

Improved ρ -domain rate control with accurate header size estimation

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Fan Zhang

fan.zhang@tum.de

Eckeard Steinbach

eckeard.steinbach@tum.de

Motivation

- **p-domain rate control ([He02],[He08])**
- **p-domain rate control in H.264**
 - Increased amount of header data

[He02] Z.He and S.K.Mitra, “*A linear source model and a unified rate control algorithm for DCT video coding,*” IEEE Trans. Circuits Syst. Video Technol., vol. 12, pp.970-982, Nov.2002

[He08] Z.He and D.O.Wu, “*Linear rate control and optimum statistical multiplexing for H.264 video broadcast,*” IEEE Trans., Multimedia, vol. 10, no. 7, pp. 1237-1249, Nov. 2008

Outline

- Motivation

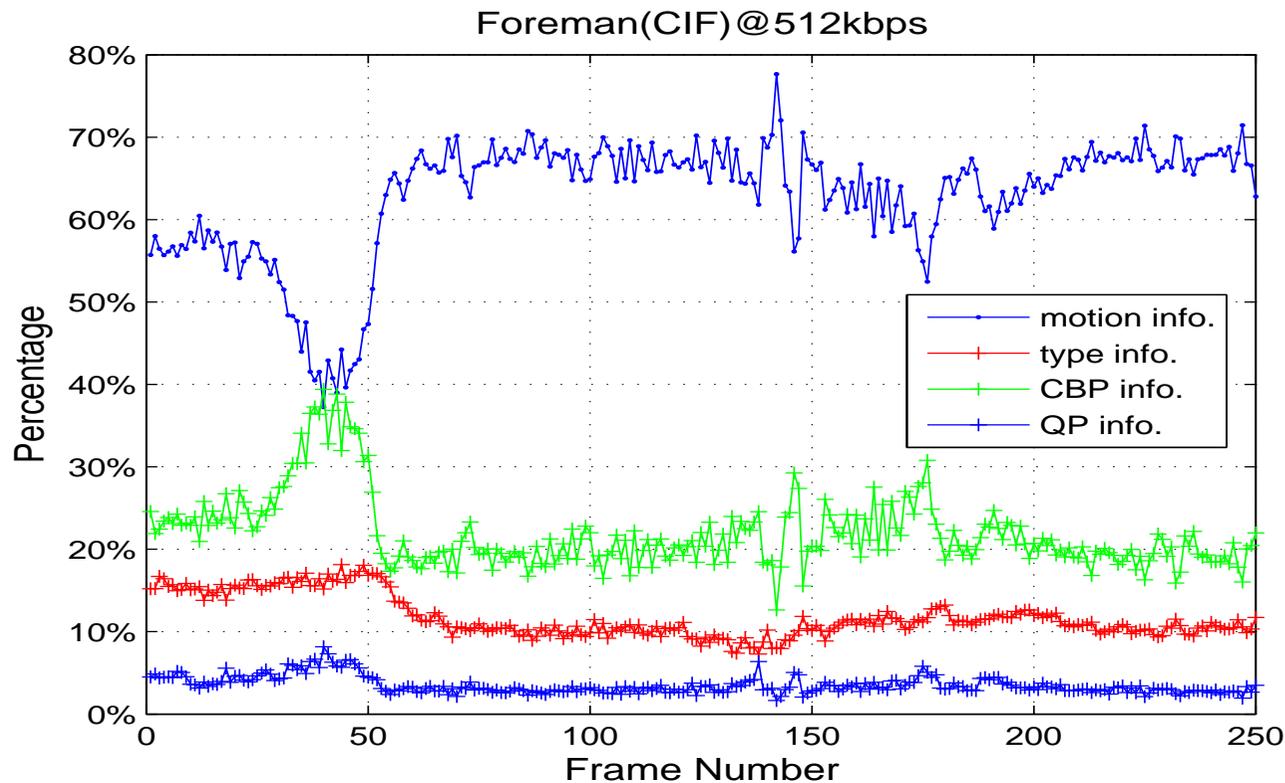
- **Proposed Rate Control Algorithm**
 - Header information in H.264
 - Rate model for motion information in inter-MB
 - Rate model for CBP information in inter-MB
 - Two-Stage Rate Control Algorithm

- **Experimental Results**
 - Bitrate accuracy
 - Frame size fluctuation
 - QP variation in a frame

- **Conclusion & Future Work**

Header Data in H.264

- **Header Size Estimation (HSE) in H.264**
 - Header Information in H.264
 - HSE for intra macroblocks
 - HSE for inter macroblocks (motion information & CBP)

