Pixel Based Illumination Compensation (PBIC)

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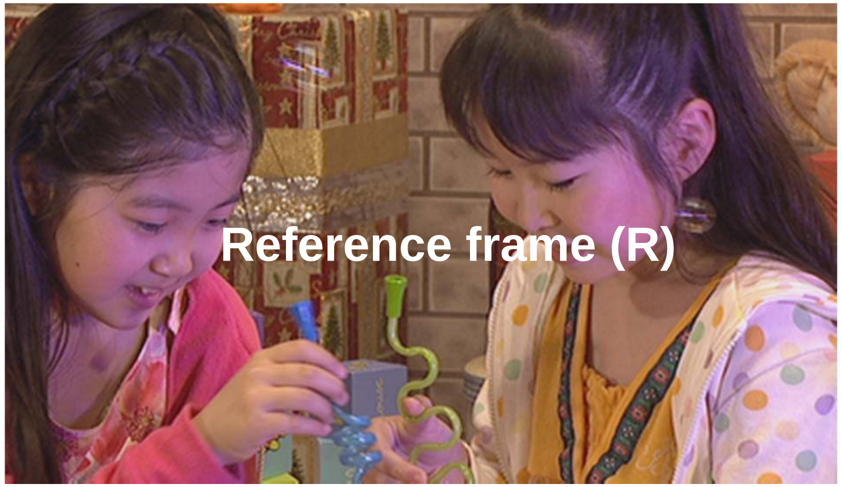
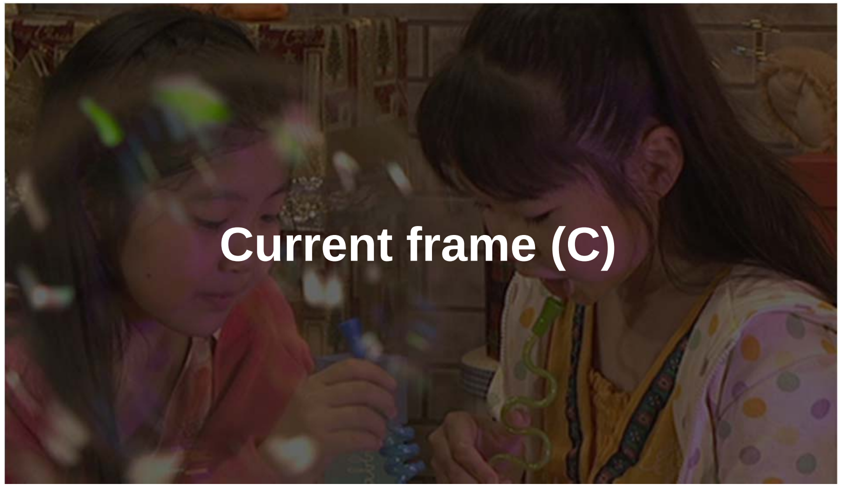
WP in H.264/AVC





WP Parameters

w : weighting factor

o : offset

Prediction

$$P = w \times R + o$$

Slice Header

LIST 0

$$w_0^{L0} \cdots w_{N-1}^{L0},\ o_0^{L0} \cdots o_{N-1}^{L0}$$

LIST 1

$$w_0^{L1} \cdots w_{N-1}^{L1},\ o_0^{L1} \cdots o_{N-1}^{L1}$$

Pixel Based Illumination Compensation

- Purpose of PBIC
- Neighboring pixel selection
- IC parameter calculation
- Prediction pixel selection
- Signaling method

