

Intra chroma prediction using inter-channel correlation

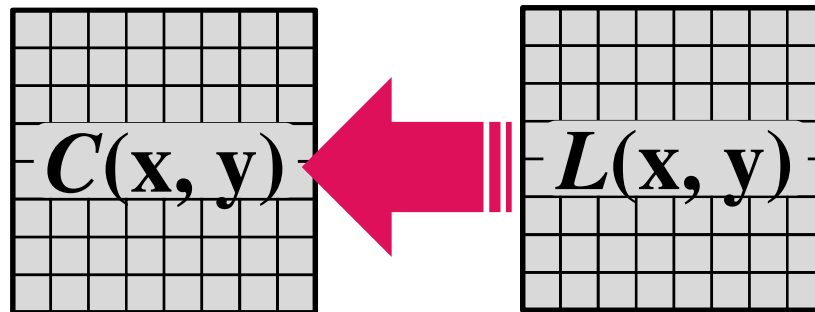
JCTVC-B021

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Introduction

- Propose a new ‘intra chroma prediction’
- Basic idea
 - Prediction of chroma from luma



- Using the correlation between chroma and luma

$$C[x, y] = \alpha \times L[x, y] + \beta$$

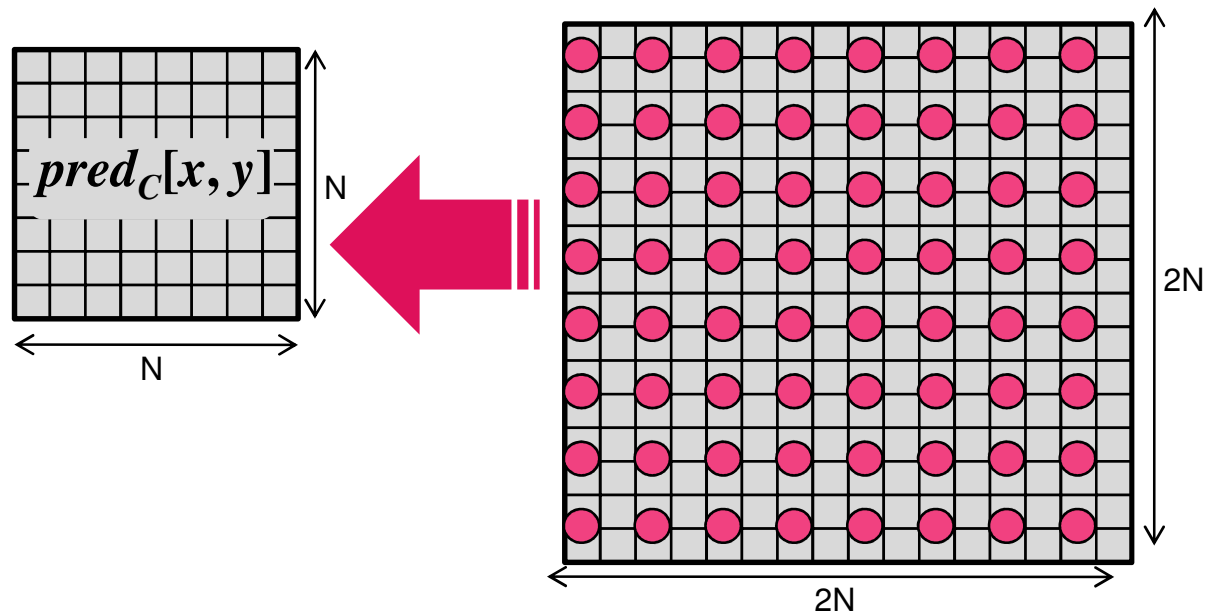
- Apply the idea to ‘intra chroma prediction’