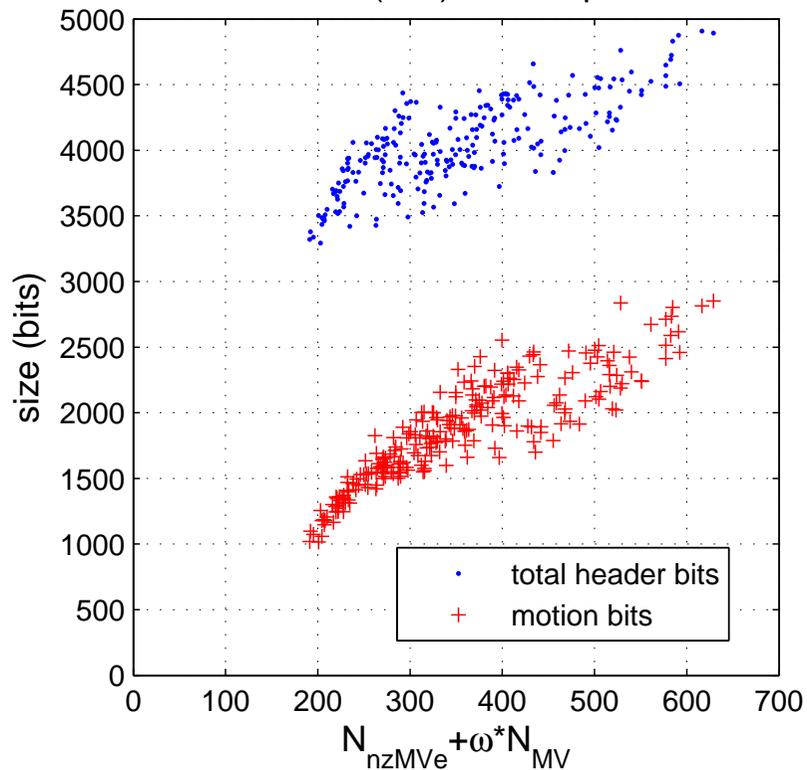


Rate model for motion information in inter-MBs

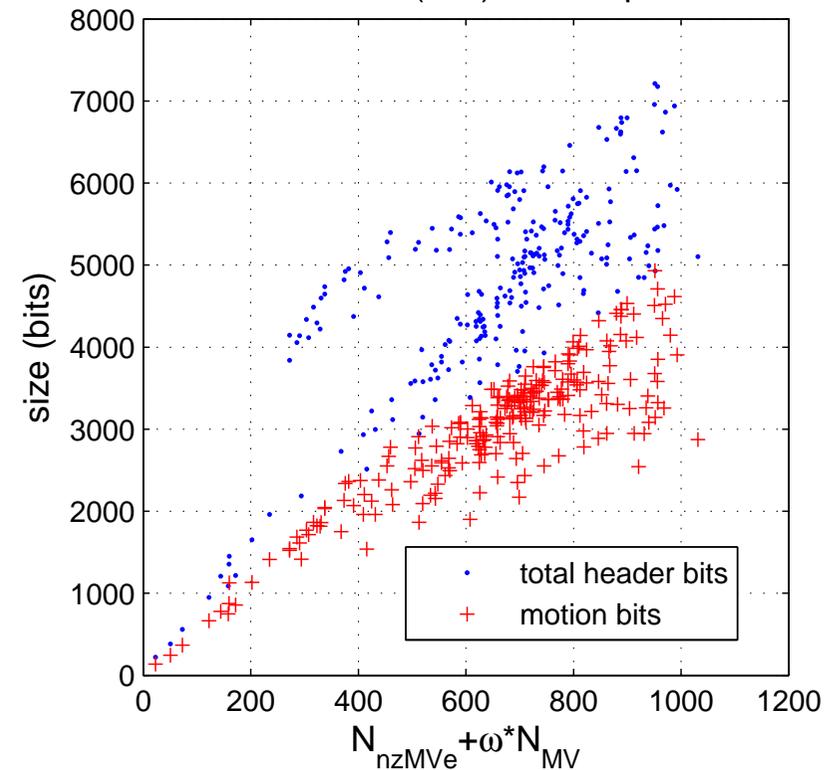
- Linear model in [Shen07]

