JCTVC-K0230 Non-CE1:
Simplification of strong filter decisions in CE1 deblocking

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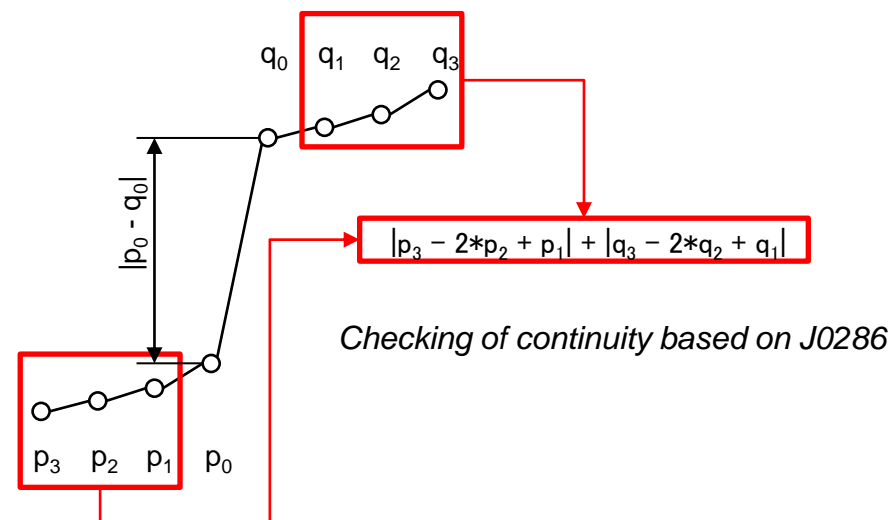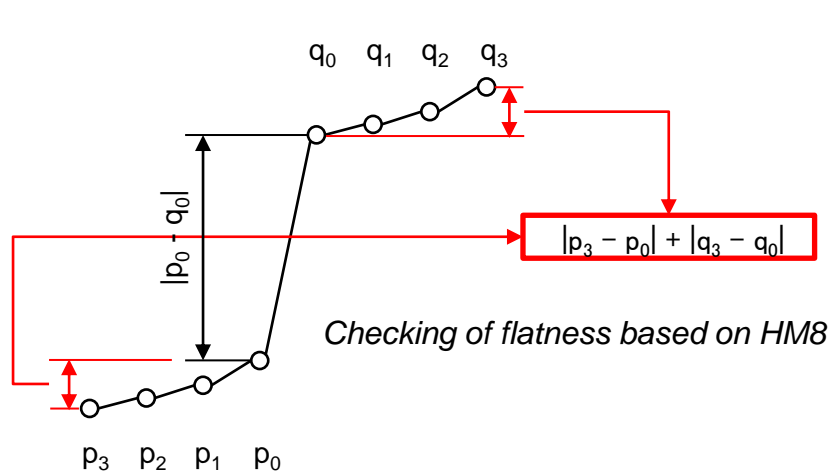
Summary

- This contribution addresses simplification of strong filter decisions in J0286 (CE1 tool b.2.1)

- The simplification can reduce the number of comparison from 6 to 4 per 4 lines with the almost same performance as tool b.2.1

- This contribution is cross-checked by Ericsson (JCTVC-K0307)

Introduction

- In J0286, modified strong filter and decisions were proposed to increase the chance to apply strong filter

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- The modification is as follows:
  - **Checking of continuity instead of that of flatness**