Purpose of PBIC

- Improve coding efficiency

- Compensate local brightness variations

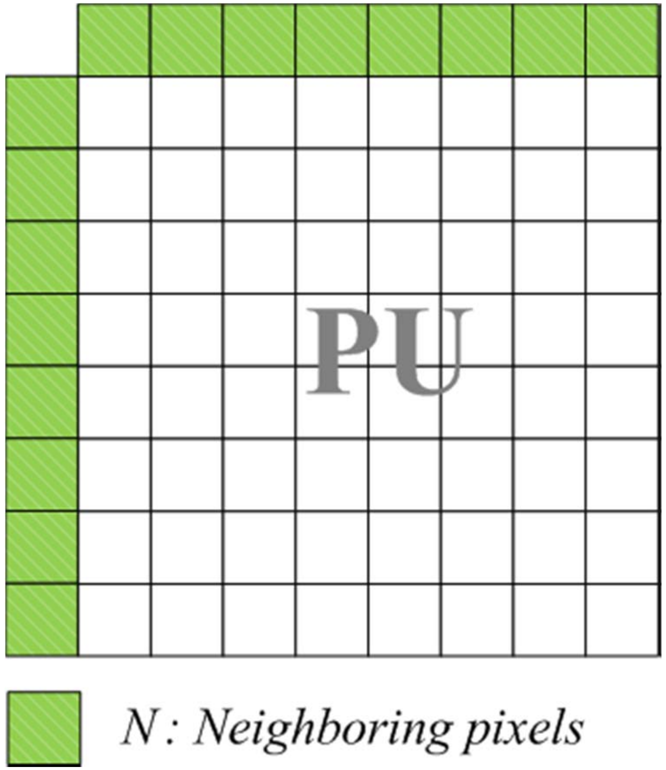
Reference frame

Current frame

Neighboring pixel selection

Pixel selection

$$N^* = \{N(i) \mid T_{\min}^N \le N(i) \le T_{\max}^N\}$$



- Thresholds

$$T_{\min}^N = m_N - \Delta_N$$

$$T_{\max}^N = m_N + \Delta_N$$

$$\Delta_N = \frac{2}{S_N} \sum_{i=1}^{S_N} |N(i) - m_N|$$

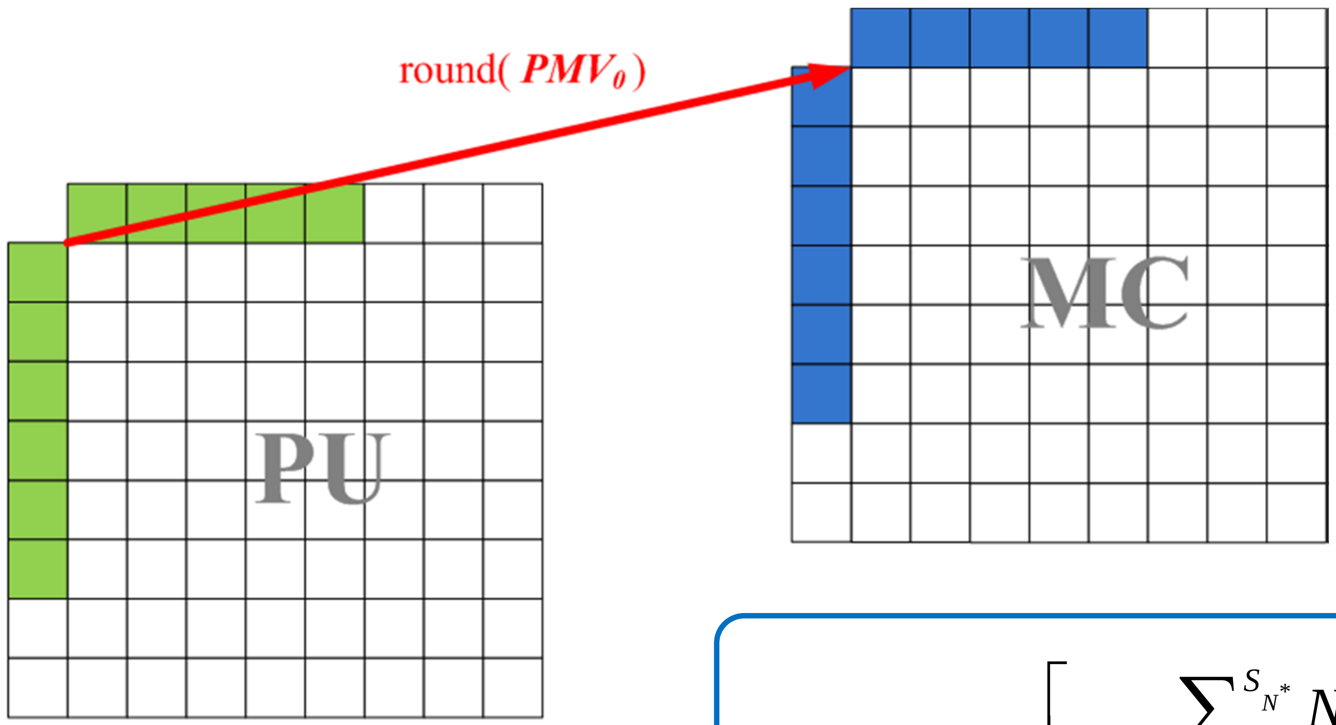
m_N: mean value of the neighboring pixels

S_N : # of neighboring pixels

- All operations can be done without division operation.

