

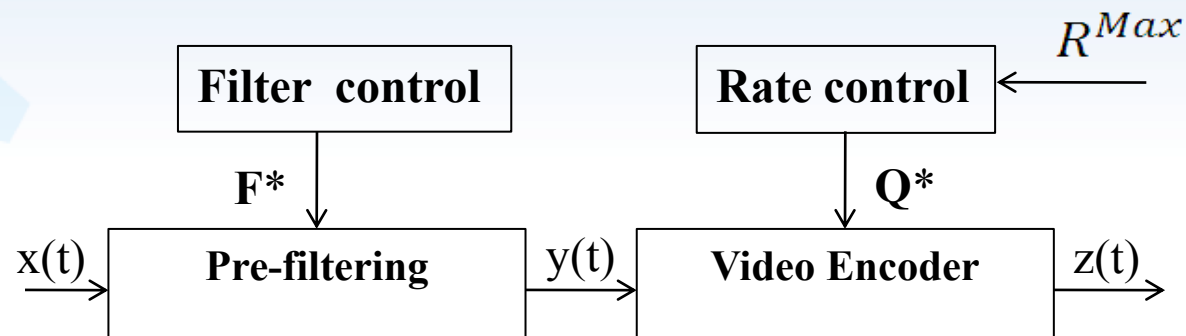
Rate-distortion Oriented Joint video pre-filtering and compression

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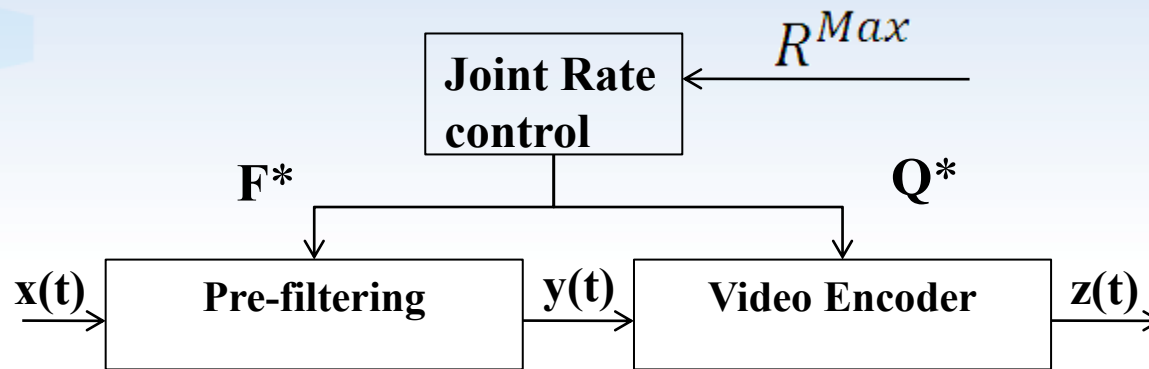


Typical scheme of Pre-filtering and compression



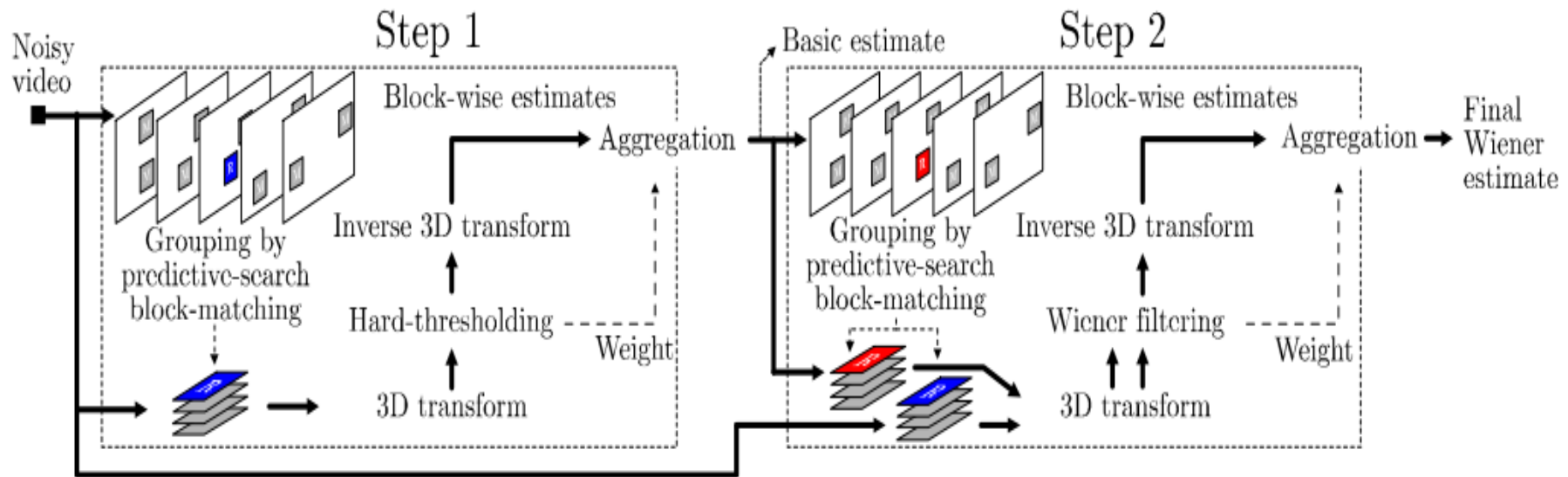
Usually we have two separate processes for pre-filtering and compression, and we choose parameters **separately**.

