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Source : JAPAN
Title : Coding efficiency comparison between multi-field prediction and adaptive frame/field prediction
Purpose : Information

1.INTRODUCTION

Two types of video coding schemes are proposed for first test model of MPEG2. One is adaptive frame/field prediction coding and the other is multi-field prediction coding. The coding efficiency of these two schemes are simulated.

2.SIMULATIONS

2.1 Multi-field prediction coding

Multi-field prediction coding is based on MPEG92/79 and SM3. The specification of the model is described in Table 2.

2.2 Adaptive frame/field prediction coding

Adaptive frame/field prediction coding is based on MPEG92/80 and SM3. Four variations of the model are calculated. The definition of the four models are shown in Table 1. The specification of these four models are described in Table 2.

Table 1. Definition of each coding model

	Motion Estimation	Prediction	DCT
frame/field adaptive prediction full adaptive coding	frame/field	frame/filed	frame/field
adaptive DCT coding	frame	frame	frame/field
adaptive MC coding	frame/field	frame/filed	frame
frame coding	frame	frame	frame
multi-field prediction	field	field	field

Table 2. Simulation specifications

	multi-field	full adaptive	adaptive DCT	adaptive MC	frame
picture format(Y)	704x240/60	704x480/30			
base coding	MPEG92/79 SM3	MPEG92/80 SM3			
GOP structure	N=24,M=3	N=12,M=3			
prediction	field	adaptive	frame	adaptive	frame
DCT	field	adaptive	adaptive	frame	frame
bit rate	4.0 Mbit/s				
Motion estimation	15.5x15.5 full search	20.5x20.5 / frame telescopic search			
Rate control	MPEG92/77 (step 1,2)				
Simulation sequence	4:2:0				
Mobile&Calendar	60 frames				
Football	60 frames				

3.SIMULATION RESULTS

Table 3 shows the simulation results. In both sequences, the frame base codings exhibit higher efficiency. Adaptive coding (adaptive MC + frame DC) and full adaptive coding (adaptive MC + adaptive DCT) exhibit good SNR.

Table 3. Simulation results

Sequence			S/N (dB)				
			multi-field	full adaptive	adaptive DCT	adaptive MC	frame
Mobile&Calendar	Total	Y	27.29	28.83	28.46	28.93	28.57
		cb	31.98	34.22	34.18	34.27	34.25
		cr	31.99	34.25	34.24	34.32	34.31
	I	Y	28.69	29.22	29.14	29.28	29.20
		cb	32.72	34.46	34.40	34.53	34.47
		cr	32.82	34.67	34.61	34.75	34.69
	P	Y	27.94	29.08	28.78	29.20	28.93
		cb	31.80	33.84	33.82	33.90	33.88
		cr	31.81	33.88	33.88	33.95	33.96
	B	Y	26.97	28.69	28.28	28.78	28.37
		cb	32.02	34.33	34.30	34.39	34.37
		cr	32.02	34.35	34.33	34.41	34.40
Football	Total	Y	32.15	32.00	31.78	31.52	31.23
		cb	36.17	35.72	35.92	35.52	35.68
		cr	37.37	37.24	37.44	37.10	37.27
	I	Y	34.24	33.95	33.96	33.45	33.38
		cb	38.09	38.11	38.11	37.88	37.82
		cr	38.82	39.08	39.08	38.90	38.86
	P	Y	32.75	32.39	32.40	31.89	31.89
		cb	36.20	35.81	36.15	35.58	35.88
		cr	37.27	37.16	37.48	37.00	37.29
	B	Y	31.82	31.68	31.37	31.21	30.81
		cb	36.06	35.46	35.63	35.28	35.40
		cr	37.33	37.08	37.26	36.95	37.11

4.CONCLUSIONS

-Multi-field prediction coding is effective for Football sequence.
-Adaptive frame/field motion compensation is effective for Mobile&Calendar sequence.
-Adaptive field/frame DCT is effective for roughly moving sequence (i.e. Football).
-Adaptive field/frame coding is superior to multi-field prediction coding on the picture quality, while the later one superior on delay time and hardware implementation.
-Feature improvements should be needed for both method, especially the reduction of delay time and hardware implementation for adaptive field/frame coding and picture quality improvement for multi-field prediction coding.

ANNEX

Simulation results of field / frame adaptive DCT coding

This annex shows the comparison results of coding efficiencies between the field/frame adaptive DCT and field-based DCT from another approach.