IC parameter calculation [1/2]

- Weighting factor



N^* : Selected neighboring pixels

C^* : Corresponding pixels

round( ) : rounding function to integer precision

$$w = round\left[2^P \times \frac{\sum_{i=1}^{S_{N^*}} N^*(i)}{\sum_{i=1}^{S_{N^*}} C^*(i)} \right]$$

IC parameter calculation [2/2]

Offset

- When $\sum_{i=1}^{S_{N^*}} C^*(i)$ is equal to '0', an offset is applied.

$$o = \frac{\sum_{i=1}^{S_N} N(i)}{S_N}$$

- Because…

$$w = round\left[2^P \times \frac{\sum_{i=1}^{S_{N^*}} N^*(i)}{\sum_{i=1}^{S_{N^*}} C^*(i)} \right]$$

Prediction pixel selection [1/4]

Selected pixels

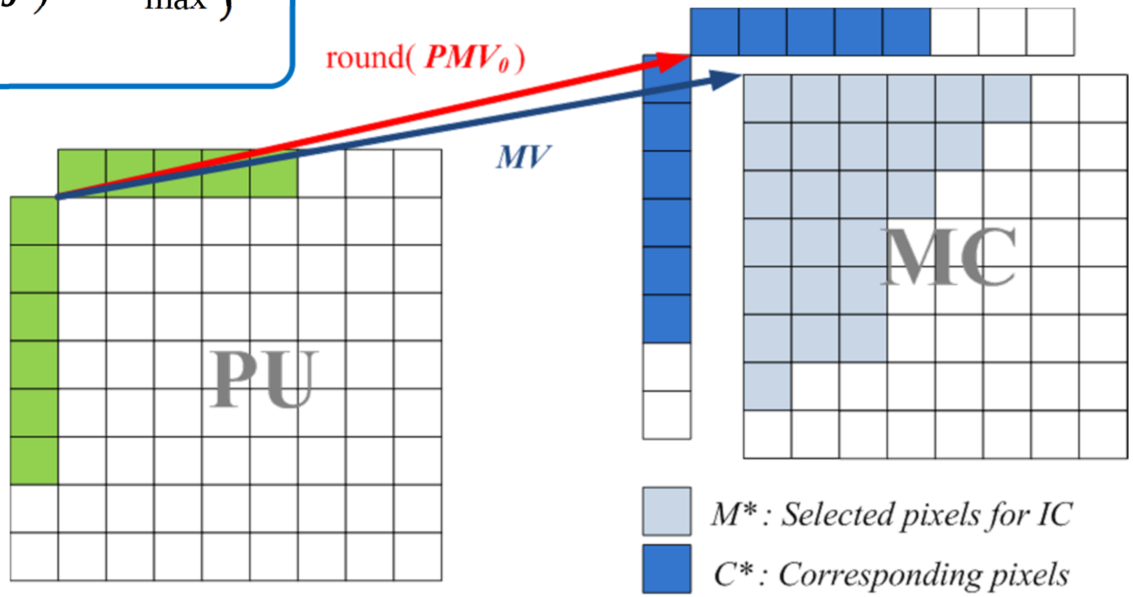
$$M^* = \left\{ M(j) \mid T_{\min}^{C} \le M(j) \le T_{\max}^{C} \right\}$$

