

MEDIATEK

CE4-related: PROF prediction sample range reduction

Tzu-Der Chuang, Zhi-Yi Lin, Ching-Yeh Chen, Chih-Wei Hsu,
Yu-Wen Huang, Shaw-Min Lei

Presented by Tzu-Der (Peter) Chuang
16th Meeting: Geneva, CH,
1–11 October 2019

Overall Summary

- Propose three methods to prevent using multipliers beyond 16-bit in the weighted prediction for PROF for input video within 12 bits
 1. Clip the PROF prediction offset within 14 bits $([-8192, 8191])$
 2. Clip the PROF refined prediction samples to 16 bits $([-32768, 32767])$
 3. PROF is disabled when weighted prediction or BCW is applied

	RA			LB		
	Y	U	V	Y	U	V
Clip offset to 14 bits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Clip refined pred. to 16 bits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
No PROF for WP & BCW	0.03%	0.07%	0.00%	0.02%	0.14%	0.08%

Problem Definition

- In the PROF of VVC Draft 6, affine prediction samples are refined with optical flow
 - $I'(i, j) = I(i, j) + \Delta I(i, j)$
 - $\Delta I(i, j) = g_x(i, j) * \Delta v_x(i, j) + g_y(i, j) * \Delta v_y(i, j)$
 - $I(i, j)$ and $\Delta I(i, j)$ are 16-bit and 17-bit, respectively
- The refined prediction sample can be further processed by weighted prediction, which leads to using multipliers beyond 16-bit in the weighted prediction
 - Not implementation friendly, especially for software implementations that require 32-bit multipliers

Proposed Method-1: Prediction Offset Clipping

- Clip the prediction offset, $\Delta I(i, j)$, to K bits with range as $[-2^{(K-1)}, 2^{(K-1)} - 1]$
- K is set to $\max(14, \text{sample-bit-depth} + 2)$
 - In case of 10-bit video, K is equal to 14
 - Clip to $[-8192, 8191]$ in 10-bit video

$dILimit = (1 \ll \max(13, \text{BitDepth}_Y + 1))$

$\text{pbSamples}[x][y] = \text{predSamples}[x+1][y+1] + \text{Clip3}(-dILimit, dILimit - 1, (dI + 1) \gg 1)$

Proposed Method-2: Refined Prediction Sample Clipping

- Clip the refined prediction sample, $I'(i, j)$, to K bits with range as $[-2^{(K-1)}, 2^{(K-1)} - 1]$
- K is set to $\max(16, \text{sample-bit-depth} + 4)$
 - In case of 10-bit video, K is equal to 16
 - Clip to $[-32768, 32767]$ in 10-bit video

$\text{pbSamplesLimit} = (1 \ll \max(15, \text{BitDepthY} + 3))$

$\text{pbSamples}[x][y] = \text{Clip3}(-\text{pbSamplesLimit}, \text{pbSamplesLimit}-1, \text{predSamples}[x+1][y+1] + ((dI+1) \gg 1))$

Proposed Method-3: Disabling PROF when Weighted Prediction or BCW is applied

- Disable the PROF when the weighted prediction or BCW is applied
- Keep the same bit-depth of $\Delta l(i, j)$ and $l'(i, j)$

The variable `cbProfFlagLX` is derived as follows:

- If one or more of the following conditions are true, `cbProfFlagLX` is set equal to FALSE.

...

- `luma_weight_lX_flag[refIdxLX]` is not equal to 0.
- `BcwIdx[xCb][yCb]` is not equal to 0
- Otherwise, `cbProfFlagLX` set equal to TRUE.

Detail Simulation Results

- Anchor: VTM6.0

	RA			LB		
	Y	U	V	Y	U	V
Clip offset to 14 bits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Clip refined pred. to 16 bits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
No PROF for WP & BCW	0.03%	0.07%	0.00%	0.02%	0.14%	0.08%

Thank Kwai for cross-checking

Conclusions

- Propose three methods to prevent using multipliers beyond 16-bit in the weighted prediction for PROF for input video within 12 bits
 1. Clip the PROF prediction offset within 14 bits $([-8192, 8191])$
 2. Clip the PROF refined prediction samples to 16 bits $([-32768, 32767])$
 3. PROF is disabled when weighted prediction or BCW is applied



everyday genius