$$R_{hdr,p} = \gamma \cdot (N_{nzMVe} + \omega \cdot N_{MV})$$

M&D(CIF)@384kbps



Foreman(CIF)@512kbps

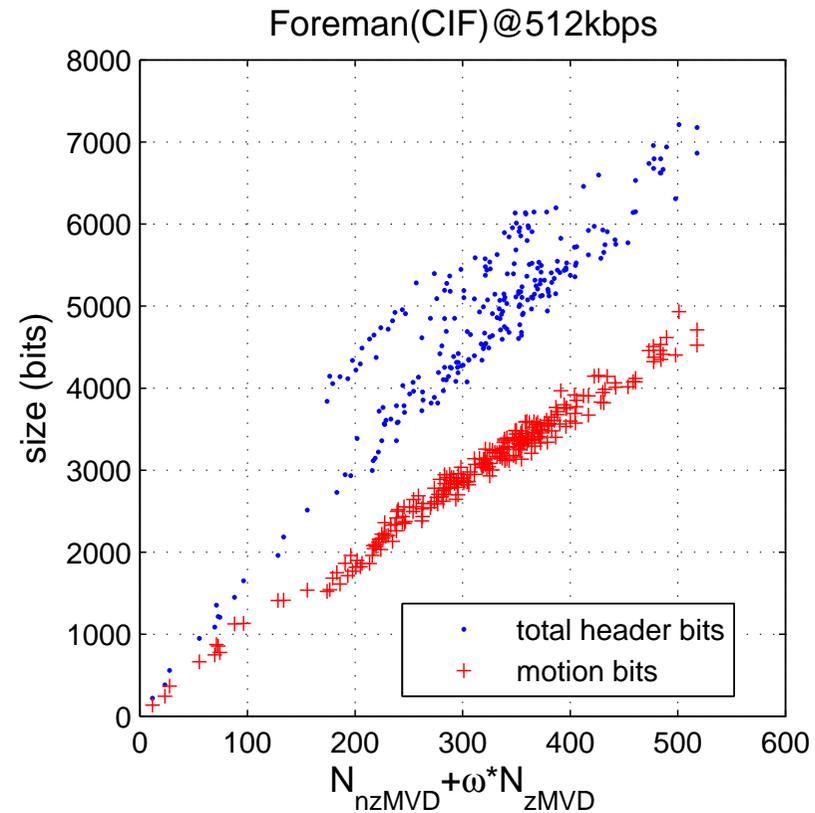
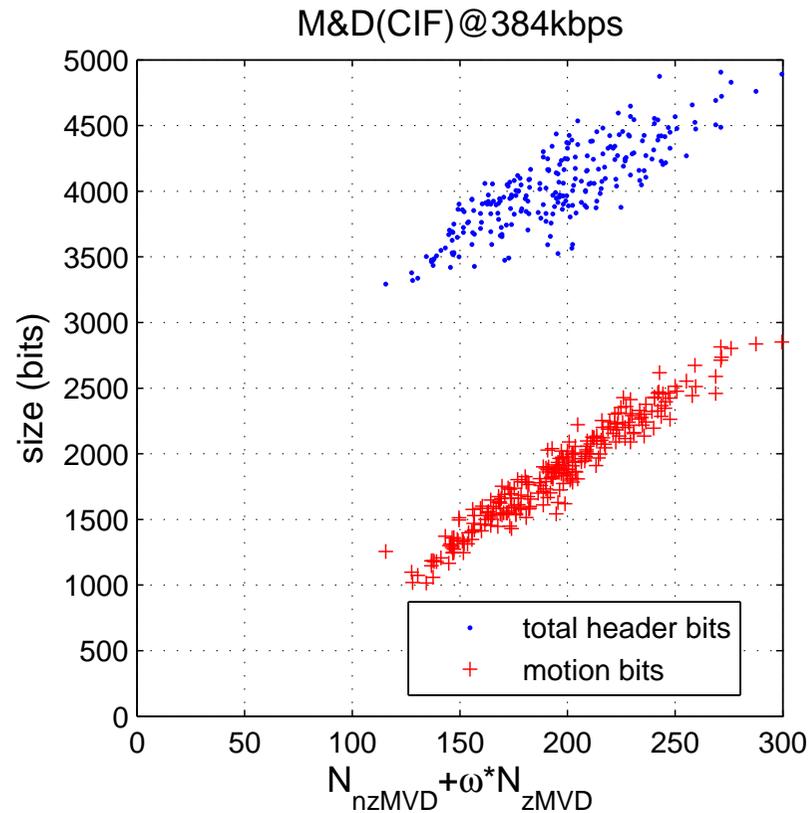


[Shen07] M.Y.Shen D.K.Kwon and C.C.J.Kuo, "Rate control for H.264 video with enhanced rate and distortion models," IEEE Trans. Circuits Syst. Video Technol., vol. 17, no, 5, pp.517-529, May 2007

Rate model for motion information in inter-MBs

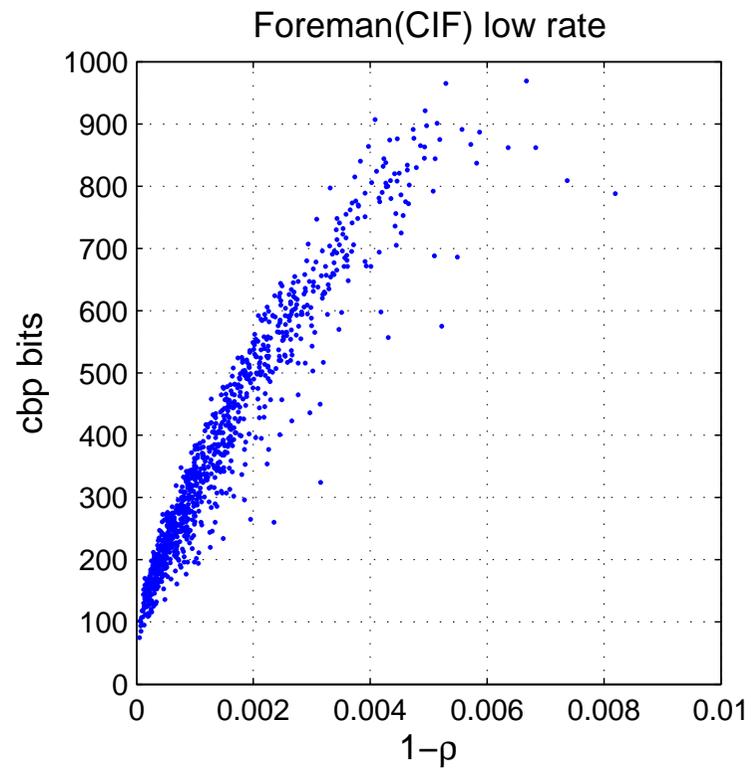
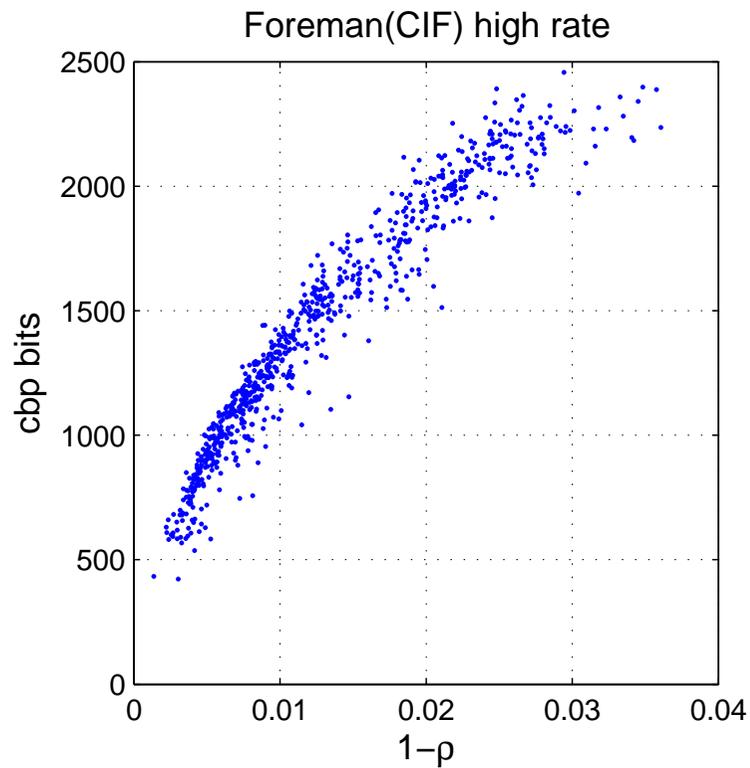
- Proposed rate model for motion information

