

Improvement of HEVC Lossless Coding using Transform Coefficient Coding

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Motivation

- Lossless coding has many applications, e.g. medical image compression.
- However, the performance of the current HEVC lossless coding (HM7.1) is not satisfactory and need to be improved.
- The goal of this contribution is to propose an improved HEVC lossless coding method based on HEVC lossy coding framework.

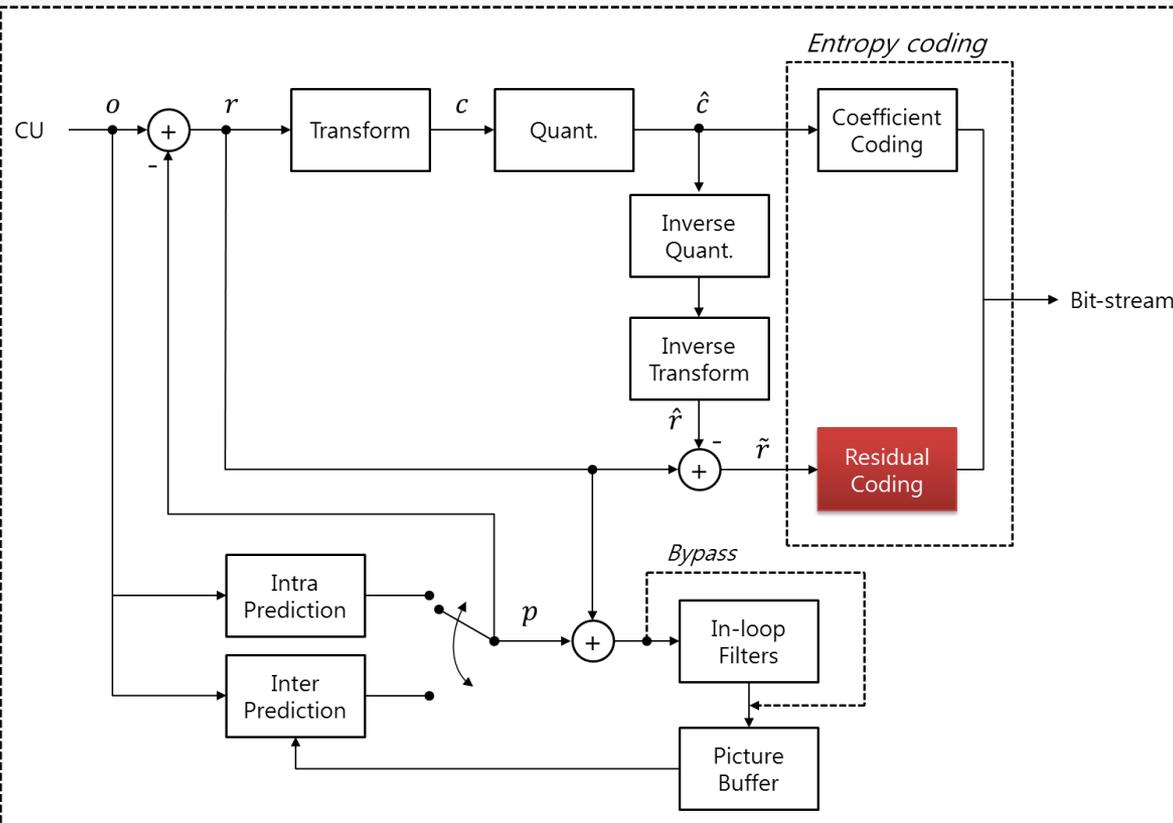
Current Design

- In the current design of HEVC, lossless coding is implemented by bypassing transform, quantization, and all the in-loop filtering (de-blocking, SAO, and ALF).
- The spatial residual, which is the difference between original and predicted CU, is directly signaled to the decoder.

Algorithm Description



- On top of HEVC lossy coding, the remaining residual is additionally signaled to the decoder to achieve lossless coding.
- Only in-loop filtering is bypassed.



o : Original CU

p : Intra/Inter-Predicted CU

r : Spatial residual
($r = o - p$)

c : Transform coefficients

\hat{c} : Quantized transform coefficients

\hat{r} : Reconstructed residual

\tilde{r} : Remaining residual
($\tilde{r} = r - \hat{r}$)



Simulation Set-up

- The proposed method is implemented on top of HM7.1.
- The simulation is performed using only All Intra Main and HE10 configurations.
- The performance of the proposed method combined with the sample-based angular prediction (SAP) proposed by JCTVC-I0117 is also provided.

Summary of the Results

- The **proposed method outperforms HM7.1 lossless coding by 8.8% and 8.3%** in All Intra Main and HE10 configurations (w/o Class F), respectively.
- The **SAP provides 1.9 ~ 2.8% additional gain on average** when combined with the proposed method.
- The complexity at the encoder side can be reduced by limiting the number of intra prediction modes to 3 (DC, Vertical, and Horizontal), and the performance degradation due to this limit is 1.3 ~ 2.4% on average.

Simulation Results (2/2)



	Proposed		Proposed + SAP		Proposed + SAP + 3 Intra pred. modes	
	AI Main	AI HE10	AI Main	AI HE10	AI Main	AI HE10
Class A	-12.4%	-11.6%	-14.5%	-13.8%	-13.3%	-12.1%
Class B	-7.4%	-6.8%	-8.1%	-8.3%	-6.7%	-7.7%
Class C	-8.0%	-7.7%	-9.5%	-10.0%	-5.7%	-7.8%
Class D	-9.1%	-9.8%	-11.5%	-13.0%	-8.8%	-11.3%
Class E	-6.7%	-5.3%	-10.8%	-12.0%	-9.5%	-11.7%
Overall (w/o F)	-8.8%	-8.3%	-10.8%	-11.2%	-8.7%	-9.9%
Overall (w/ F)	-8.3%	-7.9%	-10.9%	-11.7%	-8.5%	-10.1%
Class F	-5.8%	-5.5%	-11.4%	-13.2%	-7.5%	-11.0%
Enc Time	193%	158%	195%	156%	117%	90%
Dec Time	107%	101%	104%	94%	105%	92%



- In this contribution, **an improved HEVC lossless coding based on HEVC lossy coding framework** is proposed.
- The proposed method provides 8.8% and 8.3% coding gain in All Intra Main and HE10 configurations, respectively.
- We recommend adopting the proposed method in the HM.



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THANK YOU

