



JCTVC-G156

CU Depth Pruning for Fast Coding Tree Block Decision

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Summary

- CU depth pruning for encoder speed-up
 - Terminate CU split check for the last sub-CU if RD cost is unlikely to be reduced from splitting
- Coding results

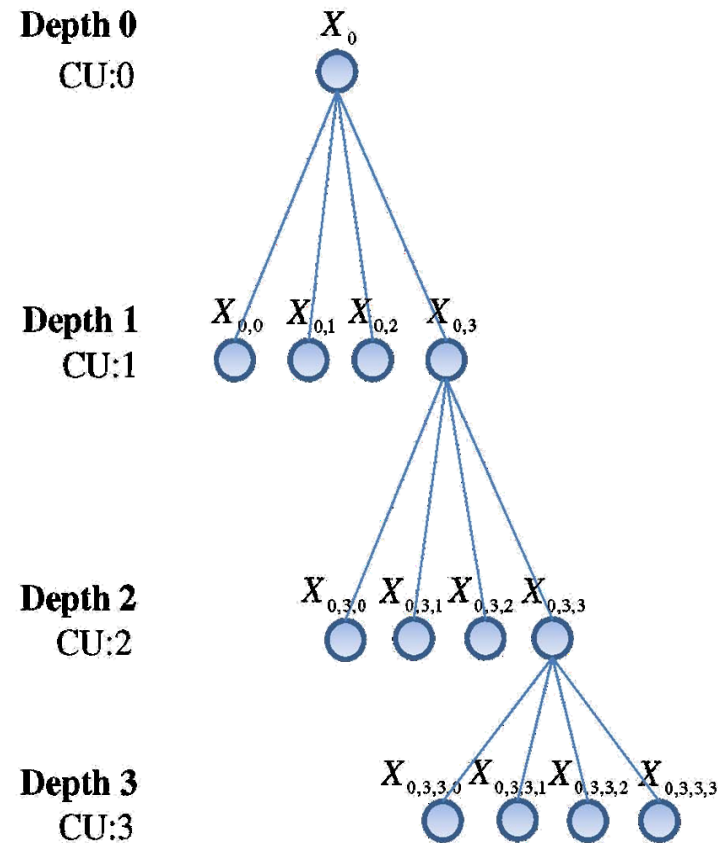
Test	Y (%)	U (%)	V (%)	Enc (%)	Dec (%)
AI-HE	0.1	-0.3	-0.2	96	98
AI-LC	0.1	0.0	0.1	94	97
RA-HE	0.1	-0.1	-0.1	92	97
RA-LC	0.1	0.2	0.1	90	96
LB-HE	0.1	-0.2	-0.1	92	97
LB-LC	0.1	0.1	0.0	92	98

Notation for addressing CUs

- X_{i_0} denotes the i_0^{th} LCU within the frame
- M denotes the maximum depth of the CTB representation ($M=4$)
- m_0 denotes a parameter for deciding the minimum CU size ($m_0=2$)
- X_{i_0, i_1, \dots, i_m} denotes a CU at depth m ($0 \leq m < M$) with size $2^{m_0 + (M-m)} \times 2^{m_0 + (M-m)}$
 - i_1, \dots, i_m ($0 \leq i_1, \dots, i_m \leq 3$) specifies the index of each CU within its parent

Illustration

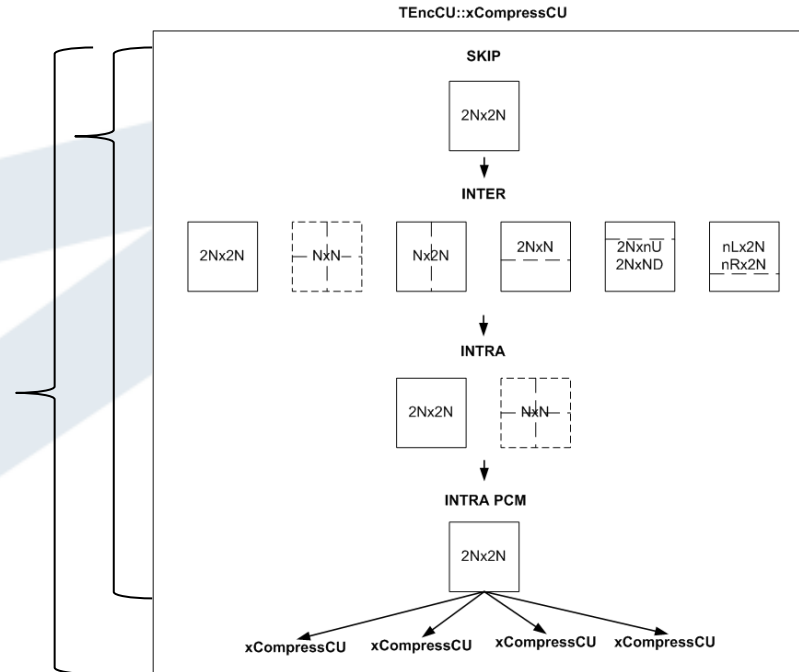
- Allows each CU to be specified uniquely
- Use $X_{i^{\overline{m}}}$ to denote X_{i_0, i_1, \dots, i_m} , i.e., $i^{\overline{m}}$ denotes the list of indices i_0, i_1, \dots, i_m