$$R_{mot,p} = \gamma_{mot} \cdot (N_{nzMVDe} + \omega_{mot} \cdot N_{zMVDe})$$



Rate model for CBP information in inter-MBs

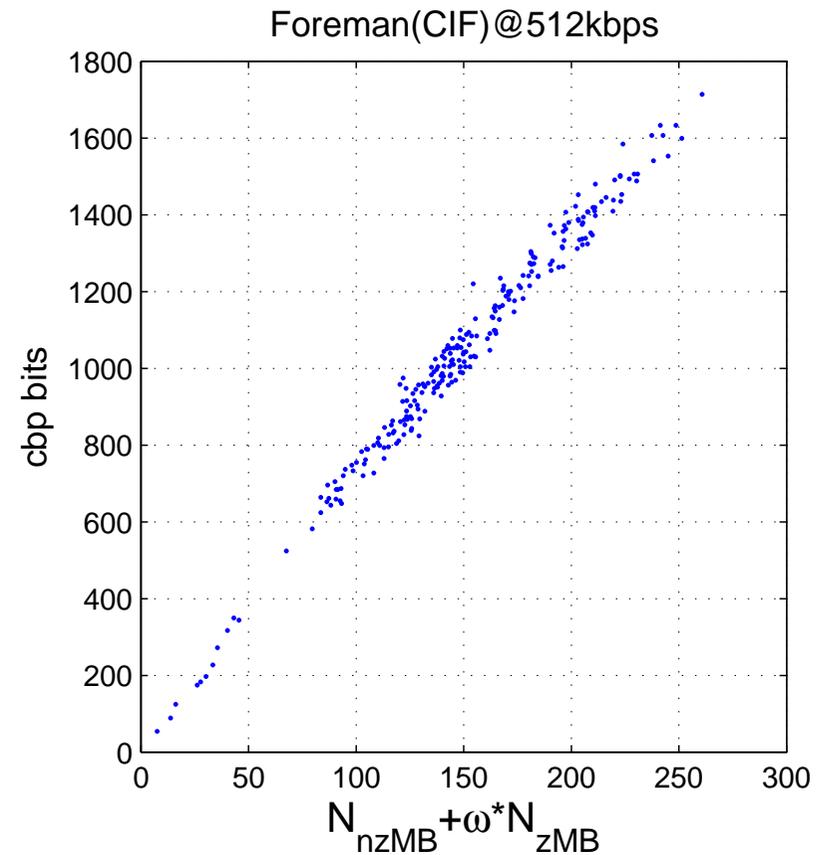
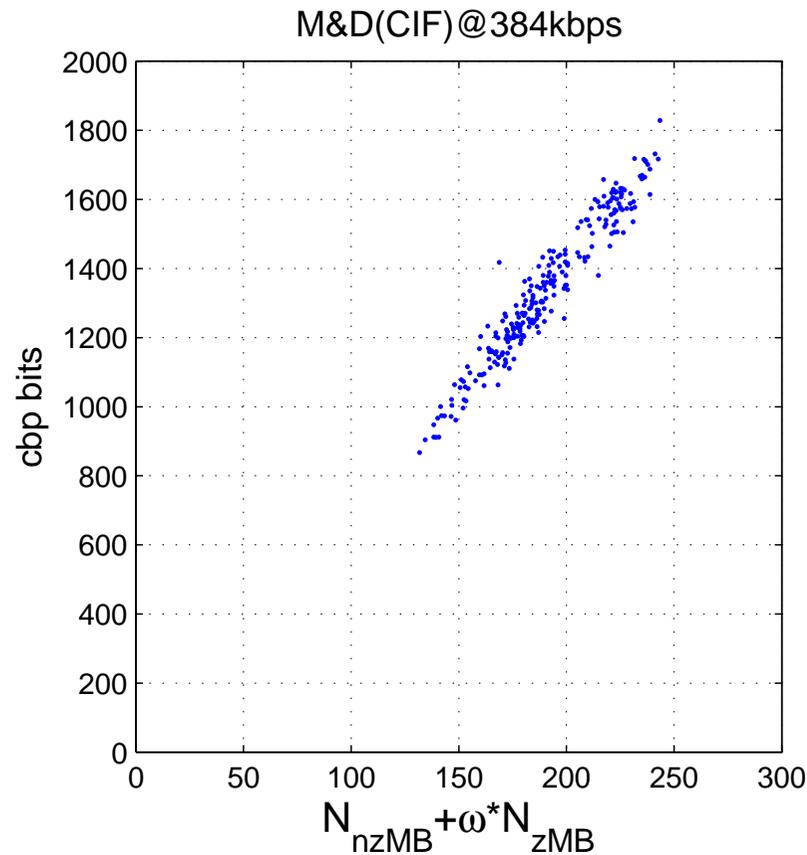
- Model in [Shen07]