A1. SIMULATIONS

(1) Coding algorithm
based on H.261
bit-rate : CBR (4Mbit/s, 8Mbit/s, 16Mbit/s)

(2) Picture format
4:2:0 (Y:704×480, C:352×240)

(3) MC prediction
16×8 block based
max. vector range : ±15.5(H) × ±7.5(V)
field-based prediction (Figure 1)

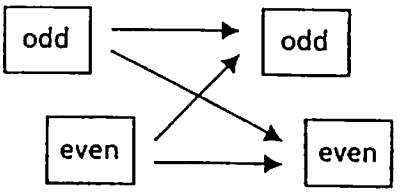

Figure 1 Prediction

(4) DCT
field/frame adaptive (method 1, 2), field-based (method 3)
- method 1 .. MPEG92/028
- method 2 .. according to the number of non-zero coeffs.

(5) Scanning
vertical scanning (Figure 2)

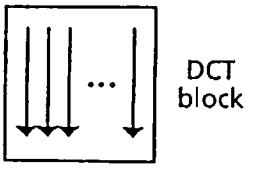

Figure 2 Scanning

A2. SIMULATION RESULTS

The comparison of coding efficiencies between the field/frame adaptive DCT (method 1, 2) and the field-based DCT (method 3) is shown in Figure 3. For 'Mobile & Calendar' sequence, the field/ frame adaptive DCT is better by about 0.5dB in SNR than the field-based DCT. For other three sequences 'Flower Garden', 'Football' and 'Popple', the difference of SNR between these methods is almost insignificant.

Generally speaking, field-based DCT shows better coding efficiency than frame-based DCT when inter-field difference signal is large, and frame-based DCT coding is better when inter-field difference signal is small. Figure 4 shows that it is necessary to improve the decision method for field/frame adaptation.

A3. CONCLUSIONS

Simulation results show there isn't significant difference of SNR between the field/frame adaptive DCT method 1 (MPEG92/028), method 2 and the field-based DCT. Both the field/frame adaptation method 1 and 2 are not sufficient for improvement of coding efficiency. More investigation is necessary for field/frame adaptation method to improve the coding efficiency.

