

JCTVC-L0057
PERFORMANCE OF COMBINED ADAPTIVE
FILTER AND SKIP SLICE TOOLS

Yong He, Yuwen He, Xiaoyu Xiu, Yan Ye

InterDigital Communications, LLC

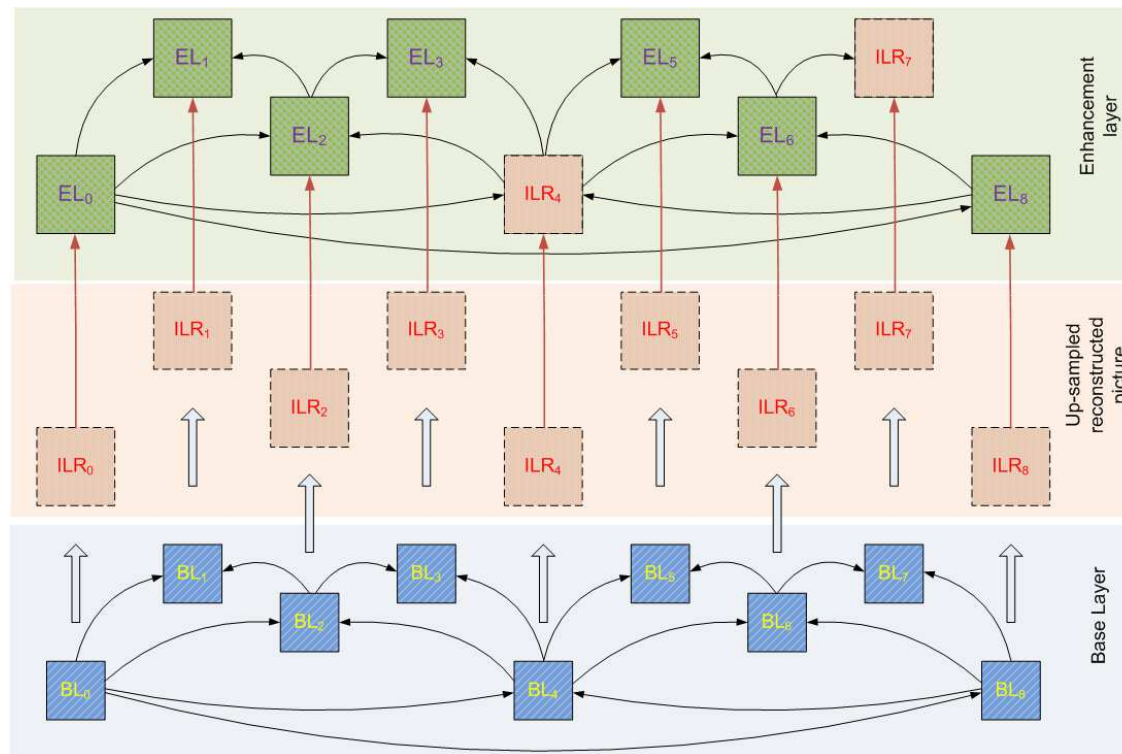
Tomoyuki Yamamoto, Yukinobu Yasugi

SHARP Corporation

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TE2 3.3.1 EL Skipped Slice (ELSkip)

- Uses inter-layer processed BL reconstructed picture as EL reconstruction.
- Sophisticated inter-layer processing techniques can enhance ELSkip performance.



- This contribution evaluates one such combination: EL skip + Adaptive Filter

TE4 4.4.1 Inter-layer Adaptive Filter (AF)

- Minimize the distortion between up-sampled base layer reconstruction and original enhancement layer picture.
- Symmetric filter applied for both luma and chroma with independent on/off flag
- Best performance among TE4 inter-layer filtering tools

Test	Avg. BD-rate spatial (2X, 1.5X)					Avg. BD-rate SNR				
	Y	U	V	Enc. Time	Dec. Time	Y	U	V	Enc. Time	Dec. Time
4.1.1	-0.3%	0.0%	0.0%	103%	111%	0.0%	0.0%	0.0%	102%	106%
	-0.3%	0.0%	0.0%	102%	116%	0.0%	0.0%	0.0%	101%	104%
4.1.2	-0.1%	-0.1%	0.0%	100%	101%	0.0%	0.0%	0.0%	101%	102%
4.2.1	-0.5%	0.1%	0.1%	102%	100%	-2.5%	0.1%	0.3%	102%	126%
4.3.1	-0.2%	-0.4%	-0.4%	100%	103%	-0.4%	-0.8%	-0.8%	100%	105%
4.3.2	-0.3%	-0.1%	-0.1%	100%	109%	-0.4%	0.0%	0.1%	100%	111%
4.4.1	-0.4%	-0.7%	-0.5%	106%	188%	-2.9%	-1.4%	-0.9%	104%	212%
4.4.2	-0.3%	-0.5%	-0.2%	100%	102%	-2.7%	-1.6%	-1.1%	100%	104%
4.4.3	-0.2%	-0.5%	-0.4%	108%	98%	-2.3%	-1.3%	-1.0%	104%	102%
5.5.1	-0.1%	0.0%	0.0%	100%	100%	-0.1%	0.0%	0.0%	100%	101%