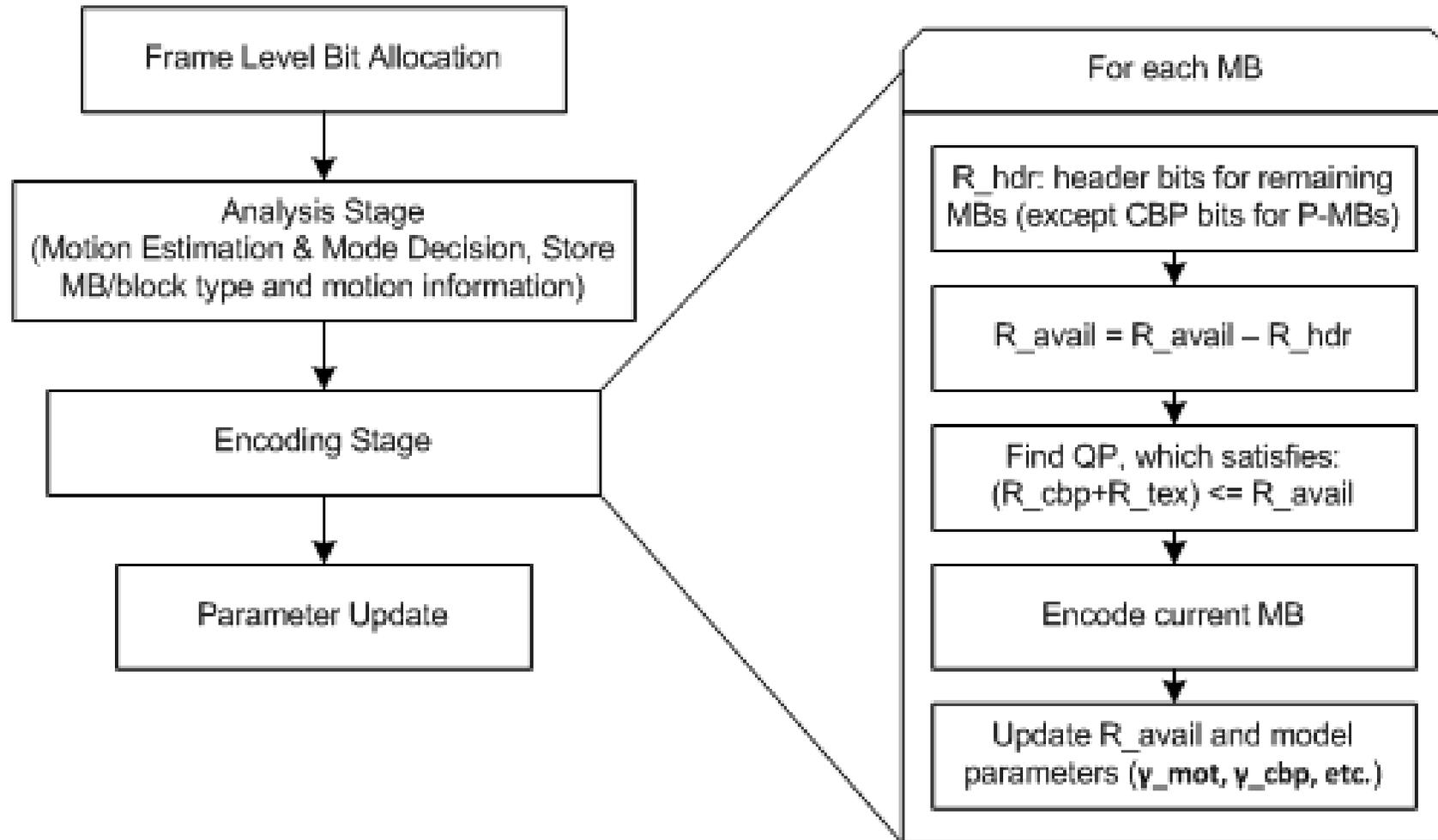
Rate model for CBP information in inter-MBs

