

JCTVC-B072

MB Mode with Joint Application of Template and Block Motion Compensations

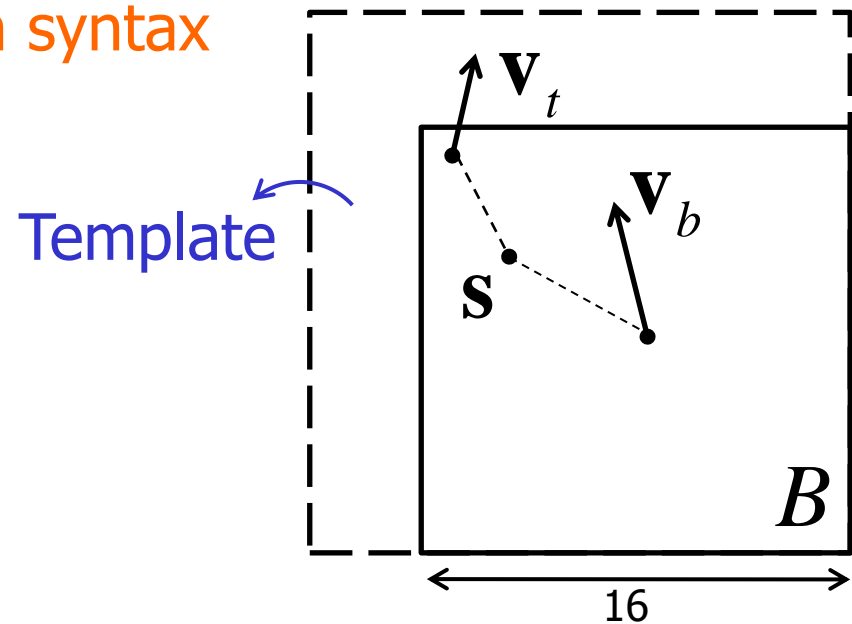


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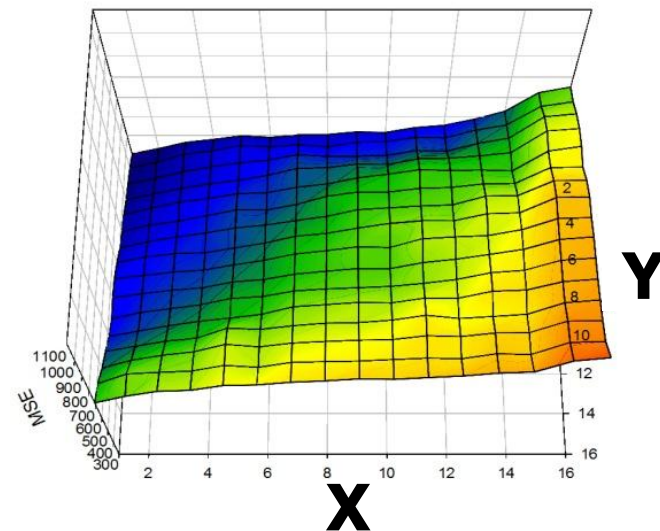
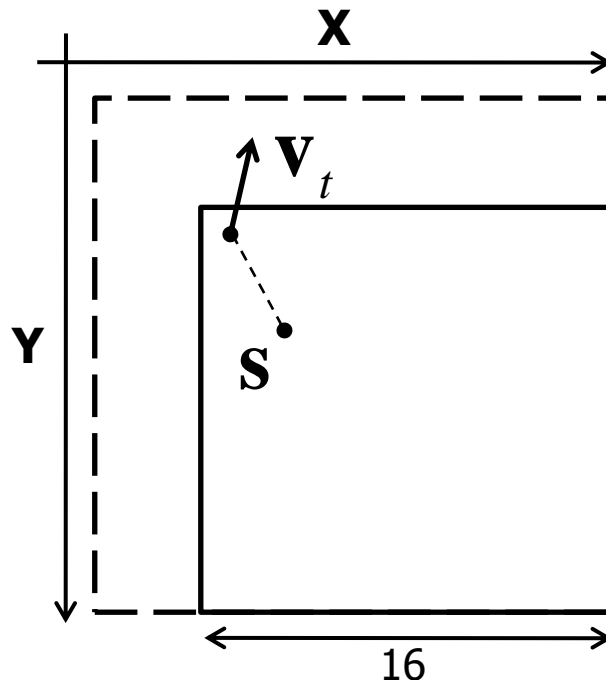
P+ Mode

- Bi-prediction with the cost of only one MV
 - Combine template and block MVs for motion comp.
- Enhancement to P16x16
 - No major change in syntax



Problem

- Given TMP MV, how to optimize block MV?



