

JCTVC-I0071

On Deblocking filter parameter

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Content

- Summary
- Introduction: problem statement
- Proposed methods
- Experiment results
- Conclusion

- This contribution proposes to strengthen current deblocking filter through expanding the range of parameter β
 - HM6.0:
 - Parameter β is selected within $[0, 64]$ by QP and `beta_offset_div2`
 - Proposal:
 - Can select β value larger than 64 to use stronger filtering
 - Can control Deblocking strength more flexibly through adaptive β
- Proposed methods can deal with the blocking artifacts. Better visual quality can be observed. Have negligible side influence on decoder side

Introduction

- Problem statement:
 - For sequence “riverbed”, clear block noises can be observed(Figure A)
 - Even the largest $\beta(= 64)$ and $tc(=13)$ is selected, which means the strongest setting of current filter, visible block noises still remain(Figure B)
 - Current deblocking filter is not effective enough

↓ ↓ ↓ ↓ ↓ ↓ Visible block artifacts



Figure A

HM6.0, LP-Main, QP37, frameNum 33

↓ ↓ ↓ ↓ ↓ Visible block artifacts remain



Figure B

HM6.0 with $\beta=64$ and $tc=13$

Proposed methods

- **Core concept**

- Using larger β to reduce visible block boundaries where no filter or weak filter is applied currently
- Can control the value of β with additional encoder-selectable setting

- **Implementation**

3 methods sharing the same concept are proposed as following.

- Method1: provide additional β when $Q > 51$
- Method2: adaptive control of β

✘ Method3: simply adaptive control of β

Method1: provide additional β when $Q > 51$

- HM6:**

$\forall Q \geq 51, \beta[51] = 64$ is chosen.

$$Q = \text{Clip}(0, 51, QP + \text{beta_offset_div2} \ll 1)$$

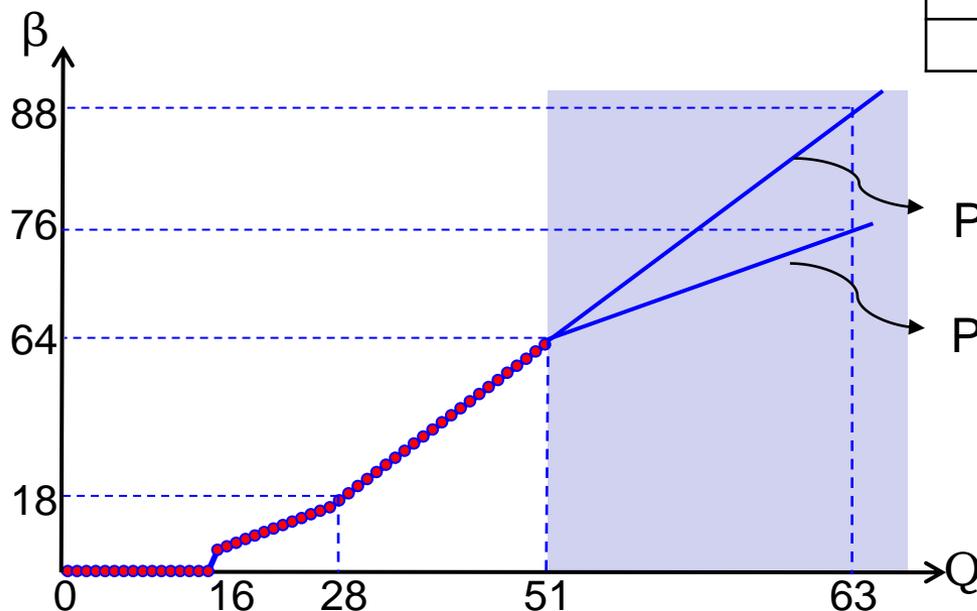
- Proposal:**

- Provide additional values of β for $Q > 51$
- Introduce one syntax **beta_k_log2** for adapting

$$Q = QP + \text{beta_offset_div2}$$

$$\beta = \beta[51] + (Q - 51) \ll \text{beta_k_log2}$$

if(!disable_deblocking_filter_flag) {	
beta_offset_div2	se(v)
tc_offset_div2	se(v)
beta_k_log2	} ue(v)