- Proposed rate model for CBP information

$$R_{cbp,p} = \gamma_{cbp} \cdot (N_{nzMB} + \omega_{cbp} \cdot N_{zMB})$$



Two-Stage Rate Control Algorithm



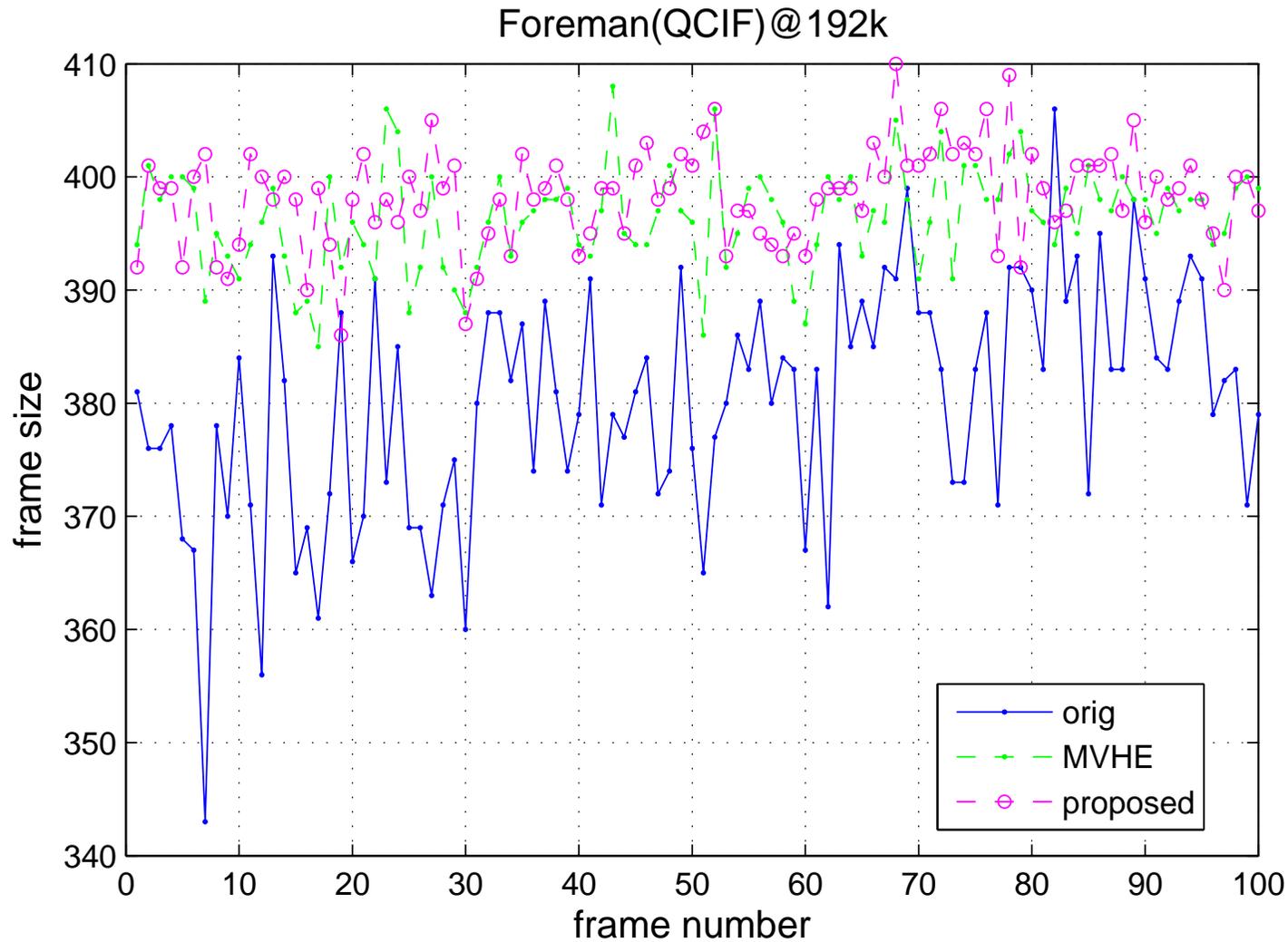
Experimental Results

- Sequence Level (deviation from target bit rate)

Seq.	Target Bitrate (kbps)	X264		ORIG		MVHE		Proposed	
		BR (kbps)	PSNR (dB)	BR (kbps)	PSNR (dB)	BR (kbps)	PSNR (dB)	BR (kbps)	PSNR (dB)
M&D (QCIF)	48	47.42	36.51	47.09	36.45 (-0.06)	47.95	36.58 (+0.07)	47.92	36.59 (+0.08)
	96	95.43	39.89	95.04	39.94 (+0.05)	95.62	40.06 (+0.18)	95.60	40.07 (+0.19)
	128	127.48	41.33	126.84	41.36 (+0.03)	127.42	41.51 (+0.18)	127.48	41.53 (+0.20)
Foreman (QCIF)	96	94.95	33.43	90.80	33.42 (-0.02)	94.54	33.59 (+0.16)	95.01	33.72 (+0.29)
	128	126.50	34.81	125.88	34.74 (-0.07)	126.20	34.94 (+0.13)	126.40	35.03 (+0.22)
	192	189.81	36.65	188.74	36.64 (-0.01)	189.16	36.76 (+0.11)	189.58	36.86 (+0.21)
M&D (CIF)	128	127.38	37.23	127.38	37.39 (+0.15)	128.08	37.30 (+0.07)	127.90	37.42 (+0.18)
	192	191.17	39.18	191.08	39.30 (+0.13)	191.48	39.35 (+0.17)	191.56	39.40 (+0.22)
	256	254.87	40.43	254.67	40.63 (+0.20)	255.04	40.65 (+0.22)	255.23	40.70 (+0.27)

