

Multiple Reference Line Coding for Most Probable Modes in Intra Prediction

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Intra-picture prediction as in HEVC exploits the nearest reference line adjacent to the current coding unit (CU) for prediction of samples. If this reference line represents a discontinuity, the reference samples in this reference line can differ to a large extent from the original samples and may lead to a large prediction error. We propose a multiple reference lines (MRLs) coding to allow not only the nearest reference line 0 but also reference lines 1 and 3 to be candidates for angular intra prediction as shown in Fig. 1. To reduce the complexity arising from additional lines to be checked at encoder side, we further propose to restrict the MRL to angular most probable modes (MPMs) only. The MRL coding signals the reference line index before the intra prediction mode. This allows to not signal the MPM flag of the current CU and implicitly derive it as true when a non-zero reference line index is signaled.

Experimental results are provided to evaluate the performance of the proposed MRL coding on top of the VVC test model VTM-2.0.1. 26 test sequences in different categories, including 4k, 1080p, 720p, WVGA, WQVGA resolutions and screen contents are tested. Two coding structures are evaluated, all intra (AI) and random access (RA). The objective coding efficiency is measured in terms of Bjøntegaard Delta (BD) rate (%) computed using four rate/PSNR points that were generated by using quantization parameters 22, 27, 32 and 37. Lower (negative) BD-rate implies better compression rate. Table 1 shows that the presented MRL provides 0.46% bitrate savings for an all-intra and 0.2% for a random-access configuration on average. Furthermore, it provides 1.45% bitrate reduction for screen content test sequences, which are representing an increasingly important video application. Because of a fairly good trade-off between coding efficiency and complexity, the proposed MRL coding mode with MPM restriction was adopted into the current VVC draft standard.

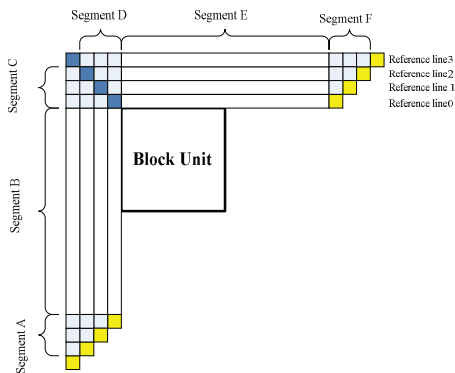


Figure 1: 3 additional reference lines.

Table 1: Summarized luma BD-rate of the MRL with MPM restriction

Category	MRL	
	AI	RA
4K-A1	-0.11%	-0.11%
4K-A2	-0.28%	-0.21%
1080p	-0.48%	-0.23%
WVGA	-0.82%	-0.25%
720p	-0.48%	
Average-CTC	-0.46%	-0.20%
Encoding / Decoding time	102/98%	100/100%
WQVGA	-0.22%	-0.02%
Screen Content	-1.45%	-0.96%