- Thresholds

$$T_{\min}^{C} = m_C - \Delta_C$$

$$T_{\max}^{C} = m_C + \Delta_C$$

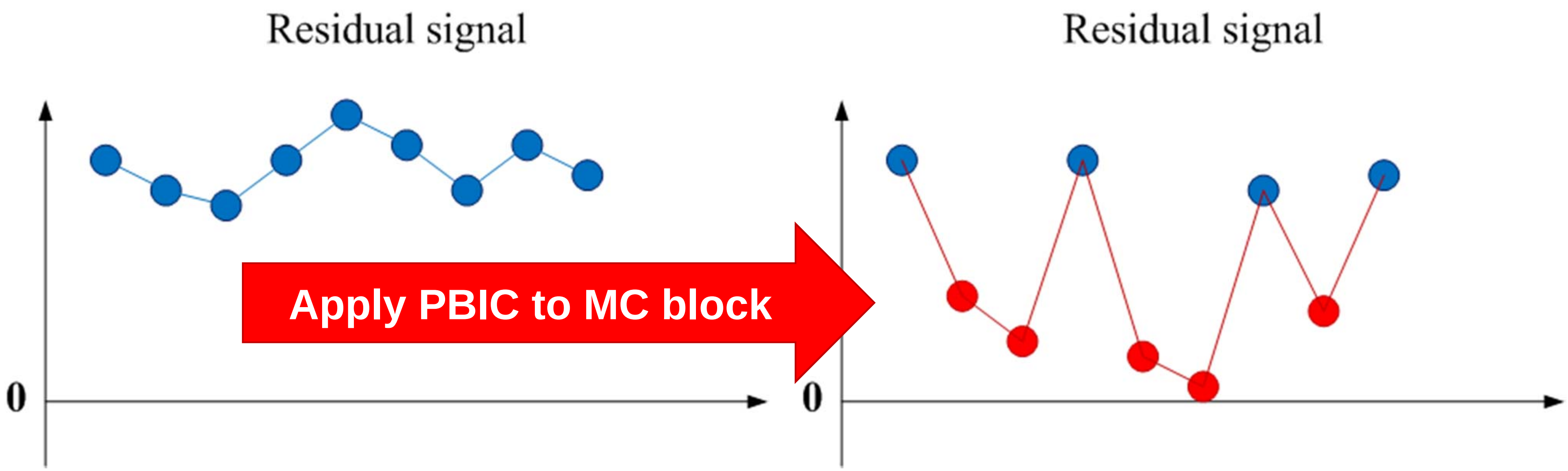
$$\Delta_C = \frac{2}{S_C} \sum_{i=1}^{S_C} \left| C(i) - m_C \right|$$



m_C: mean value of the corresponding pixels

Prediction pixel selection [2/4]

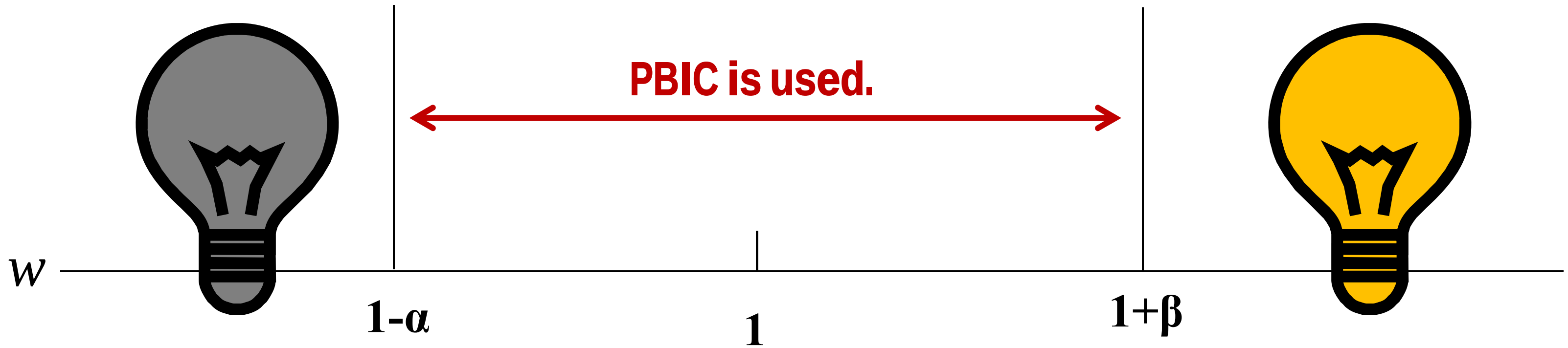
- Adaptation of application level
  - Bad case
    - When strong illumination change is occurred,



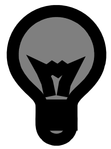
High-frequency signal could be generated.

Prediction pixel selection [3/4]

Adaptation of application level (cont.)