Proposal with **beta_k_log2=1**

Proposal with **beta_k_log2=0**

Method2: adaptive control of β

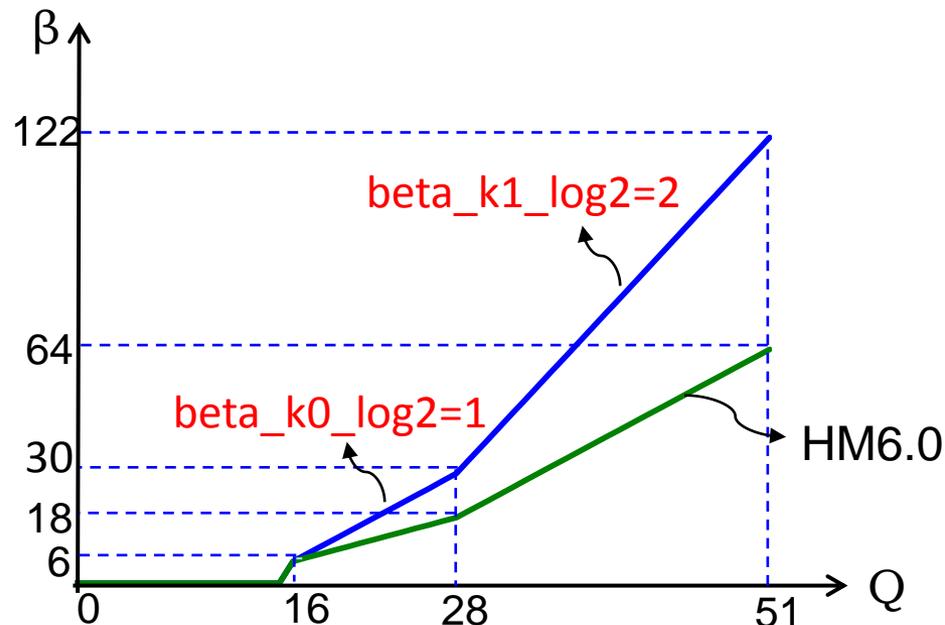
- HM6:**

Mathematically the value of β and QP forms a piecewise-linear function as:

$$\begin{aligned} \beta &= 0, && \text{for } Q \in [0, 16) \\ &= \beta [16] + ((Q - 16) \ll 0), && \text{for } Q \in [16, 28] \\ &= \beta [28] + ((Q - 28) \ll 1), && \text{for } Q \in (28, 51] \end{aligned}$$

- Proposal:**

- Generalize the relation between β and Q to be configurable
- More flexible, but complexity increases



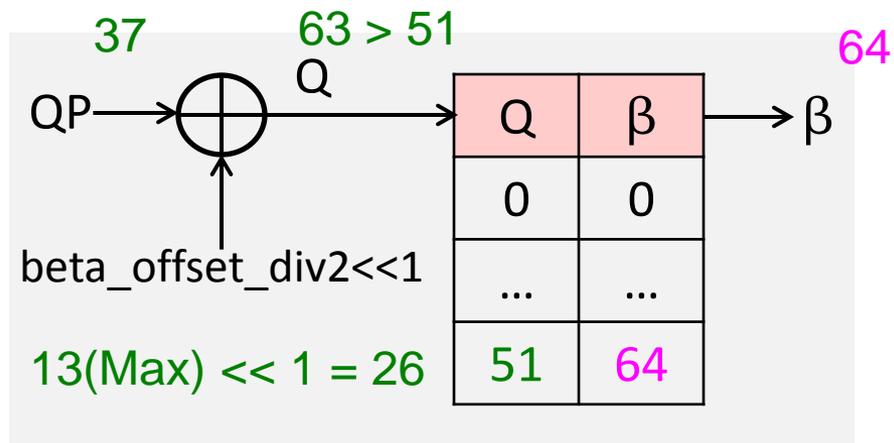
$$\begin{aligned} \beta &= 0, && \text{for } Q \in [0, 16) \\ &= \beta [16] + ((Q - 16) \ll \text{beta_k0_log2}), && \text{for } Q \in [16, 28] \\ &= \beta [28] + ((Q - 28) \ll \text{beta_k1_log2}), && \text{for } Q \in (28, 51] \end{aligned}$$