TMP tends to minimize error in upper left quarter

Objective

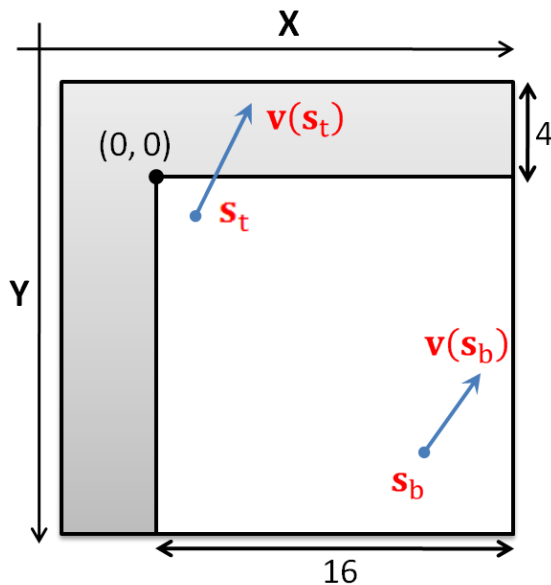
- Block MV should contribute more to minimizing error in the remaining part
- Search criterion for block MV

POBMC

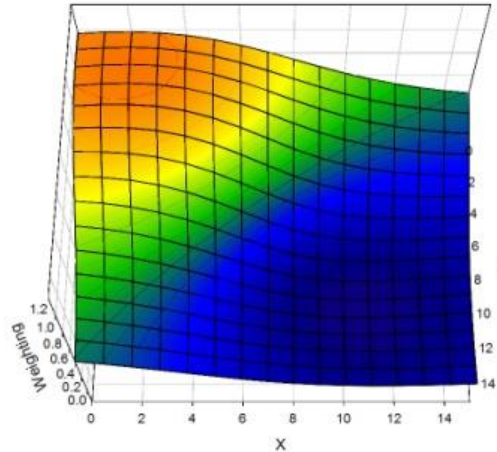
$$\arg \min_{\mathbf{v}_b} \sum_{s \in B} \left(I_k(s) - \underbrace{w(s) I_{k-1}(s + \mathbf{v}_t)}_{\text{TMP Predictor}} - \underbrace{(1 - w(s)) I_{k-1}(s + \mathbf{v}_b)}_{\text{BMC Predictor}} \right)^2$$

Weighting Functions

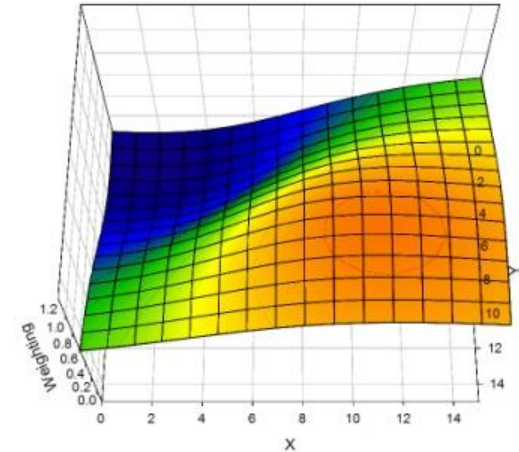
- A special case of geometry partition



Template MV



Block MV



Motion Search Criterion

- Given theoretical weighting functions, try to find a block MV that minimizes

POBMC

$$\arg \min_{\mathbf{v}_b} \sum_{\mathbf{s} \in B} \left(I_k(\mathbf{s}) - \underbrace{w^*(\mathbf{s}) I_{k-1}(\mathbf{s} + \mathbf{v}_t)}_{\text{Theoretical weighting functions}} - \underbrace{(1 - w^*(\mathbf{s})) I_{k-1}(\mathbf{s} + \mathbf{v}_b)}_{\text{Theoretical weighting functions}} \right)^2$$

Theoretical weighting functions

- Least-squares solutions are possible



Test Conditions

- Anchor: KTA2.4r1 with all KTA tools turned off
- Adaptive selection of P16x16 and P16x16+
- Single hypothesis TMP of width 4
- IPPP encoding
- First 100 frames

Reference Frame	4
CABAC	On
8x8 Transform	On
Deblocking	On
RDO	On
MV Search Range	128
Motion Search	EPZS
Sub-pel MC	On
Quantization Parameter (I/P)	22/23, 27/28, 32/33, 37/38
Adaptive Rounding	Off
Prediction Structure	IPPP...
Block Partitioning	16x16 to 4x4

