CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

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SOURCE : Japan
TITLE : Results of Low Delay Core Experiments
PURPOSE : Discussion/Proposal

1. Introduction

In this document, results of low delay core experiments are reported. Almost every experiments are carried out with TM1 coding algorithm. And the first picture is handled as intra picture.
This document is followed by D-1 tape demonstration.

2. Experiments

2.1 General condition

General condition of experiments are following.

Image format : 4:2:0
Coding rate : 4 Mbps
MV detection : Orig/Orig with half-pel accuracy
Rate control : TM1 Step3
First picture : Intra picture

2.2 Prediction mode & picture structure

Experimental results are shown in Table2.1 where YSNR is the average value of 2 seconds, and is calculated between the original frame image and the reconstructed frame image. The performance of FAMC is good so that it may be used as sole predictor.

Table2.1 Comparison of coding efficiency (2 seconds) [dB]

	Frame M=1			Field M=1
	Fr/Fi	FAMC	DUAL'	FAMC
flower	28.13 (0.00)	29.28 (+1.15)	28.82 (+0.69)	27.27
mobile	25.81 (0.00)	25.97 (+0.16)	25.46 (-0.35)	24.68

2.3 Intra picture vs Intra slice

Additional conditions are following.

Image structure : Frame, M=1
Prediction : FAMC
GOP structure : M=1, N=15 (when intra picture)

Experimental results are shown in Table2.2 and Table2.3 where YSNR is the average value of 5 seconds, and delay is calculated with equation (1).

$$delay = (Bm-Ba)/Ba*Tf \quad \text{---------- (1)}$$

where Bm : Maximum bits per picture
Ba : Average bits per picture
Tf : displaying time per picture

There is no significant difference between intra slice and intra picture in terms of the value of SNR. From subjective point of view, the decoded images of intra slice contain cyclic distortion deriving from intra slice, while those of intra picture contain periodical distortion that have time interval of GOP. But totally judging, any superiority cannot be recognized.

Intra slice, however, has the great advantage of short delay time. Its superiority is drastic.

Results with other experimental conditions are also shown in Annex of this document, and exhibit almost the same characteristic.

Table2.2 Comparison of intra slice and intra picture

	Intra slice		Intra picture	
	YSNR [dB]	delay [ms]	YSNR [dB]	delay [ms]
flower	28.72	5	28.57	100
mobile	26.06	14	25.99	97
bicycle	27.88	9	27.83	50
cheer	28.42	9	28.32	55

2.4 With or without picture skipping

Additional conditions are following.

Refresh method : Intra slice
Image structure : Frame, M=1
Prediction : FAMC
Test sequence : 2 seconds of flower + 2 seconds of mobile

Experimental results are shown in Table2.3 and Fig.2.1.

When without picture skipping, the value of SNR decrease by about 2dB just after the scene change. It takes more than 10 frames to be the steady state. But from the point of subjective quality, inferiority after the scene change is not eminent.

When with picture skipping, the value of SNR retain the steady state from the scene change. But the subjective quality just after the scene change is not excellent because of the lack of smoothness.

In terms of delay time, the scheme with picture skipping is superior.

Table2.3 Comparison of delay time

with picture skipping	14 msec
without picture skipping	51 msec

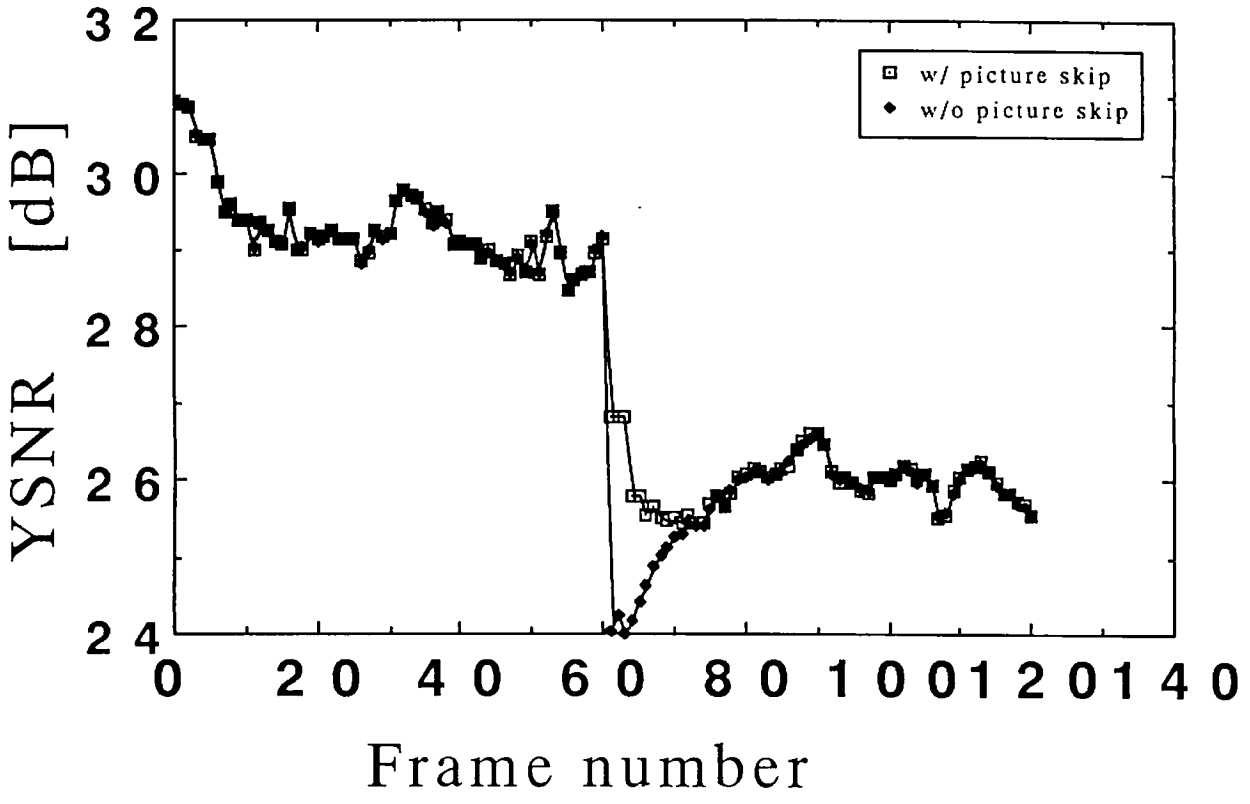

Fig.2.1 Comparison of YSNR

3. Conclusion

Judging from coding efficiency of low delay mode, FAMC can be used as a sole predictor, while dual prime is necessary to be used with another prediction mode.

To realize low delay coding, the technique of forced intra slice is recommended.

The technique of picture skipping can be thought to be useful in order to obtain the low delay coding.

Annex Another contribution of intra slice vs intra picture

1. Experimental conditions

Image structure : Frame, M=1
Prediction : Frame/Field
Rate control : Appendix H/TM2 for low delay, Step2
Coding rate : 4 Mbps

2. Experimental results

	Intra slice		Intra picture	
	YSNR [dB]	delay [ms]	YSNR [dB]	delay [ms]
flower	29.22	8	29.38	97
mobile	27.07	7	27.18	78