Proposed method

- Use the reconstructed luma samples with same sampling position with chroma samples

$$pred_C[x, y]$$

$$= \alpha \times \{ (P_L[2x, 2y] + P_L[2x, 2y+1]) \gg 1 \} + \beta$$

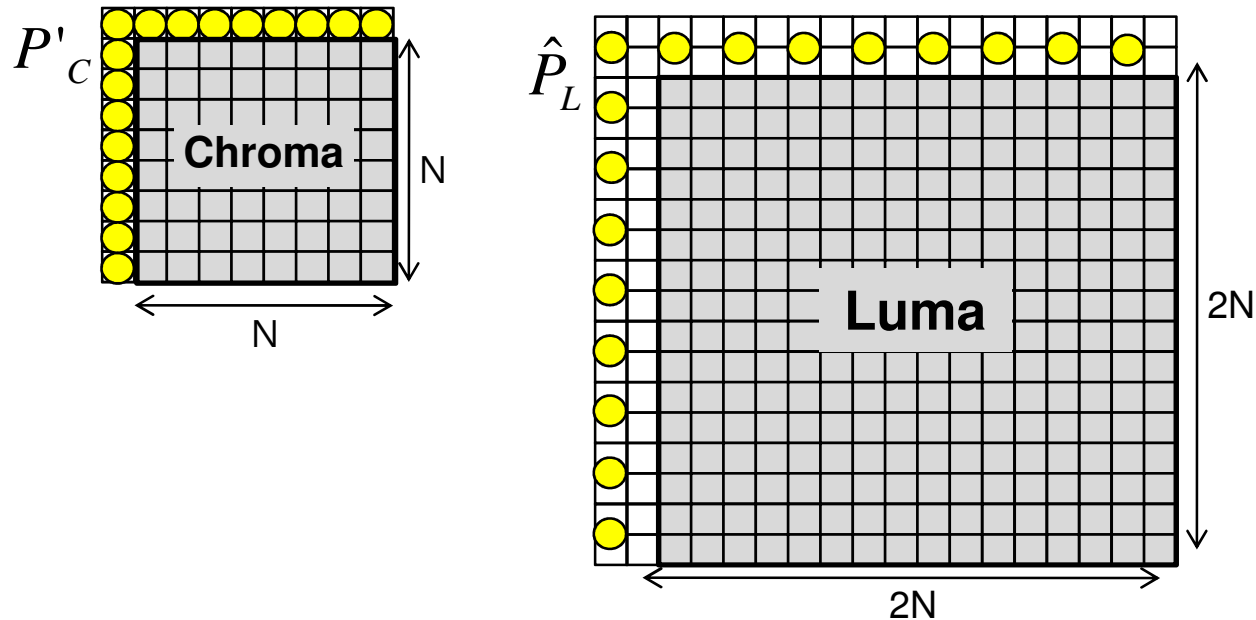


Proposed method

- **Derivation of parameters α and β**
 - Least-squares method
 - Neighboring samples around current block are used

$$\alpha = \frac{R(\hat{P}_L, P'_C)}{R(\hat{P}_L, \hat{P}_L)}, \quad \beta = M(P'_C) - \alpha \times M(\hat{P}_L)$$