Simulation Results (AF+ELSkip vs. Simulcast)

	AI HEVC 2x			AI HEVC 1.5x		
	Y	U	V	Y	U	V
Class A	-27.2%	-27.7%	-28.5%			
Class B	-21.3%	-21.6%	-21.3%	-33.0%	-33.5%	-33.5%
Overall (EL+BL)	-23.0%	-23.4%	-23.4%	-33.0%	-33.5%	-33.5%
Overall (EL)	-35.1%	-35.8%	-36.0%	-58.8%	-59.1%	-59.3%
Enc Time[%]		127.0%			120.4%	
Dec Time[%]		172.2%			161.8%	
BL Match		Matched			Matched	

	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-18.7%	-8.2%	-9.6%				-24.9%	-14.1%	-13.4%
Class B	-15.4%	-9.0%	-7.6%	-26.2%	-20.5%	-18.8%	-20.4%	-11.4%	-7.9%
Overall (EL+BL)	-16.3%	-8.8%	-8.2%	-26.2%	-20.5%	-18.8%	-21.7%	-12.1%	-9.5%
Overall (EL)	-25.2%	-13.5%	-12.8%	-47.2%	-38.3%	-35.4%	-34.3%	-20.4%	-16.5%
Enc Time[%]		119.1%			115.9%			113.1%	
Dec Time[%]		300.0%			282.0%			205.9%	
BL Match		Matched			Matched			Matched	

	LD-P HEVC 2x			LD-P HEVC 1.5x			LD-P HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-13.9%	-2.4%	-3.6%				-19.3%	-10.2%	-9.1%
Class B	-12.0%	-7.2%	-5.2%	-22.2%	-17.6%	-15.7%	-14.6%	-6.5%	-2.4%
Overall (EL+BL)	-12.5%	-5.8%	-4.7%	-22.2%	-17.6%	-15.7%	-16.0%	-7.5%	-4.3%
Overall (EL)	-20.0%	-9.1%	-7.6%	-41.1%	-33.5%	-30.2%	-25.6%	-14.3%	-9.5%
Enc Time[%]		117.2%			111.6%			109.1%	
Dec Time[%]		314.5%			284.3%			211.7%	
BL Match		Matched			Matched			Matched	

Simulation Results

- The performance gain of AF is additive to EL-Skip tool (anchor: ELSkip)

	AI HEVC 2x			AI HEVC 1.5x					
	Y	U	V	Y	U	V			
Class A	-0.3%	-1.0%	-1.0%						
Class B	-0.4%	-0.5%	-0.5%	-0.7%	-1.0%	-1.1%			
Overall (EL+BL)	-0.4%	-0.7%	-0.7%	-0.7%	-1.0%	-1.1%			
Overall (EL)	-0.7%	-1.5%	-1.4%	-2.8%	-3.7%	-3.3%			
	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.3%	-0.6%	-0.6%				-4.7%	-2.6%	-2.0%
Class B	0.2%	0.2%	0.3%	-0.3%	-0.4%	0.0%	-1.3%	-0.4%	0.2%
Overall (EL+BL)	0.0%	0.0%	0.1%	-0.3%	-0.4%	0.0%	-2.2%	-1.0%	-0.4%
Overall (EL)	0.0%	-0.2%	0.0%	-1.3%	-1.6%	0.1%	-4.6%	-2.5%	-1.3%
	LD-P HEVC 2x			LD-P HEVC 1.5x			LD-P HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.4%	-0.9%	-0.9%				-6.7%	-3.2%	-3.0%
Class B	-0.3%	-0.4%	-0.3%	-0.8%	-1.2%	-0.7%	-2.2%	-1.3%	-0.6%
Overall (EL+BL)	-0.4%	-0.6%	-0.4%	-0.8%	-1.2%	-0.7%	-3.5%	-1.9%	-1.3%
Overall (EL)	-0.8%	-1.3%	-1.0%	-2.9%	-4.4%	-2.6%	-6.5%	-4.1%	-3.1%