Optimization Task



$$\left\{ \begin{array}{l} F^*, Q^* = \arg \min_{\substack{F \in \{F\} \\ Q \in \{Q\}}} \sum_i D(F_i, Q_i), \\ \sum_i R(F_i, Q_i) \leq R^{Max}. \end{array} \right. \quad (1)$$

VBM3D (Video Block-Matching 3D Filtering)



K. Dabov, A. Foi, and K. Egiazarian, "Video denoising by sparse 3D transform-domain collaborative filtering," in Proc. 15th European Signal Processing Conference, EUSIPCO, Poznan, Poland, September 2007

Practical Results

Pre-filtering: VBM3D

Video Encoder: H.264/AVC (JM V.17.1)

Experiments modes:

- Constant quantization mode
- Constant bitrates mode



Practical Results

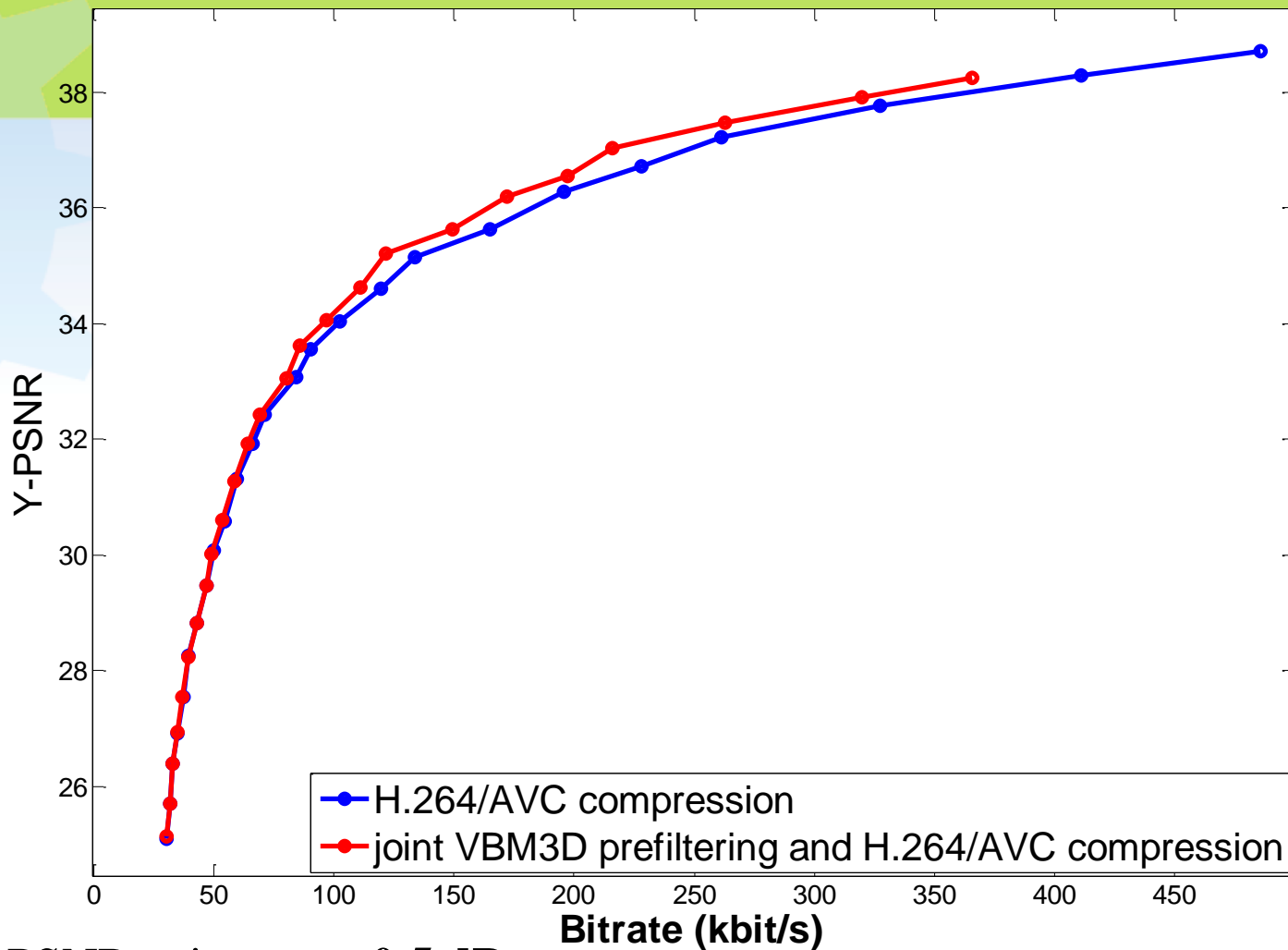
Constant Quantization Mode

- In compression part: quantization parameters Q include
 - $QPI = \{21, 22, \dots, 45\}$, respectively $QPP = QPI + 5$
 - other fixed codec setting
- In filtering part: for each Q , filtering parameters F include
 - $\text{Sigma} = \{0, 0.5, 1, \dots, 5\}$,
 - other fixed filter setting
- Full search: for each Q , find the best sigma under rate-distortion framework.