$$|p_3 - p_0| + |q_3 - q_0|$$

Checking of flatness based on HM8

$$|p_3 - 2*p_2 + p_1| + |q_3 - 2*q_2 + q_1|$$

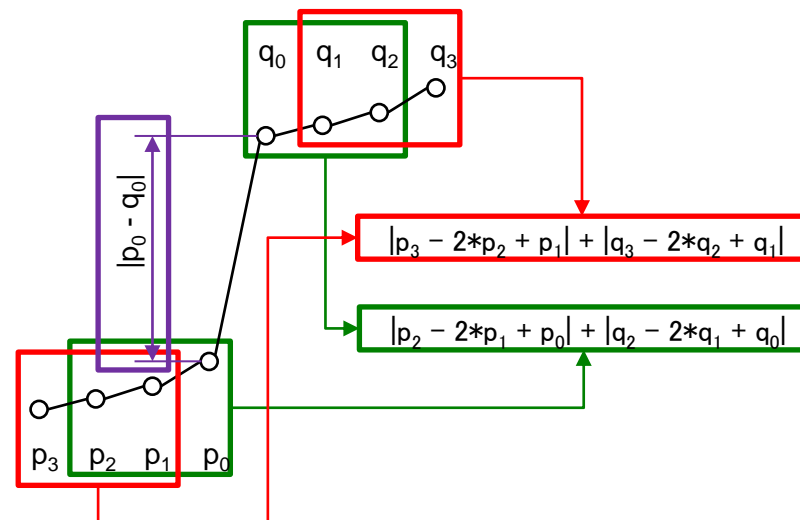*Checking of continuity based on J0286*

Introduction

- In J0286, modified strong filter and decisions were proposed to increase the chance to apply strong filter

- The modification is as follows:
  - Checking of continuity instead of that of flatness

- Both expression **(1)** and **(2)** check the continuity for pixels on both sides of block boundary, and that is a little bit redundant

Strong filter decisions in J0286

1. $2*(|p_2 - 2*p_1 + p_0| + |q_2 - 2*q_1 + q_0|) < (\beta >> 2)$
2. $((|p_3 - 2*p_2 + p_1| + |q_3 - 2*q_2 + q_1|)<<1) < (\beta >> 2)$
3. $|p_0 - q_0| < (t_c << 4)$

$|p_0 - q_0|$

$q_0 \quad q_1 \quad q_2 \quad q_3$

$|p_3 - 2*p_2 + p_1| + |q_3 - 2*q_2 + q_1|$

$|p_2 - 2*p_1 + p_0| + |q_2 - 2*q_1 + q_0|$
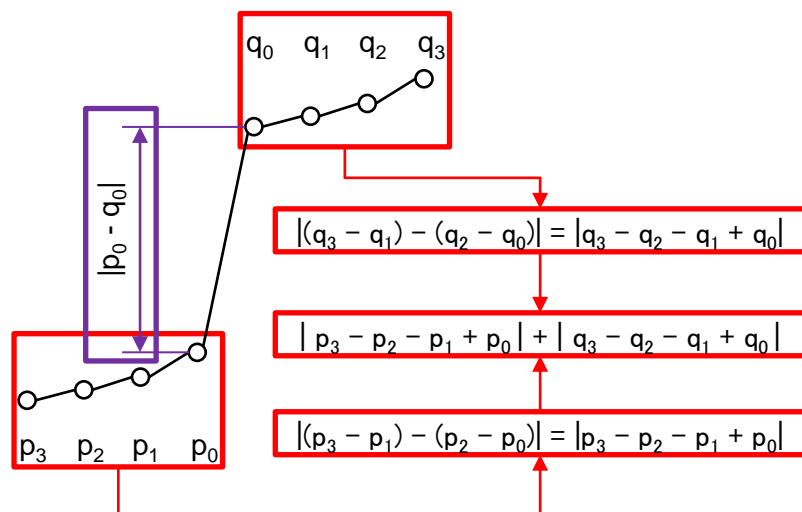
$p_3 \quad p_2 \quad p_1 \quad p_0$