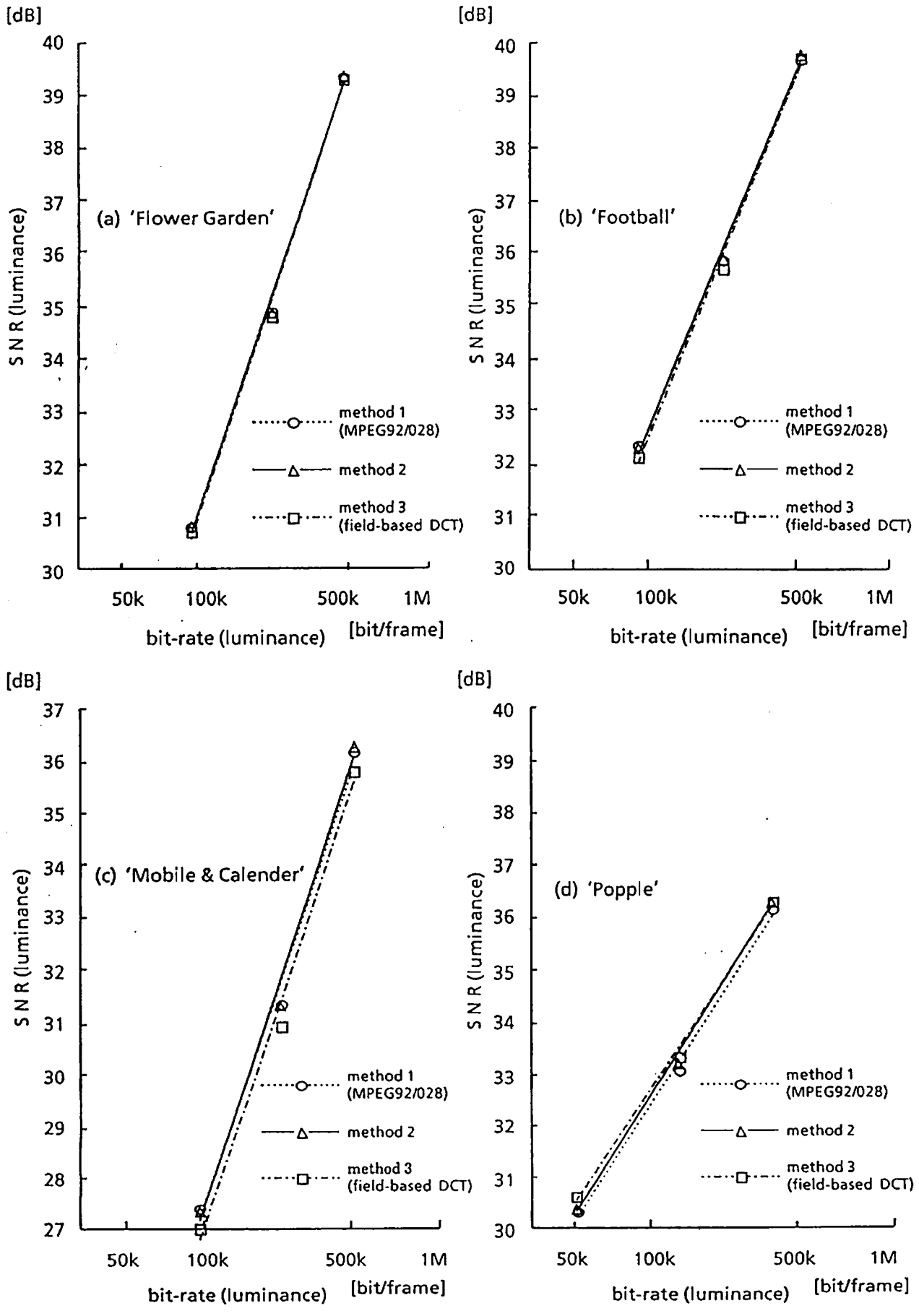

Figure 3 Comparison of coding efficiency

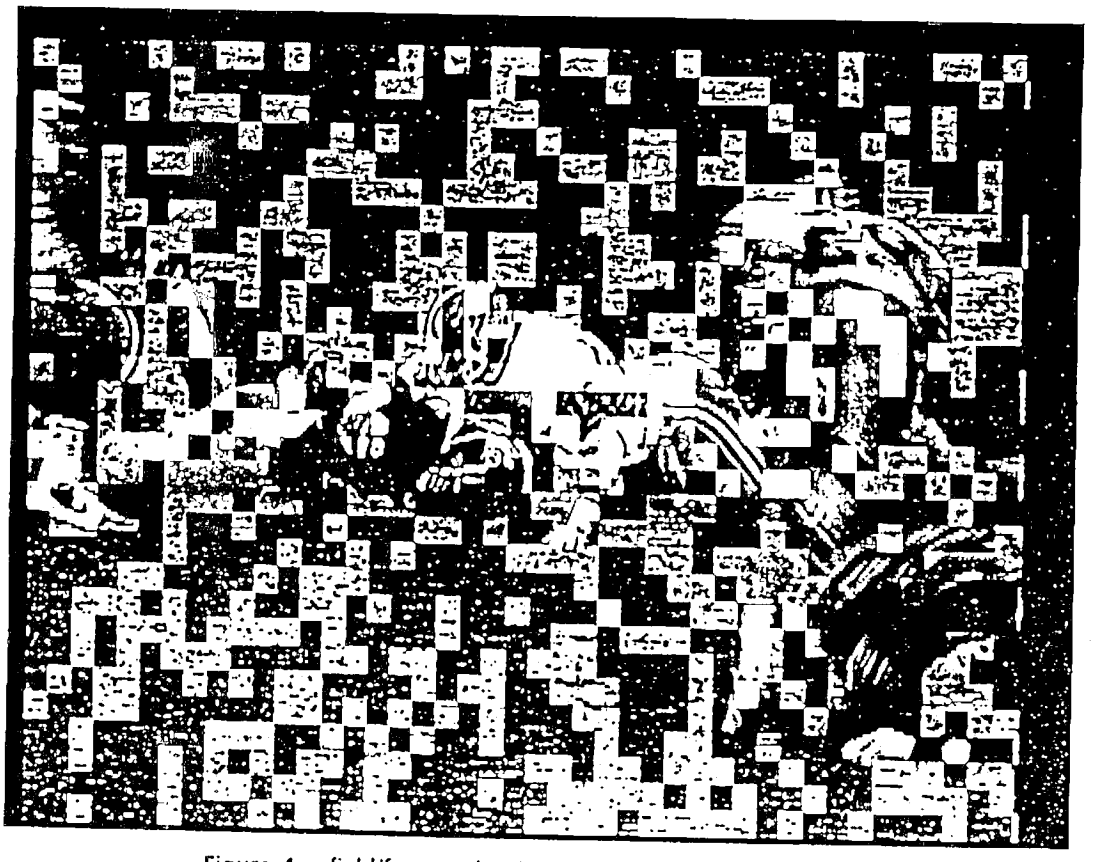

Figure 4 field/frame adaptive blocking result by method 2
(bright part : field block, dark part : frame block)