If (!disable_deblocking_filter_flag) {	
beta_offset_div2	se(v)
tc_offset_div2	se(v)
beta_k0_log2	ue(v)
beta_k1_log2	ue(v)
}	

Method 3: simply adaptive control of β

- HM6:**

Use `beta_offset_div2` to adapt QP
(the position of β in LookUpTable)



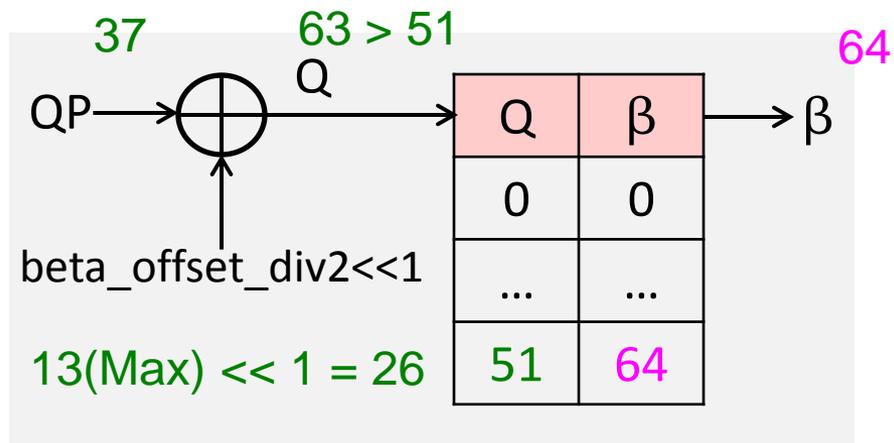
- Proposal:**

- Control the value of β directly

Method 3: simply adaptive control of β

• HM6:

Use $\beta_{\text{offset_div2}}$ to adapt QP
(the position of β in LookUpTable)



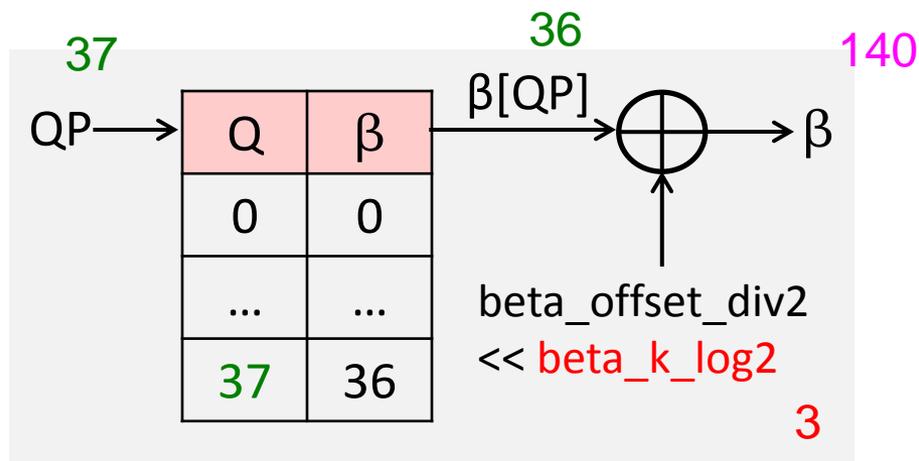
• Proposal:

– Control the value of β directly

$Q = QP$

$\beta = \beta[Q] + \beta_{\text{offset_div2}} \ll \beta_{\text{k_log2}}$

if(!disable_deblocking_filter_flag) {	
beta_offset_div2	se(v)
tc_offset_div2	se(v)
beta_k_log2	ue(v)
}	



13(Max) << 3 = 104

Experiment results

- Configurations:**

- The proposed methods can be controlled with encoder-selectable parameters. **Examples** are shown as below:

Encoder Configuration	HM6.0	HM6.0 with offset13	Method1	Method2	Method3
DeblockingFilterControlPresent	0	1	1	1	1
LoopFilterBetaOffset_div2	0	13	12	3	13
LoopFilterTcOffset_div2	0	13	13	13	13
LoopFilterBetaK_log2	N/A	N/A	3	0	3
LoopFilterBetaK1_log2	N/A	N/A	N/A	3	N/A

- With these parameters, when QP=37, corresponding β will be:

QP	HM6.0	HM6.0 with offset13	Method1	Method2	Method3
37	36	64	144	138	140

Since the values of β are close, the effect will also be similar. The decoded results from Method3 are shown as representative.

Experiment results-1

- **Representative cases:**

Sequence: riverbed

Settings: LP-Main, QP37, Deblocking filter configurations are set as prior page

↓ ↓ ↓ ↓ ↓ ↓ ↓ Visible block artifacts



Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 33



Figure B

Proposed Method3 with $\beta=140$ and $tc=13$

Experiment results-1

- Representative cases:**

Green lines: boundaries where weak filter applied

Red lines: boundaries where strong filter applied

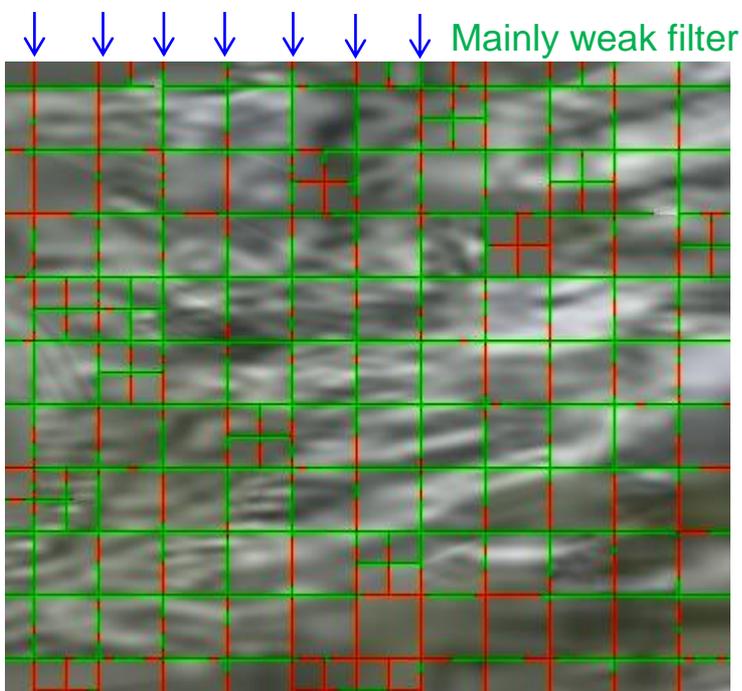


Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 33

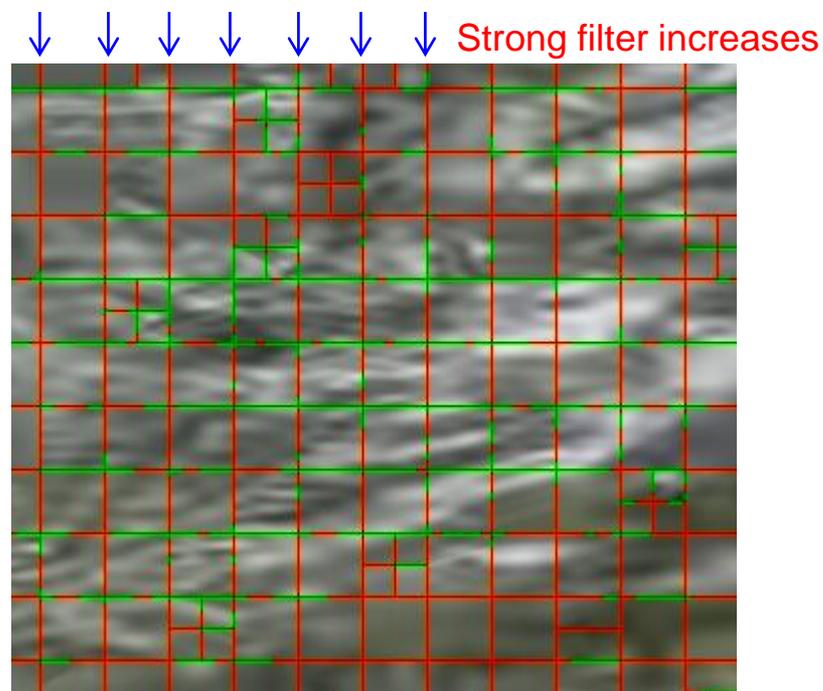


Figure B

Proposed Method3 with $\beta=140$ and $tc=13$

Experiment results-1

- Objective:**

Proposed methods can improve Visual quality, while keep or improve bitrate and PSNR

QP	Condition	Bitrate [kbps]	Ypsnr [dB]	Upsnr [dB]	Vpsnr [dB]
37	HM6.0	2910.48	31.71	37.91	40.73
	HM6.0 with offset13	2903.44	31.73	37.91	40.73
	Method1	2897.95	31.73	37.91	40.72
	Method2	2898.35	31.73	37.91	40.72
	Method3	2898.75	31.73	37.90	40.73

Conclusion

It is recommended to adopt one from proposed methods:

- ✓ Proposed methods can deal with the blocking artifacts.
- ✓ Better visual quality can be observed
- ✓ Have no side influence on decoder side
- ✓ Text is also tight and clean
- Among them, Method3 is simple and flexible★