CTB mode decision in HM4 encoder

- $F(X_{i\bar{m}})$ is the best RD cost of CU $X_{i\bar{m}}$ without splitting
- $C(X_{i\bar{m}})$ is the best RD cost of CU $X_{i\bar{m}}$
- Mode decision is done using the recursion:

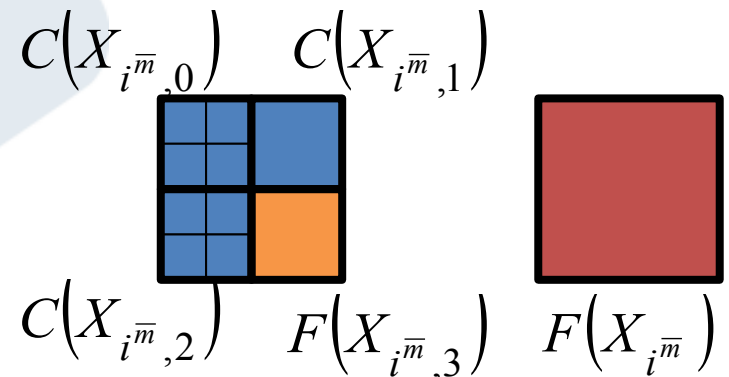
$$C(X_{i\bar{m}}) = \begin{cases} \min \left(C_0 + F(X_{i\bar{m}}), C_1 + \sum_{i_{m+1}=0}^3 C(X_{i\bar{m}, i_{m+1}}) \right) & \text{if } m < M - 1, \\ C_0 + F(X_{i\bar{m}}) & \text{otherwise} \end{cases}$$



Proposed method

- For the last sub-CU, $X_{i^{\bar{m}},3}$, check before splitting if:

$$F(X_{i^{\bar{m}},3}) + \sum_{i_{m+1}=0}^2 C(X_{i^{\bar{m}},i_{m+1}}) > F(X_{i^{\bar{m}}})$$



- If so, terminate splitting for $X_{i^{\bar{m}},3}$
- Only done for $m=1$ (32x32) and $m=2$ (16x16)

Experimental Setup

- Implemented in HM4 reference software
 - Source patch is attached for study
- Follow common conditions for AI,RA,LB and LC,HE

Results

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	0.2%	-0.3%	-0.3%	0.1%	0.1%	0.1%
Class B	0.1%	-0.2%	-0.3%	0.1%	0.1%	0.1%
Class C	0.1%	-0.1%	-0.2%	0.0%	0.0%	0.0%
Class D	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%
Class E	0.2%	-0.6%	-0.3%	0.1%	0.0%	0.1%
Overall	0.1%	-0.3%	-0.2%	0.1%	0.0%	0.1%
	0.1%	-0.2%	-0.2%	0.1%	0.0%	0.1%
Enc Time[%]	96%			94%		
Dec Time[%]	98%			97%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.1%	-0.3%	-0.1%	0.1%	0.6%	0.1%
Class B	0.1%	-0.1%	-0.4%	0.1%	0.1%	0.1%
Class C	0.1%	0.0%	0.0%	0.1%	0.1%	0.1%
Class D	0.1%	-0.1%	0.0%	0.0%	-0.2%	0.0%
Class E						
Overall	0.1%	-0.1%	-0.1%	0.1%	0.2%	0.1%
	0.1%	-0.2%	-0.1%	0.1%	0.1%	0.1%
Enc Time[%]	92%			90%		
Dec Time[%]	97%			96%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.1%	0.0%	-0.3%	0.1%	0.1%	0.3%
Class C	0.1%	-0.1%	-0.1%	0.1%	0.3%	-0.2%
Class D	0.1%	-0.1%	0.3%	0.1%	0.3%	-0.1%
Class E	0.1%	-1.0%	0.0%	0.1%	-0.1%	-0.1%
Overall	0.1%	-0.2%	-0.1%	0.1%	0.1%	0.0%
	0.1%	-0.2%	-0.1%	0.1%	0.1%	0.0%
Enc Time[%]	92%			92%		
Dec Time[%]	97%			98%		

Conclusions

- Proposed CU depth pruning for encoder speed-up
 - Terminate CU split check for the last sub-CU if RD cost is unlikely to be reduced from splitting
- 4%-10% reduction in encoding runtime with 0.1% Luma BD-Rate
- Recommend adopting method into reference encoder software