$M(A)$: Mean of A $R(A, B) = M((A - M(A)) \times (B - M(B)))$



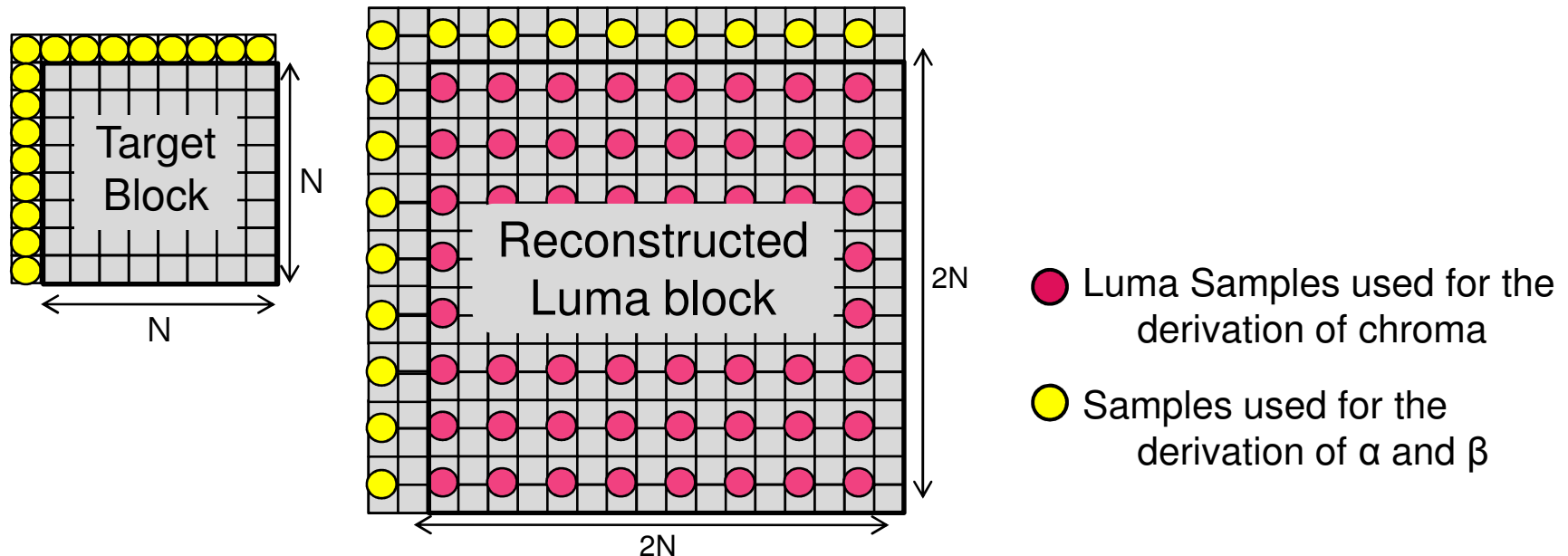
Proposed method

■ Summary

Prediction of chroma block

$= \alpha \times \text{Reconstructed luma samples with same sampling position with chroma samples} + \beta$

, where α and β are derived by least-squares method using **the neighboring pixels around target block**



Proposed method

- **Signaling of the proposed method**
 - 1bit flag (intra_chroma_estimation_flag)
 - 1 : Proposed method
 - 0 : Conventional method (e.g. H.264 intra chroma pred.)
- **Proposed method is applied to both U and V comp. in the same way**

Test conditions

- **Test conditions are based on JCTVC-B004 (Intra prediction AHG)**
 - Implemented on JM-KTA 2.6r1
 - Two QP sets
 - {22, 26, 30, 34} – Lower QPs
 - {26, 30, 34, 38} – Higher QPs
 - Coding configurations
 - Intro only coding
 - CS1 – GOP8
 - For Class A seq., bit-depth is set to 8 instead of 12 due to memory limitation
 - For CS1, Class A sequences are not tested due to lack of time
 - Comparison
 - **Anchor** (JM-KTA 2.6r1)
 - **Proposed** (JM-KTA 2.6r1 + proposed method)

Objective quality results

- BD Rate(%) for all sequences

Intra only coding		Lower QP set			Higher QP set		
		Y	U	V	Y	U	V
	Avg.	-1.59	-5.11	-4.09	-1.56	-7.42	-5.72
	Max.	-7.24	-11.44	-12.55	-8.08	-18.54	-18.83

CS1		Lower QP set			Higher QP set		
		Y	U	V	Y	U	V
	Avg.	-0.88	-5.25	-4.26	-0.97	-7.27	-5.88
	Max.	-3.05	-9.57	-8.52	-3.80	-13.88	-11.65