Thank NEC for cross check

Appendix

Experiment results-2

- **Representative cases:**

Sequence: Kimono

Settings: AI-Main, QP37, Deblocking filter configurations are set as prior page



Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 19



Figure B

Proposed Method3 with $\beta=140$ and $tc=13$

Experiment results-2

- Representative cases:**

Green lines: boundaries where weak filter applied

Red lines: boundaries where strong filter applied

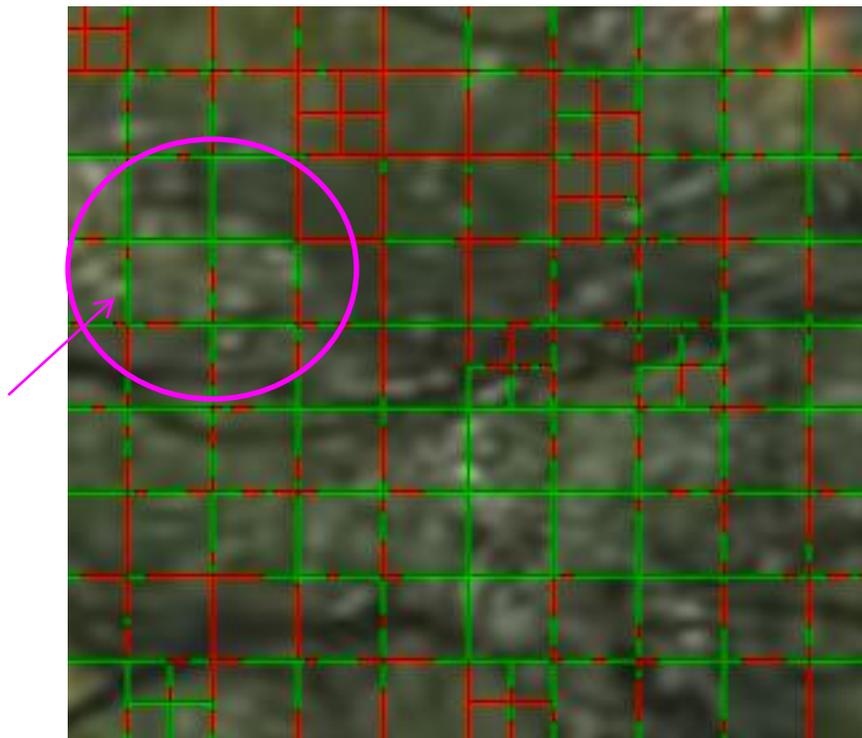


Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 19

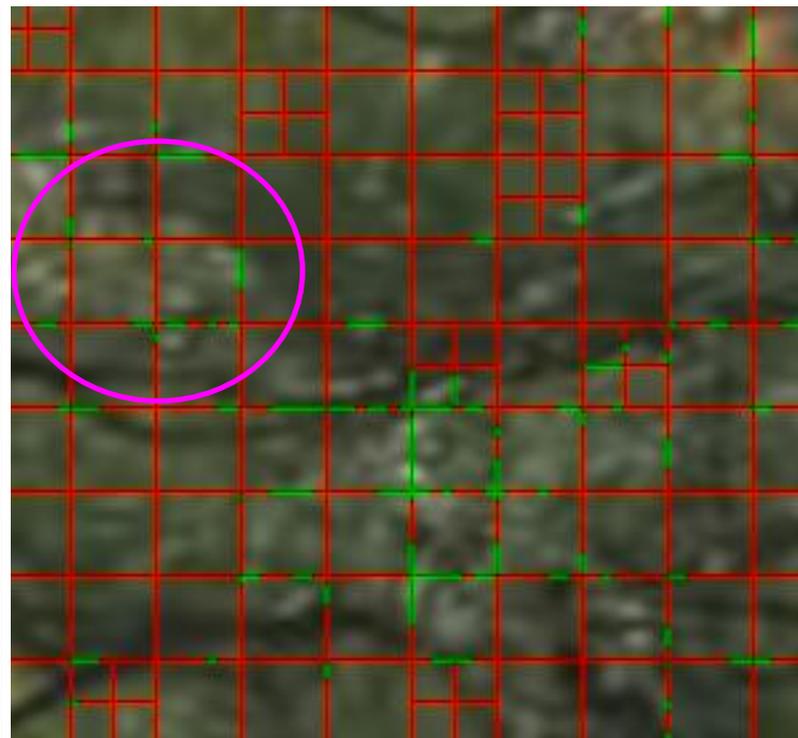


Figure B

Proposed Method3 with $\beta=140$ and $tc=13$

Experiment results-2

- Objective:**

Proposed methods can improve Visual quality, while keep or improve bitrate and PSNR

QP	Condition	Bitrate [kbps]	Ypsnr [dB]	Upsnr [dB]	Vpsnr [dB]
37	HM6.0	3795.37	36.51	40.05	41.13
	HM6.0 with offset13	3794.66	36.50	40.05	41.13
	Method1	3793.88	36.47	40.05	41.13
	Method2	3793.90	36.47	40.05	41.13
	Method3	3793.88	36.47	40.05	41.13

Experiment result-3

- Configurations:**

- The proposed methods can be controlled with encoder-selectable parameters. **Examples** are shown as below:

Encoder Configuration	HM6.0	HM6.0 with offset13	Method1	Method2	Method3
DeblockingFilterControlPresent	0	1	1	1	1
LoopFilterBetaOffset_div2	0	13	10	1	13
LoopFilterTcOffset_div2	0	13	13	13	13
LoopFilterBetaK_log2	N/A	N/A	3	0	3
LoopFilterBetaK1_log2	N/A	N/A	N/A	3	N/A

- With these parameters, when QP=42, corresponding β will be:

QP	HM6.0	HM6.0 with offset13	Method1	Method2	Method3
37	36	64	152	146	150

Experiment results-3

- **Representative cases:**

Sequence: riverbed

Settings: AI-Main, QP42, Deblocking filter configurations are set as prior page



Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 100



Figure B

Proposed Method3 with $\beta=150$ and $tc=13$

Experiment results-3

- Representative cases:**

Green lines: boundaries where weak filter applied

Red lines: boundaries where strong filter applied

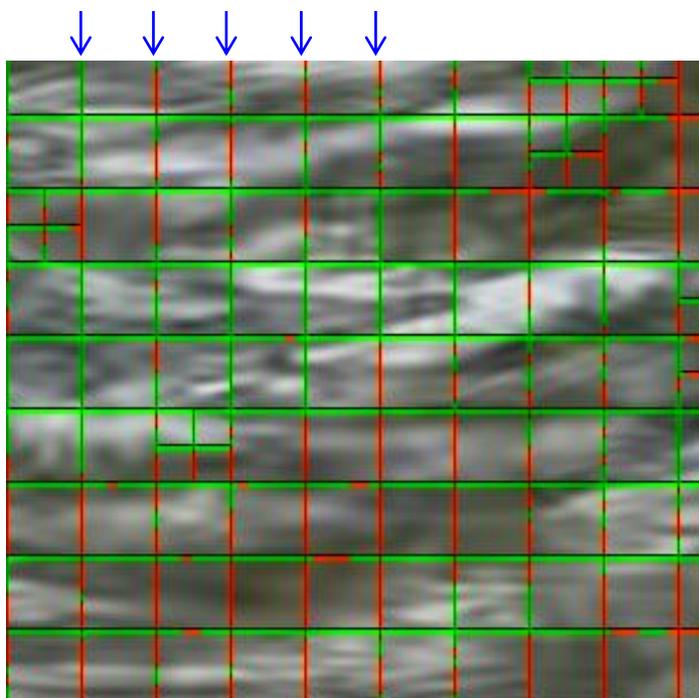


Figure A

HM6.0 with $\beta=64$ and $tc=13$, frameNum 100

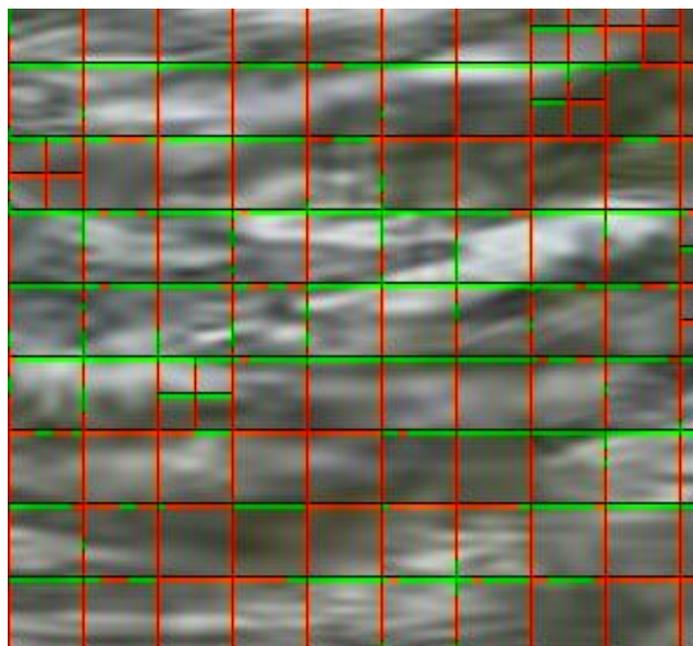


Figure B

Proposed Method3 with $\beta=150$ and $tc=13$

Experiment results-3

- Objective:**

Proposed methods can improve Visual quality, while keep or improve bitrate and PSNR

