.2	-4.2
Animation YUV 444	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	-0.1	0.0
RangeExt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC(444) GBR Optional	-13.5	-7.9	-7.7	-14.2	-7.7	-7.6	-14.6	-7.7	-7.6
SC(444) YUV Optional	-13.0	-8.6	-8.4	-14.5	-8.5	-8.4	-16.8	-8.6	-8.5
Enc Time[%]	114%	112%	113%	114%	113%	114%	114%	113%	114%
Dec Time[%]	97%	94%	94%	97%	94%	94%	97%	94%	94%

- * Compared to $M=4$ and $M=N$, the line-based scheme shows rather limited additional gains, except in PCB_layout, CAD_waveform and etc.
- * $M=4$ and $M=N$ perform almost identically, and they both provide 5-7% gains in SC sequences
- * Since $M=N$ ($N \times 2N / 2N \times N$) is already supported by HEVC Version 1, it may be worth considering allowing intra block copy to be performed on such PU's