JCTVC-N0106
Generalized residual prediction with motion vector clipping
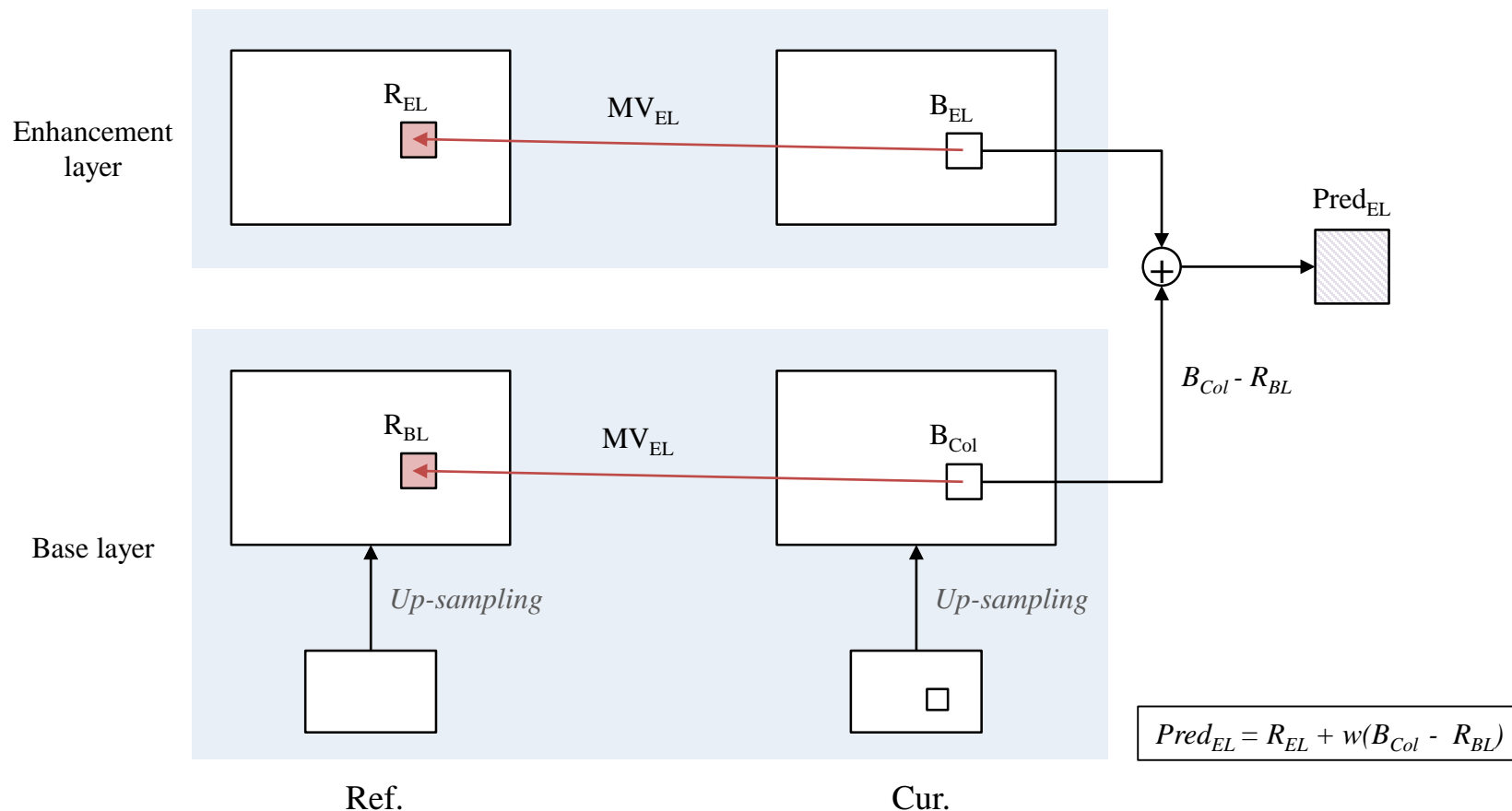
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Contents
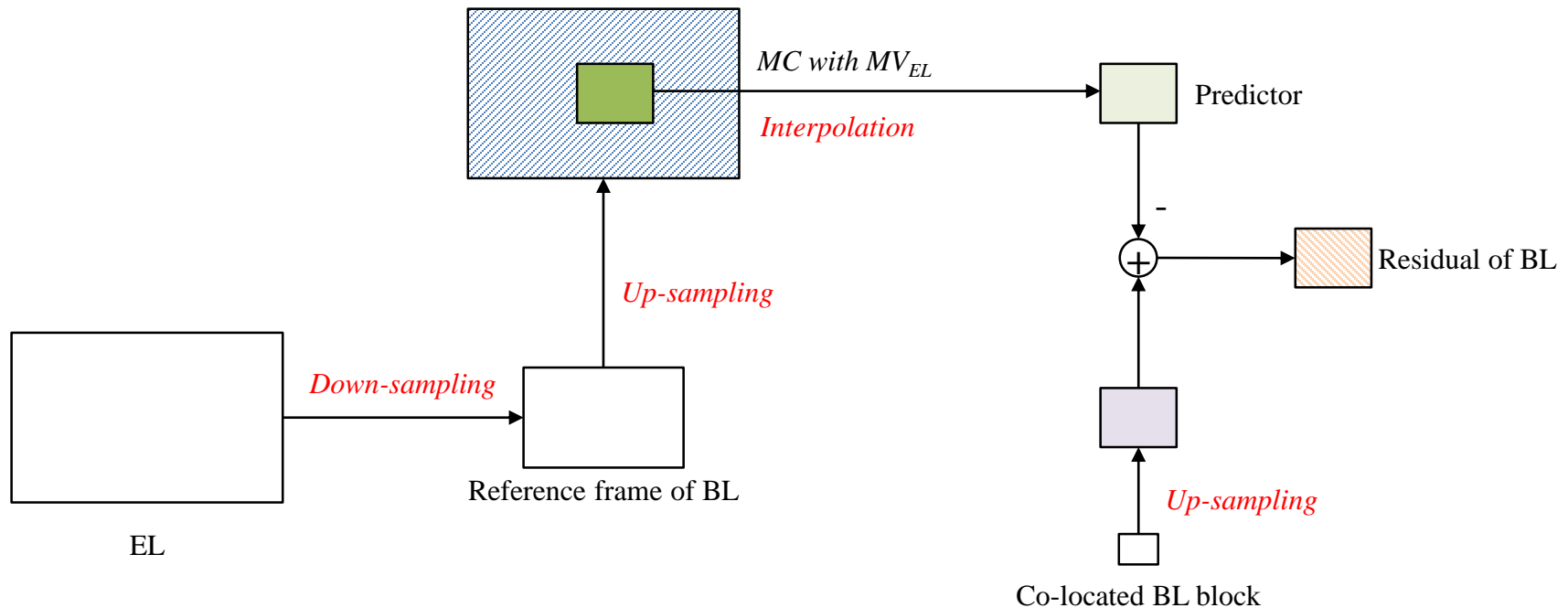
- Introduction
- Proposed Method
- Performance
- Conclusion