Proposed simplification

- Introduce the following one comparison combined both (1) and (2)

$$|p3 - p2 - p1 + p0| + |q3 - q2 - q1 + q0| < (\beta >> 3)$$

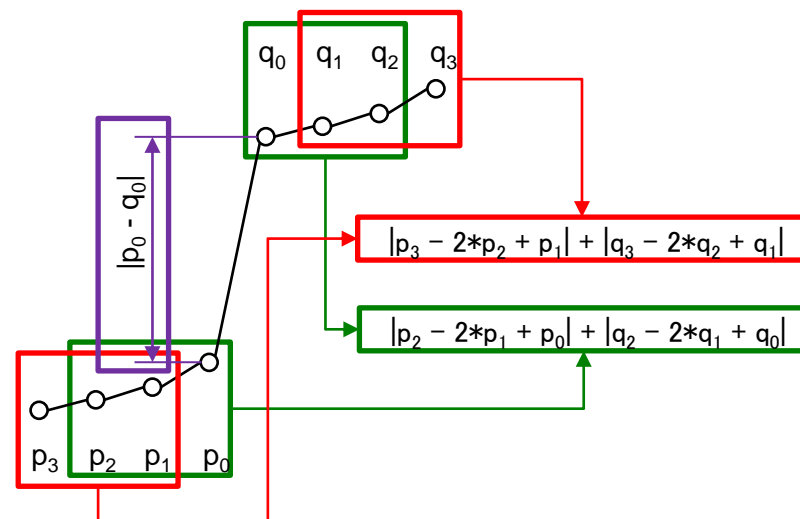- Reduce the number of comparison from 3 to 2 per line, totally from 6 to 4 per 4 lines

K0230

1. $(|p_3 - p_2 - p_1 + p_0| + |q_3 - q_2 - q_1 + q_0|) < (\beta >> 3)$
2. $|p_0 - q_0| < (t_c << 4)$

J0286

1. $2*(|p_2 - 2*p_1 + p_0| + |q_2 - 2*q_1 + q_0|) \quad < (\beta >> 2)$
2. $((|p_3 - 2*p_2 + p_1| + |q_3 - 2*q_2 + q_1|)<<1) < (\beta >> 2)$
3. $|p_0 - q_0| < (t_c << 4)$

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CE1 b.2.2: Modified strong filter proposed by J0286

CE1 b.2.1+b.2.2 vs. Proposed simplification + CE1 b.2.2

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	101%			100%		
Dec Time[%]	100%			100%		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.1%	0.1%	0.2%	0.0%	0.1%	-0.1%
Class B	0.0%	0.1%	0.0%	-0.1%	0.0%	-0.1%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Class D	0.0%	-0.1%	-0.1%	0.0%	-0.2%	-0.1%
Class E						
Class F	0.1%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Overall	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
Enc Time[%]	100%			98%		
Dec Time[%]	100%			100%		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.1%	-0.2%	-0.1%	0.0%	-0.2%
Class C	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	0.0%
Class D	0.0%	0.2%	-0.1%	0.0%	0.1%	-0.2%
Class E	-0.4%	0.2%	-0.4%	-0.8%	-0.7%	-0.3%
Class F	-0.1%	0.4%	0.6%	0.1%	0.1%	-0.3%
Overall	-0.1%	0.1%	0.0%	-0.1%	-0.1%	-0.2%
	-0.1%	0.1%	0.0%	-0.1%	-0.1%	-0.2%
Enc Time[%]	97%			100%		
Dec Time[%]	100%			100%		

	Low delay P Main			Low delay P HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-0.1%	0.4%	0.1%	-0.1%	-0.2%
Class C	0.0%	0.1%	0.0%	0.0%	-0.1%	-0.2%
Class D	0.0%	-0.2%	-0.1%	0.0%	0.2%	0.0%
Class E	0.1%	0.1%	0.1%	0.0%	-0.1%	-0.1%
Class F	0.0%	0.0%	-0.1%	0.1%	0.0%	-0.1%
Overall	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%
	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%
Enc Time[%]	96%			100%		
Dec Time[%]	100%			100%		

Encoder time is not reliable since using the cluster PC
Decoder time is measured in single PC

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CE1 test3: Beta Table Modificaton
New Strong Filter + Decisions
Bs Modification
Intra Smoothing Restricted

