
CE7-RELATED: JOINT CHROMA RESIDUAL CODING WITH MULTIPLE MODES

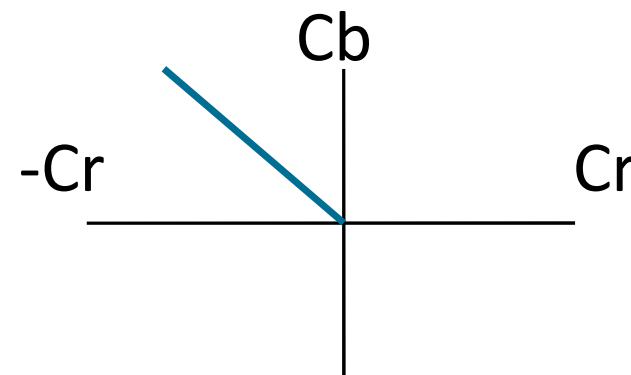
C. Helmrich, C. Rudat, T. Nguyen,
H. Schwarz, D. Marpe, T. Wiegand
Fraunhofer HHI

Input document JVET-N0282



Introduction: JVET-M0305 and CE7-1

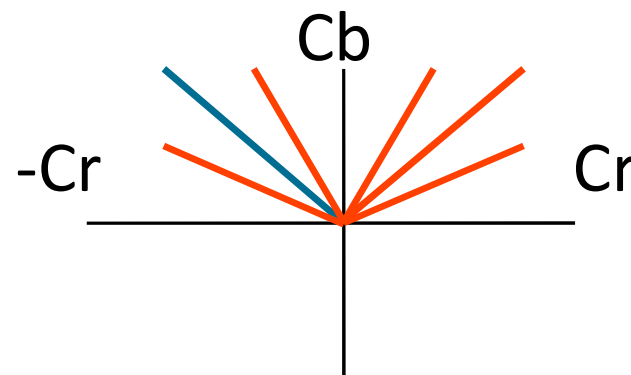
- JVET-M0305 proposed TU-selective joint coding of chroma residuals as single residual
- **Principle:** quantize and encode downmix of chroma residuals, upmix it at decoder
 - Fixed upmix weights 1 (Cb) and -1 (Cr), i. e., $\text{resi}_{\text{Cr}} = -\text{resi}_{\text{Cb}}$, using QP offset of -2
- One additional R/D test per chroma TU in encoder search-loop, 103% encoding time
 - BD-R gain: about 0.38% AI, 0.26% RA, 0.07% LD, no increase in decoding time
- Joint-chroma mode signaled via $\text{cbf}_{\text{Cb}} = 1$ and $\text{cbf}_{\text{Cr}} = 1$ (but only one residual coded)



Proposal: Extension of CE7-1 for More Flexibility

- JVET-N0282 extends CE7-1 by providing **5** further downmix characteristics (**6** in total)
- **Principle:** let encoder choose from **3** different joint-chroma modes, R/D test best mode
 - More upmix weights: ± 1 or ± 0.5 (Cb), ± 1 or ± 0.5 (Cr)*, using QP offset of -2 or -1
- Still only one additional R/D test per chroma TU in search-loop, 103% encoding time
 - BD-R gain: **0.58%** AI, **0.34%** RA, 0.03% LD, still no increase in decoding time
- Joint-chroma mode signaled via $\text{cbf}_{\text{Cb}} = 1$ **or** $\text{cbf}_{\text{Cr}} = 1$ (one residual, **3** possible modes)

* weight signs (CSign) signaled per slice in slice header



Algorithmic Details of N0282 Proposal

- Two proposal configurations: **ver. A** with single-channel modes, **ver. B** incl. Hadamard mode
- Fixed joint-mode dependent chroma QP offsets for "rate-reduction vs. BD-R gain" tradeoff
- Encoder, **ver. A**: low-complexity pre-selection of "best" mode, R/D test only that mode
- Encoder, **ver. B**: pre-selection of non-Hadamard mode, R/D test that and Hadamard mode

cbf		ver. A		ver. B	
Cb	Cr	mode	joint synth.	mode	joint synth.
1	0	1	$C_b = C, C_r = \pm C/2$	2	$C_b = C, C_r = \pm C$
1	1	2	$C_b = C, C_r = \pm C$	Had.	$C_b = C_1 \pm C_2, C_r = C_1 \mp C_2$
0	1	3	$C_r = C, C_b = \pm C/2$	1 or 3	$C_b = C, C_r = \pm C/2$ or $C_r = C, C_b = \pm C/2$

ver. B: choice of mode 1 or 3 signaled per slice in slice header

BD-Rate Results of N0282 Proposal

- On CTC, ver. A has more gain in AI, RA than CE7-1 with same runtimes → large gains over VTM 4.0

N0282		versus VTM 4.0					versus CE7-1				
		Y	Cb	Cr	encT	decT	Y	Cb	Cr	encT	decT
AI	ver. A	-0.58%	-0.76%	-1.13%	103%	100%	-0.20%	-0.29%	0.38%	100%	99%
	ver. B	-0.67%	-0.67%	-1.12%	107%	98%	-0.30%	-0.20%	0.38%	104%	98%
RA	ver. A	-0.34%	-2.53%	-1.74%	102%	100%	-0.07%	-1.79%	-0.86%	101%	100%
	ver. B	-0.37%	-2.28%	-1.68%	104%	100%	-0.10%	-1.53%	-0.81%	102%	100%
LD	ver. A	-0.03%	-1.47%	-4.95%	101%	100%	0.03%	1.56%	-0.26%	100%	98%
	ver. B	-0.03%	-1.02%	-4.34%	104%	100%	0.03%	2.01%	0.47%	103%	98%

Summary and Conclusions

- JVET-N0282 provides significant **gain** over adopted CE7-1, with **no** runtime increase for ver. A
- Conclusion: ver. A is cross-checked and appears mature, adoption of N0282 ver. A is requested
- Thanks to K. Misra (Sharp) for cross-checking