Introduction

- Conventional generalized residual prediction (GRP)

Enhancement layer

R_{EL} MV_{EL} B_{EL}

$Pred_{EL}$

$B_{Col} - R_{BL}$

Base layer

R_{BL} MV_{EL} B_{Col}

Up-sampling   Up-sampling

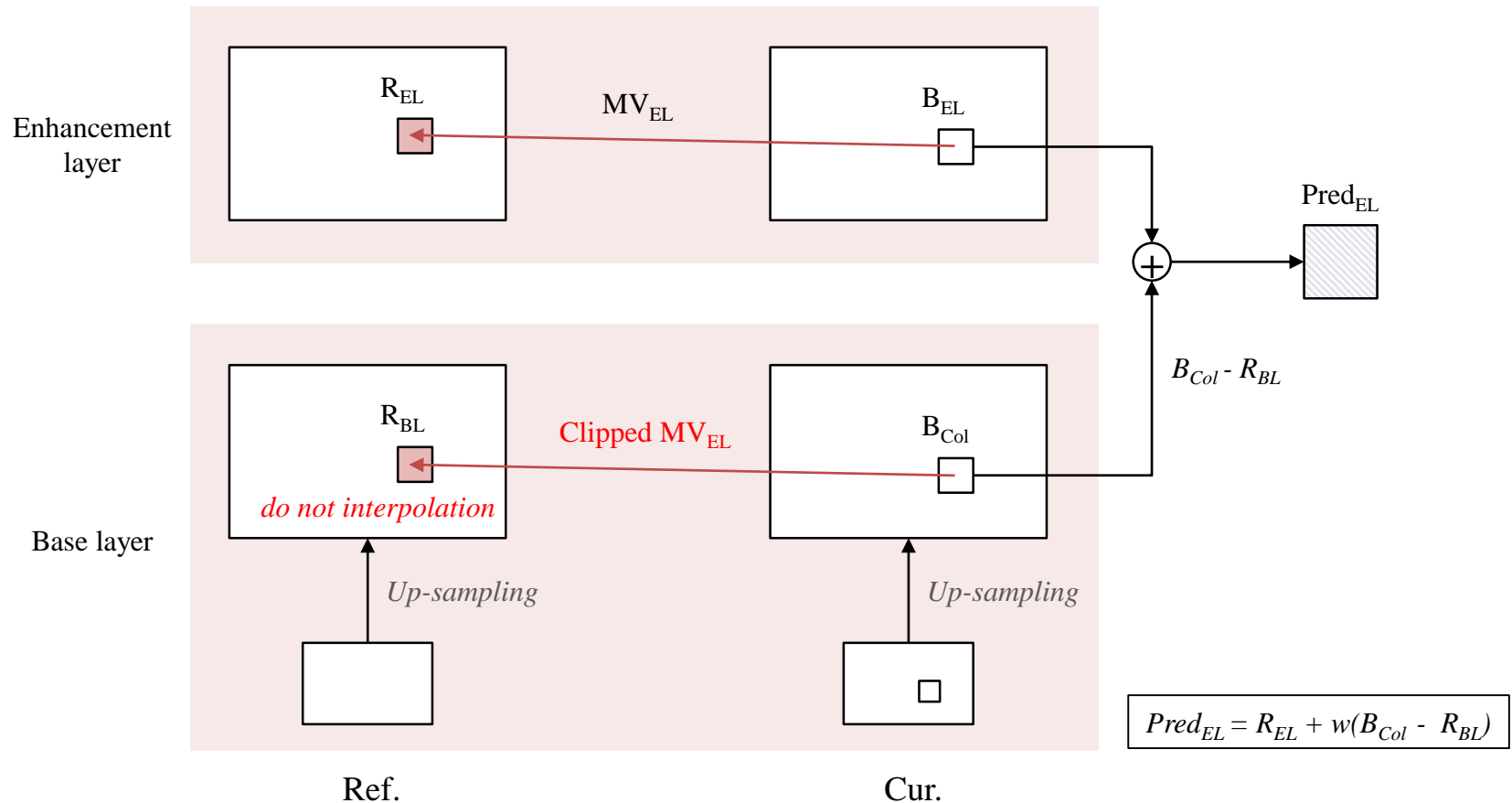$$Pred_{EL} = R_{EL} + w(B_{Col} - R_{BL})$$