Practical Results

hall.yuv, 25 points, QPI=21:1:45, QPP=26:1:50

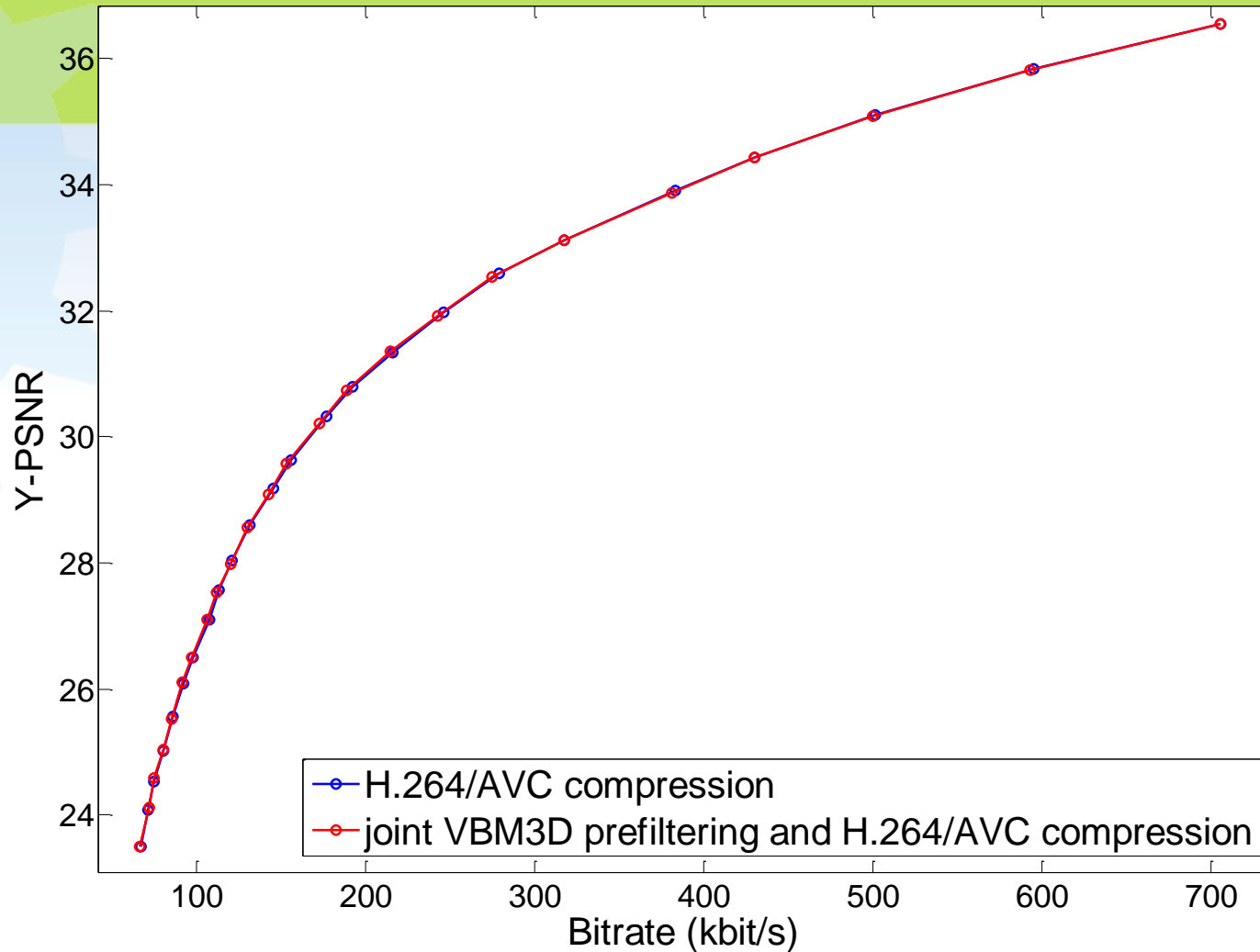


PSNR gains up to **0.5 dB**.

Bitrates savings up to **13.4%**.



foreman.yuv, 24 points, QPI=22:1:45, QPP=27:1:50



PSNR gains up to **0.1 dB**.

Bitrates savings up to **1.2%** could be reached.