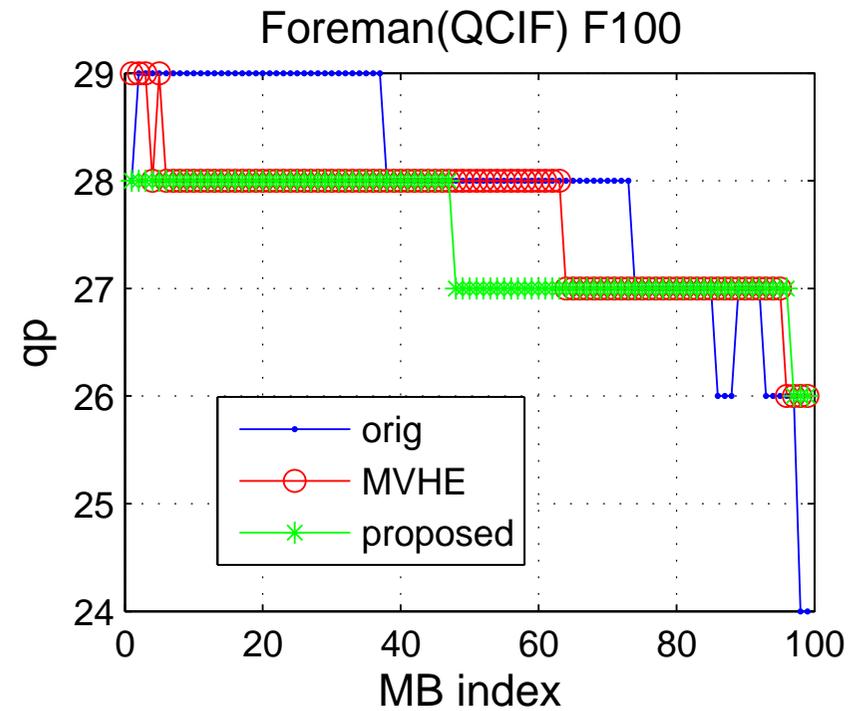
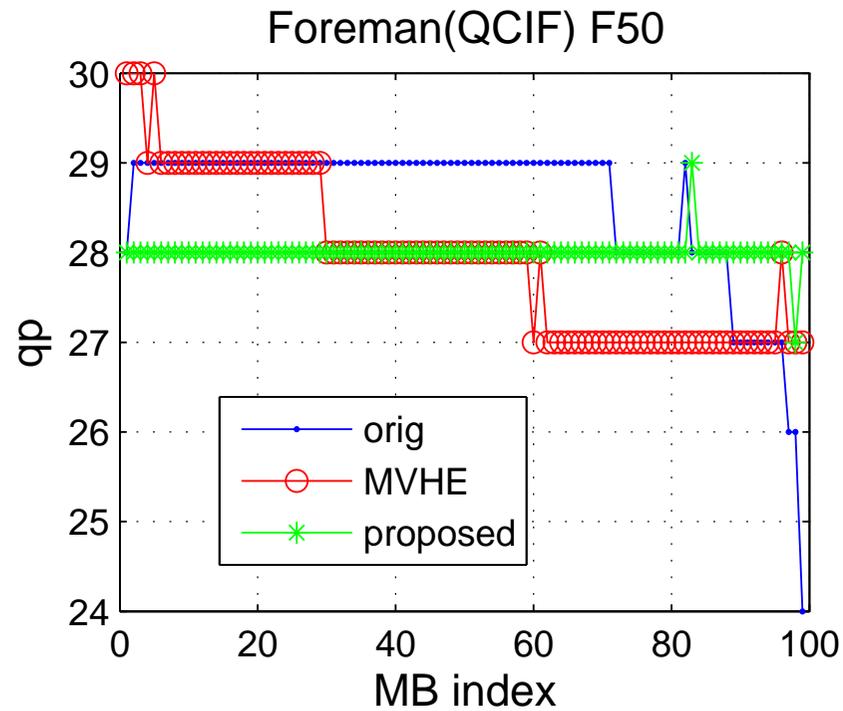
Experimental Results