$w = 2^P - 2^H$ $\quad$ $w = 2^P$ $\quad$ $w = 2^P + 2^H - 1$

In  and  , IC is applied to all pixels on the MC block

Implementation

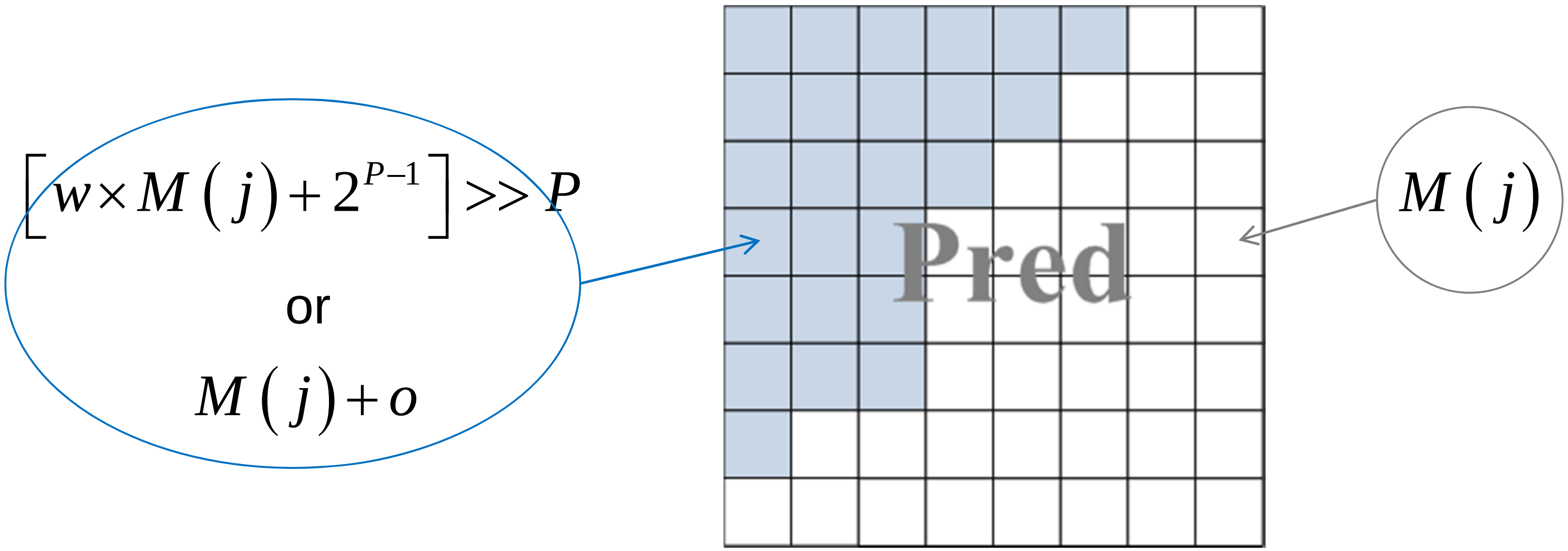
$$\begin{cases} \text{Pixel based IC} & ,\text{if } w_d = 2^{P-H} \\ \text{IC for all pixels} & ,otherwise \end{cases}$$

$$w_d = \left(w + 2^{H-1}\right) >> H$$

Prediction pixel selection [4/4]

□ Prediction

$$\mathrm{Pred}(j)=\begin{cases}\left[w\times M(j)+2^{P-1}\right]>>P & ,if\ \ M(j)\in M^{*}\ \&\ 0\neq\sum_{i=1}^{S_{N^*}}C^{*}(i)\\ M(j)+o & ,if\ \ M(j)\in M^{*}\ \&\ 0=\sum_{i=1}^{S_{N^*}}C^{*}(i)\\ M(j) & otherwise\end{cases}$$



SK telecom

MSP LAB

Signaling method

- Partition type
  - 2Nx2N
- Prediction direction
  - Uni-prediction
- 1-bit flag is used to indicate whether PBIC is used or not.
- PMV index is not signaled.
  - PMV index shall be set to 0 when PBIC flag is set to 'On'.
  - PMV has integer pixel precision.

Simulation results

- Simulation conditions
  - Anchor : HM3.2
  - Test conditions : JCTVC-E700

Results of HM3.2+PBIC

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1	-0.1	-0.9	-0.2	0.6	-0.1
Class B	-0.3	-0.2	-0.1	-0.3	0.0	-0.1
Class C	-0.2	-0.1	-0.1	-0.3	-0.2	-0.2
Class D	0.0	0.0	0.1	-0.1	-0.1	-0.1
Class E						
Overall	**-0.2**	**-0.1**	**-0.3**	**-0.2**	**0.0**	**-0.1**
Enc Time[%]	128%			130%		
Dec Time[%]	99%			97%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.3	-0.1	0.0	-0.3	0.0	0.0
Class C	-0.3	-0.2	-0.4	-0.5	-0.2	-0.1
Class D	-0.2	-0.1	-0.3	-0.2	0.3	0.3
Class E	-0.4	0.3	-0.2	-0.7	0.6	-0.2
Overall	**-0.3**	**-0.1**	**-0.2**	**-0.4**	**0.2**	**0.0**
Enc Time[%]	123%			124%		
Dec Time[%]	100%			99%		

Conclusions

- PBIC is proposed to improve coding efficiency for general test sequences by using IC scheme.
  - 0.2~0.4% bit rate reductions are achieved.
- Encoding complexity would be handled by using fast algorithms.

THANK YOU!