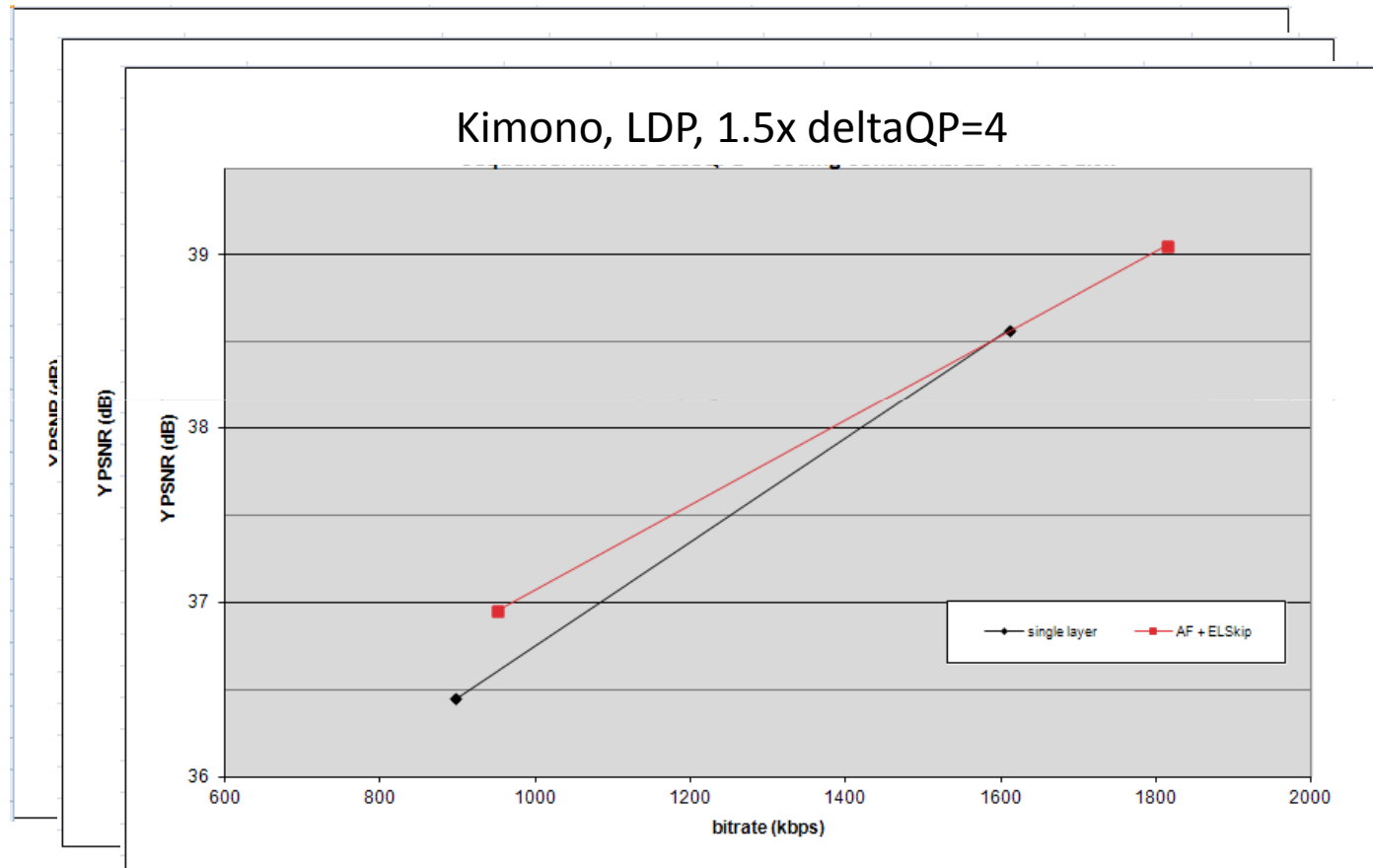
- ELSkip adds further gain (up to 0.7%) on top of AF (anchor: AF)

	AI HEVC 1.5x			RA HEVC 1.5x			LD-P HEVC 1.5x		
	Y	U	V	Y	U	V	Y	U	V
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Overall (EL+BL)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Overall (EL)	-0.4%	-0.4%	-0.4%	-0.1%	0.0%	-0.3%	-0.7%	0.4%	0.1%

- ELSkip gain is more by combining AF than ELSkip gain in SMuC (w/o AF)

Simulation Results (AF+ELSkip vs. AF)

- In some cases, the coding efficiency is comparable to single layer coding



Simulation Results

- The number of skipped slice is increased with inter-layer adaptive filter

	Without AF		With AF	
LD-P 1.5x	# EL Skipped slice	% EL skipped slice	# EL Skipped slice	% EL skipped slice
Kimono QP26/28	13	5.4%	16	6.7%
Kimono QP26/30	85	35.4%	91	37.9%
Kimono QP30/32	38	15.8%	54	22.5%
Kimono QP30/34	236	98.3%	240	100.0%

- The decoding time can be reduced by more skipped slice

LD-P 1.5x	AF decoding time (sec.)	AF + ELSkip decoding time (sec.)	percentage
Kimono QP26/28	93.813	91.245	97.3%
Kimono QP26/30	96.162	85.825	89.3%
Kimono QP30/32	91.483	85.473	93.4%
Kimono QP30/34	94.147	69.093	73.4%

Conclusions

- EL skip slice tool improves the coding performance with extra decoding complexity reduction
- EL skip slice can be used to reduce encoding complexity too
 - Encoder decision can also consider complexity
- Sophisticated inter-layer processing techniques can further enhance the EL Skip performance.
- Recommend to adopt for SHVC