- **Frame level fluctuation**



Experimental Results

- MB level QP fluctuation



Conclusion

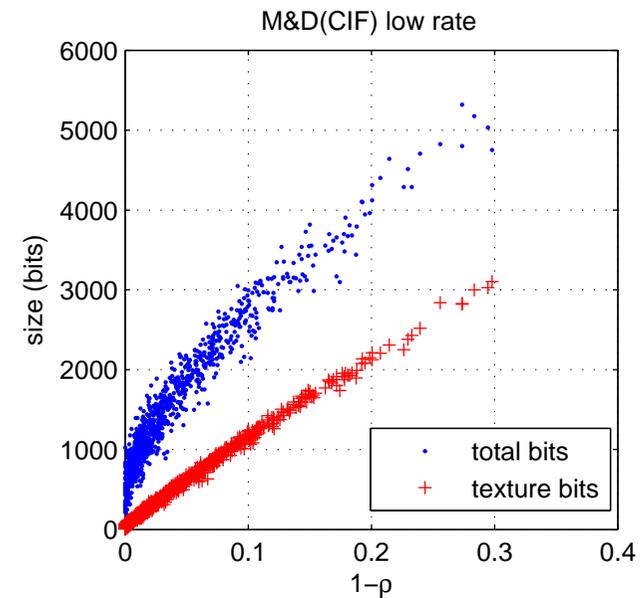
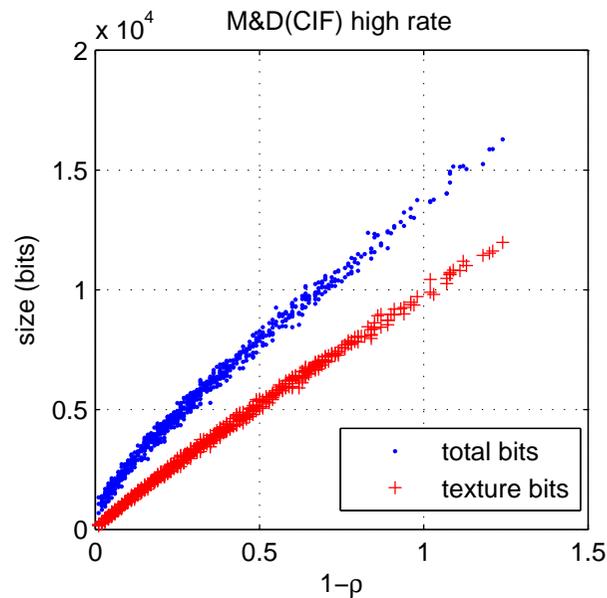
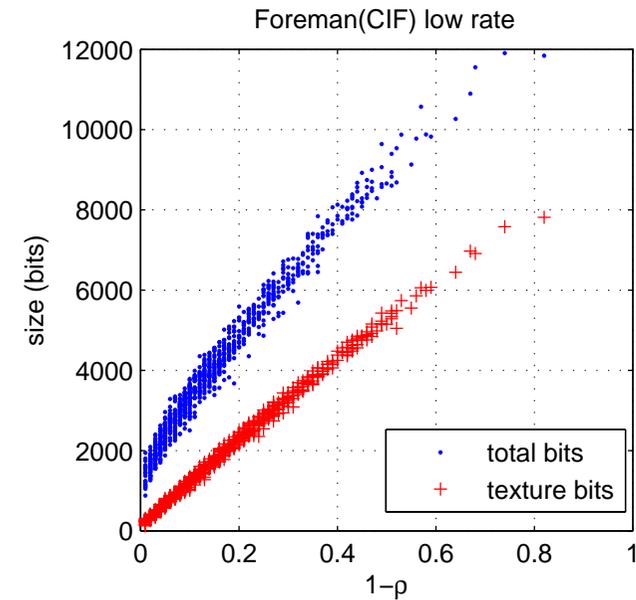
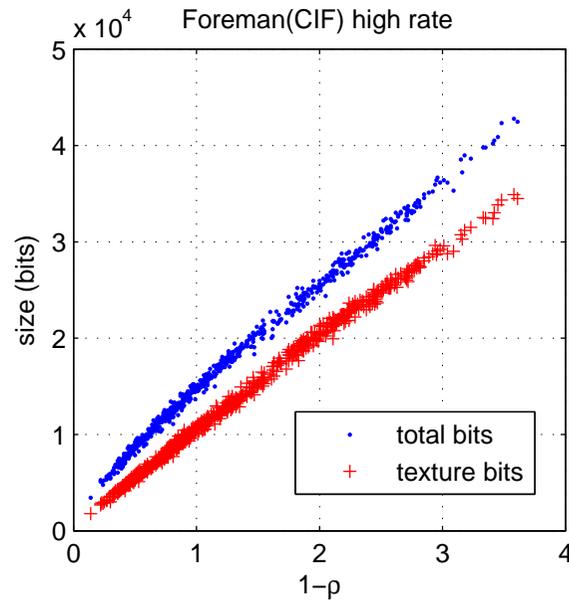
- **Rate models for header information of H.264**
 - Bits for Motion Information
 - Bits for Coded Block Pattern (CBP)
- **Two-stage ρ -domain rate control algorithm**
- **Better rate control accuracy through header estimation**
 - Smaller frame size fluctuation in a sequence
 - Smaller QP variation within a frame

Thank you for your attention



Motivation

- X264 encoded
- Foreman/M&D
- High Rate:
QP:25-33
- Low Rate:
QP:34-45



Rate model for CBP information in inter-MBs

- Performance of the proposed CBP rate model

Seq.	Bitrate (kbps)	R ² Value
M&D (CIF)	384	0.9347
Foreman (CIF)	512	0.9725
Football (CIF)	640	0.9749
Carphone (CIF)	384	0.9740

Rate model for motion information in inter-MBs

- Performance comparison

Seq.	Bitrate (kbps)	R ² Value	
		Kwon07	Proposed
M&D (CIF)	384	0.5742	0.9219
Foreman (CIF)	512	0.7373	0.9767
Football (CIF)	640	0.7119	0.9730
Carphone (CIF)	384	0.7800	0.9772