Results

■ BD-Rate saving

- Avg 2.4%
- Max 4.2%
- Min 0.4%

■ BD-PSNR gain

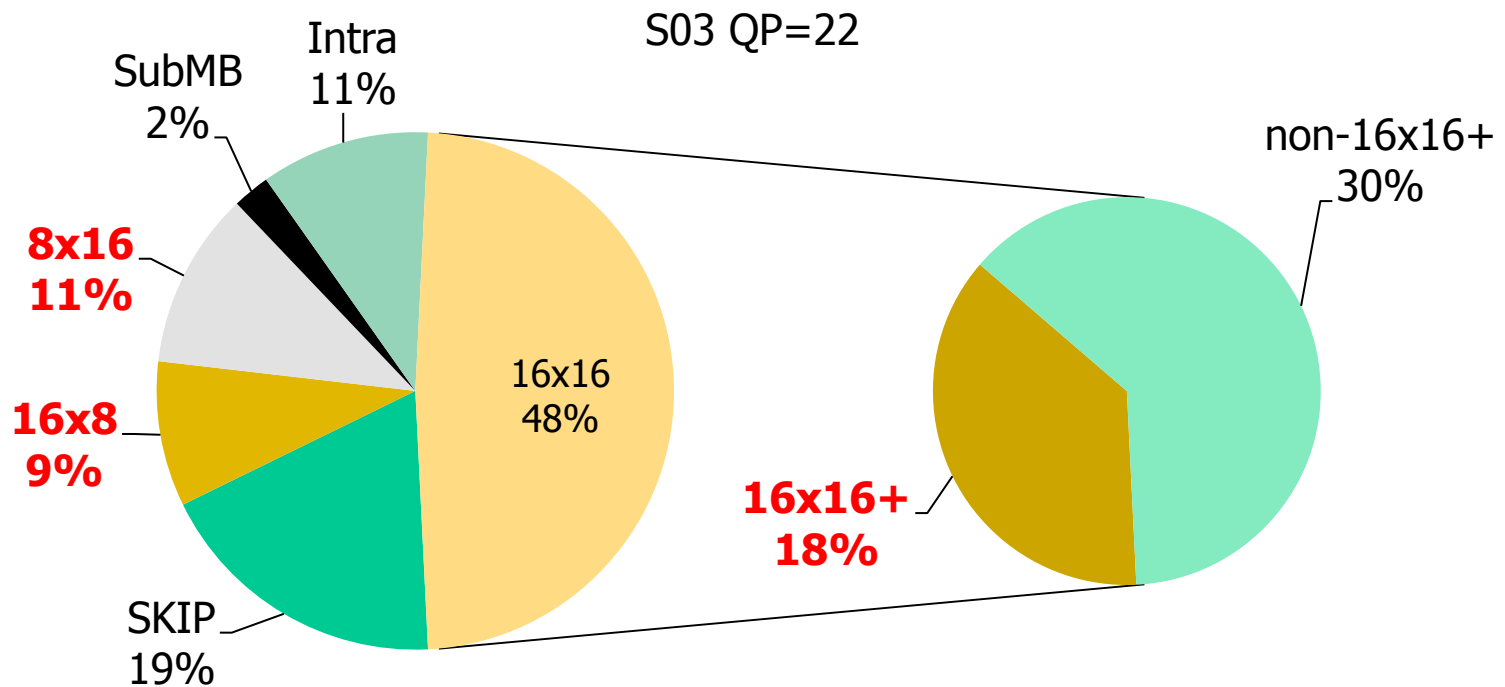
- Avg 0.08 dB
- Max 0.15 dB
- Min 0.02 dB

	Sequences	BD-PSNR Gain	BD-Rate Saving
Class A	S01	0.082	-2.24%
	S02	0.070	-1.51%
	Average	0.076	-1.88%
Class B	S03	0.158	-4.21%
	S04	0.033	-0.91%
	S05	0.047	-1.89%
	S06	0.083	-3.12%
	S07	0.094	-3.49%
	Average	0.083	-2.72%
Class C	S08	0.102	-2.64%
	S09	0.097	-2.20%
	S10	0.018	-0.40%
	S11	0.046	-1.04%
	Average	0.066	-1.57%
Class E	S16	0.140	-3.76%
	S17	0.074	-1.87%
	S18	0.059	-2.01%
	Average	0.091	-2.55%
Overall Average		0.079	-2.42%



Mode Distribution

- 10%-20% of MBs use P+ mode
- 2-3 times higher relative to 16x8 or 8x16





Conclusions

- P+ mode has bi-prediction performance, but requires only one MV
- It was currently applied to P16x16 only, but even so, there was a moderate gain
- The notion can be extended to any MB or sub-MB partition with single- or multi-hypothesis prediction
- The template MV can also be replaced with a MV inferred by other means