QP	Condition	Bitrate [kbps]	Ypsnr [dB]	Upsnr [dB]	Vpsnr [dB]
42	HM6.0	3063.07	32.10	38.49	40.83
	HM6.0 with offset13	3063.36	32.11	38.49	40.83
	Method1	3063.51	32.12	38.49	40.83
	Method2	3063.33	32.11	38.49	40.83
	Method3	3063.53	32.11	38.49	40.83

Common Test Conditions

- Common Test Conditions**

- Method2 need to transmit two additional syntax for common test conditions

- Method1 and Method3 can be enabled only when blocking artifacts appear.
- Work as optional configuration, therefor have on influence on common test conditions.

Encoder Configuration	HM6.0	Method2
DeblockingFilterControlPresent	0	1
LoopFilterBetaOffset_div2	0	0
LoopFilterTcOffset_div2	0	0
LoopFilterBetaK_log2	N/A	0
LoopFilterBetaK1_log2	N/A	1

	All Intra Main				Random Access Main				Low delay B Main				Low delay P Main		
	Y	U	V		Y	U	V		Y	U	V		Y	U	V
Class A	0.0%	0.0%	0.0%	Class A	0.0%	0.0%	0.0%	Class A				Class A			
Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	Class D	0.1%	0.1%	0.1%	Class D	0.1%	0.1%	0.1%	Class D	0.1%	0.1%	0.1%
Class E	0.0%	0.0%	0.0%	Class E				Class E	0.1%	0.1%	0.1%	Class E	0.1%	0.1%	0.1%
Class F	0.0%	0.0%	0.0%	Class F	0.0%	0.0%	0.0%	Class F	0.0%	0.0%	0.0%	Class F	0.1%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	Overall	0.0%	0.0%	0.0%	Overall	0.1%	0.0%	0.0%	Overall	0.1%	0.0%	0.0%
	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%		0.1%	0.0%	0.0%		0.1%	0.1%	0.1%
Enc Time	101%			Enc Time	100%			Enc Time	100%			Enc Time	100%		
Dec Time	100%			Dec Time	99%			Dec Time	100%			Dec Time	99%		

Common Test Conditions

- **Common Test Conditions**

- Exclude the influence of transmitting offsets for β and t_c

※ Configurations for CTC with deblocking filter control

Encoder Configuration	HM6.0	Method2
DeblockingFilterControlPresent	1	1
LoopFilterBetaOffset_div2	0	0
LoopFilterTcOffset_div2	0	0
LoopFilterBetaK_log2	N/A	0
LoopFilterBetaK1_log2	N/A	1

	All Intra Main				Random Access Main				Low delay B Main				Low delay P Main		
	Y	U	V		Y	U	V		Y	U	V		Y	U	V
Class A	0.0%	0.0%	0.0%	Class A	0.0%	0.0%	0.0%	Class A				Class A			
Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%	Class B	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%	Class C	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	Class D	0.0%	0.0%	0.0%	Class D	0.0%	0.0%	0.0%	Class D	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	Class E				Class E	0.0%	0.0%	0.0%	Class E	0.1%	0.1%	0.1%
Class F	0.0%	0.0%	0.0%	Class F	0.0%	0.0%	0.0%	Class F	0.0%	0.0%	0.0%	Class F	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	Overall	0.0%	0.0%	0.0%	Overall	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%		0.0%	0.0%	0.0%
Enc Time	100%			Enc Time	100%			Enc Time	100%			Enc Time	100%		
Dec Time	100%			Dec Time	99%			Dec Time	100%			Dec Time	100%		

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