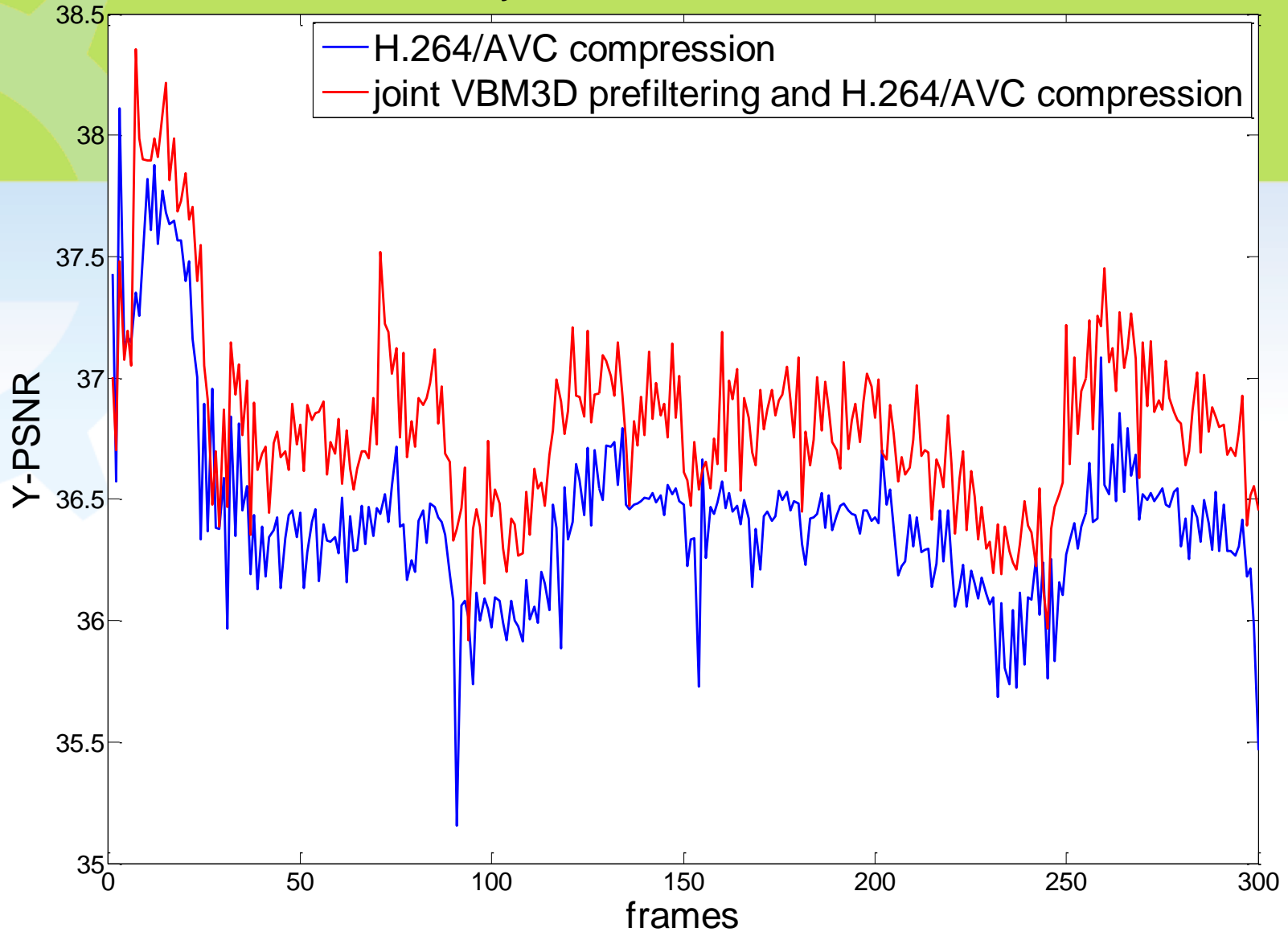


Practical Results

Constant Bitrates Mode

- In compression part: enable the **constant bitrates control**.
- In filtering part: filtering parameters {F} include
 - $\text{Sigma} = \{0, 0.5, 1, \dots, 5\}$,
 - other fixed filter setting
- Full search: find the best output under rate-distortion framework

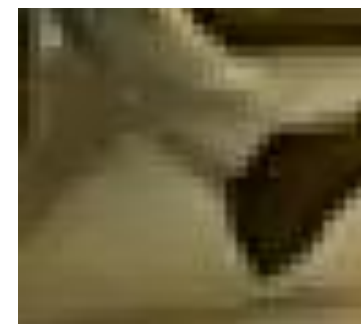
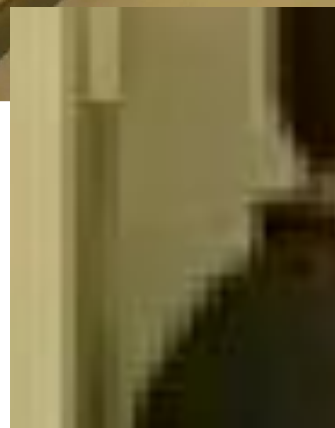
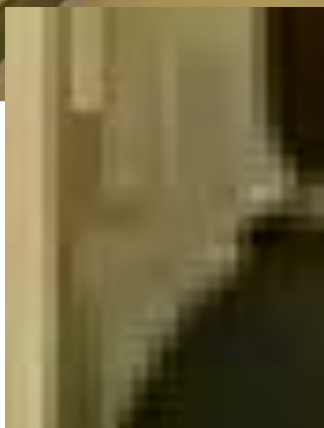




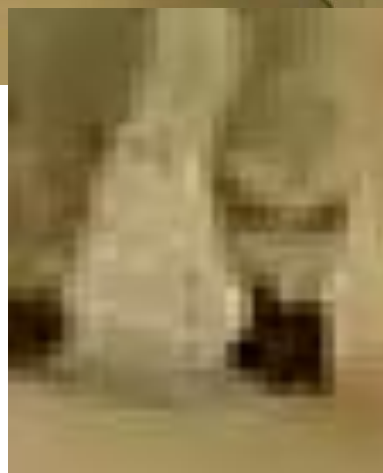
PSNR gains up to **1.2 dB** .

H.264/AVC, frame 23

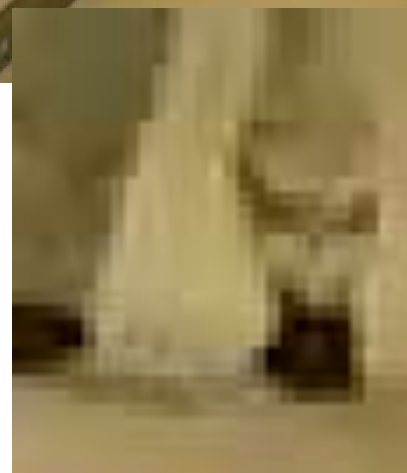
VBM3D+H.264/AVC, frame 23



H.264/AVC, frame 91



VBM3D+H.264/AVC, frame 91



Summary:

1. Produce output videos with less compression artifacts.
2. Output videos have consistent PSNR gains.
 - can be up to 1.2 dB under constant bitrates mode.
 - can be up to 0.5 dB under constant quantization mode.
3. Can reduce the bitrates up to 13.4% in comparison with only compression.



Thank you!



Fixed setting of filter and codec setting

Filter setting (F)

Parameters	Settings
denoiseFrames	5
transform-2D-HT-name	Identity transform
transform-3rd-dim-name	Haar
N1	8
Nstep	6
Nb	16
N2	4
Ns	5
tau-match	3000
lambda-thr3D	2.7
Wiener filtering	–

Codec setting (Q)

JM codec V.17.1	Settings
Profile	Baseline
Motion estimation	16×16 block in radius 16
search mode	Simplified UMHexagon search
Number of reference frames	1
Skip mode	Enable
De-blocking filter	Enable
RD optimization	Low complexity mode
Rate control	Disable
slice size	50 macroblocks