Ref.   Cur.

Introduction

- Computation of BL residual
  - If MV_{EL} has fractional-pel accuracy, the up-sampled BL should be again interpolated accordingly.
  - The up-sampled BL has low bandwidth, compared to EL, interpolation of the up-sampled BL would not enhance prediction performance of GRP.

MC with MV_{EL}

Interpolation

Predictor

-

Residual of BL

Up-sampling

+

Up-sampling

Down-sampling

Reference frame of BL

EL

Co-located BL block

Proposed method

- Generalized residual prediction with clipped motion vector
  - The proposed method forgoes interpolation of the up-sampled BL and the residual is constructed with clipped MV to integer pixel unit.

$$Pred_{EL} = R_{EL} + w(B_{Col} - R_{BL})$$

Performance

- Test conditions

Anchor	SHM2.0-based IntraBL
Configuration	Random access
Spatial scalability	1.5x / 2x

	Test software
Test1	PU-level weighted GRP w = 0, 0.5 or 1
Test2	PU-level weighted GRP with MV clipping ($MV_{clip} = (MV_{EL} >> 2) << 2$) w = 0, 0.5 or 1

Performance

- Test result (Compared to SHM2.0 IntraBL)

Table 1. SHM2.0 vs. Conventional GRP

Test 1	RA HEVC 2x			RA HEVC 1.5x		
	Y	U	V	Y	U	V
Class A	-1.7%	-5.0%	-6.6%			
Class B	-0.9%	-4.0%	-4.8%	-0.9%	-5.5%	-6.1%
Overall (Test vs Ref)	-1.1%	-4.3%	-5.3%	-0.9%	-5.5%	-6.1%
Overall (Test vs single layer)	18.6%	28.6%	26.3%	16.6%	25.0%	24.7%
Overall (Ref vs single layer)	19.9%	34.7%	33.6%	17.5%	32.4%	32.9%
EL only (Test vs Ref)	-2.4%	-5.7%	-6.7%	-2.8%	-8.1%	-8.8%
Enc Time[%]	130.2%			114.8%		
BL Match	Matched			Matched		

Table 2. SHM2.0 vs. Proposed GRP

Test 2	RA HEVC 2x			RA HEVC 1.5x		
Proposed method	Y	U	V	Y	U	V
Class A	-0.8%	-3.1%	-4.6%			
Class B	-0.5%	-2.6%	-3.2%	-0.2%	-3.3%	-3.7%
Overall (Test vs Ref)	-0.6%	-2.8%	-3.6%	-0.2%	-3.3%	-3.7%
Overall (Test vs single layer)	19.2%	30.9%	28.7%	17.3%	28.0%	28.0%
Overall (Ref vs single layer)	19.9%	34.7%	33.6%	17.5%	32.4%	32.9%
EL only (Test vs Ref)	-1.4%	-3.6%	-4.5%	-1.3%	-4.8%	-5.3%
Enc Time[%]	115.1%			107.0%		
BL Match	Matched			Matched		

Conclusion

- This contribution proposes a method that reduces a computational complexity of GRP by removing interpolation with motion vector clipping.

- With the proposed method, encoding time increases by 11% and BD-rate decreases by 0.4% compared to SHM2.0.