Objective quality results

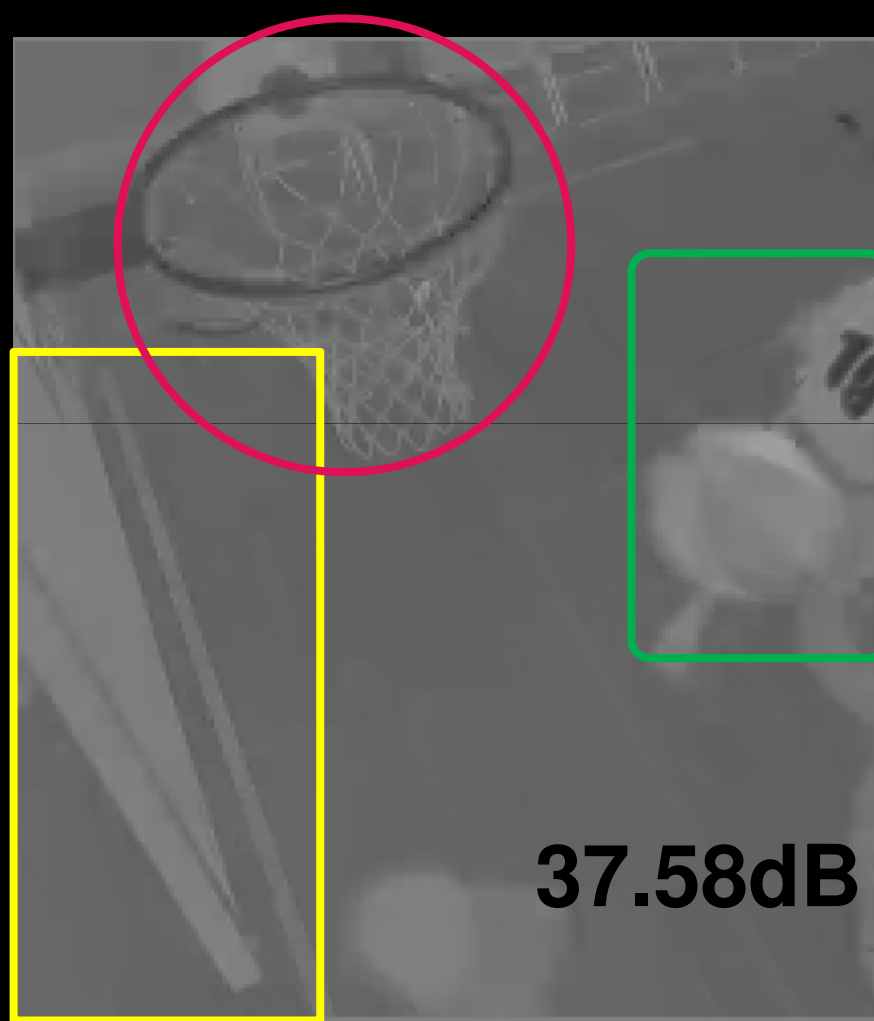
- **More than 55% chroma blocks** are coded with the proposed method on average for all QPs of all sequences under intra only constraint
- For Basketball drill sequence, **73% chroma blocks** are coded with the proposed method on average for all QPs under intra only constraint

Subjective quality comparison

- **U component** (Frame#14 of Basketball Drill / QP36)



JM-KTA 2.6r1



JM-KTA 2.6r1 + Proposed

Subjective quality comparison

- **V component** (Frame#14 of Basketball Drill / QP36)



JM-KTA 2.6r1



JM-KTA 2.6r1 + Proposed

Conclusion

- **New intra chroma prediction using luma comp.**
- **Improvements in objective(BD-Rate) and subjective qualities**
 - **Significant improvement for chroma**
 - Intra only coding, higher QP set {26, 30, 34, 38}
 - On average, **-7.4%** for U comp. **-5.7%** for V comp.
 - Maximum, **-18.5%** for U comp., **-18.8%** for V comp.
 - **Reasonable improvement for luma**
 - Intra only coding, higher QP set {26, 30, 34, 38}
 - On average, **-1.6%**
 - Maximum, **-8.1%**
- **More efficient for 4:2:2 or 4:4:4 coding**
- **Recommend the proposed scheme to be studied within TE**