CE1 test3 vs. CE1 test3 + Proposed simplification

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			101%		
Dec Time[%]	101%			100%		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.1%	0.1%	0.0%	0.0%	0.3%
Class B	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
Class C	0.0%	-0.1%	0.0%	0.0%	0.0%	0.1%
Class D	0.0%	-0.1%	0.2%	0.0%	0.0%	0.1%
Class E						
Class F	-0.1%	-0.2%	-0.1%	0.1%	0.0%	0.0%
Overall	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			101%		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%
Class C	-0.1%	0.0%	-0.1%	0.0%	0.3%	0.2%
Class D	0.0%	-0.2%	0.0%	0.0%	-0.2%	0.1%
Class E	-0.4%	0.0%	0.0%	-0.8%	-0.7%	-0.3%
Class F	0.1%	0.6%	0.3%	0.0%	-0.2%	-0.6%
Overall	-0.1%	0.1%	0.0%	-0.1%	-0.2%	-0.1%
	-0.1%	0.1%	-0.1%	-0.1%	-0.2%	-0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay P Main			Low delay P HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.1%	0.2%	-0.1%	0.1%	-0.2%	-0.6%
Class C	0.0%	-0.2%	0.3%	0.0%	0.0%	0.1%
Class D	0.0%	-0.3%	-0.8%	0.1%	0.2%	-0.2%
Class E	0.1%	-0.4%	-0.2%	-0.2%	0.2%	-0.3%
Class F	0.1%	0.0%	0.5%	0.1%	-0.4%	0.3%
Overall	0.1%	-0.1%	0.0%	0.0%	-0.1%	-0.2%
	0.1%	0.0%	0.0%	0.0%	0.0%	-0.2%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

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Experimental results 3

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CE1 test5: Beta Table Modificaton
New Strong Filter + Decisions
Intra Smoothing Restricted
Intra tc offset

CE1 test5 vs. CE1 test5 + Proposed simplification

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	#NUM!			#NUM!		
Dec Time[%]	#NUM!			#NUM!		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.1%	0.1%	0.0%	0.1%	0.4%
Class B	0.0%	0.0%	0.0%	-0.1%	0.1%	0.0%
Class C	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%
Class E						
Class F	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Enc Time[%]	#NUM!			#NUM!		
Dec Time[%]	#NUM!			#NUM!		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	-0.3%	-0.1%	-0.2%	-0.5%
Class C	0.0%	0.2%	-0.2%	-0.1%	-0.2%	-0.3%
Class D	0.0%	0.2%	-0.2%	0.0%	0.1%	0.1%
Class E	-0.2%	0.2%	-0.1%	-0.7%	-0.6%	-0.2%
Class F	0.1%	0.4%	-0.2%	0.1%	-0.4%	0.3%
Overall	0.0%	0.2%	-0.2%	-0.1%	-0.3%	-0.1%
	0.0%	0.2%	-0.1%	-0.1%	-0.3%	-0.1%
Enc Time[%]	#NUM!			#NUM!		
Dec Time[%]	#NUM!			#NUM!		

	Low delay P Main			Low delay P HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.1%	0.1%	0.2%	0.1%	0.0%	-0.3%
Class C	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Class D	0.0%	0.0%	0.4%	0.0%	-0.4%	0.0%
Class E	0.1%	-0.3%	0.1%	0.0%	-0.2%	0.4%
Class F	0.0%	0.1%	0.1%	0.1%	-0.4%	0.7%
Overall	0.0%	0.0%	0.2%	0.0%	-0.2%	0.1%
	0.0%	0.1%	0.2%	0.0%	-0.2%	0.1%
Enc Time[%]	#NUM!			#NUM!		
Dec Time[%]	#NUM!			#NUM!		

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Decoder time is measured in single PC

Conclusions

- The proposed simplification can reduce the number of comparison from 6 to 4 per 4 lines

- The average performance is -0.2~0.1% and the simplification provides no impact

- It is recommended to be discussed and adopt this simplification with new strong filter in CE1 (b.2.2)

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