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Title : A study of low delay mode.
Purpose: Information

Introduction

The ultimate goal in developing a video coding system is to attain minimal delay in order to achive real time telecommunication. However, according to our experiment (Experiment 1), we have confirmed that the backward prediction or interpolative prediction method have had a good effect on coding performance with the sacrifice of delay time. To reduce the system's delay, we tried to improve the performance of the "low delay mode," which is performed as the TM0 algorithm with M=1 (Experiment 2, 3). Note that the number "M" is related to system's delay time. Abstracts of these experiments are given as follows (see appendix for detail):

Experiment 1

We compared three modes of the TM0 algorithm, IPB(M=3), IPP'(M=3) and IP(M=1), with respect to the reconstructed image's quality. Here, P' denotes the B-picture without backward prediction.

Experiment 2

With "IP(M=1)", we confirmed that increasing a number of frames in a GOP (group of pictures) could improve quality of the reconstructed image data.

Experiment 3

To implove coding performance of the "IP(M=1)", we periodically interleaved "p"-pictures, which had poor quality, among P-pictures.

Conclusion

As a result of our experiments, we found that "IPB(M=3)" was better than "IP(M=1)" by 2.1dB at 4Mbps and the difference was reduced to 1.7dB at 9Mbps for the luminance of "mobile" (Ex.1). However, the low delay mode is necessary to create comunication systems. Therefore, the algorithm should be flexible so that it can decide whether to use backward prediction or not. Further considerations to develop the low delay mode must be made.

APPENDIX

Experiment 1

This experiment compares three modes of TM0 algorithm, IPB(M=3), IPP' (M=3) and IP(M=1), where P' denotes B-picture without backward prediction, under the condition that: (1) frame based coding (MPEG92/080), (2) TM0's rate control (MPEG92/077) without "MQUANT": and (3) N=12. Table 1 summarizes the simulation result.

Table 1 : Coding performance

Sequence name			Mobile & Calendar			Flower garden		
Coding mode			IPB	IPP'	IP	IPB	IPP'	IP
S/N [dB]	4 Mb/s	Y	29.4	28.3	27.3	30.4	29.0	28.7
		Cb	34.4	33.5	32.3	34.9	34.3	33.7
		Cr	34.4	33.6	32.4	33.4	32.5	32.1
	9 Mb/s	Y	33.4	32.1	31.7	34.6	33.1	33.5
		Cb	37.6	36.4	35.4	37.2	36.1	35.8
		Cr	37.3	36.2	35.2	36.6	35.3	35.2

Experiment 2

Figure 1 illustrates average SNR for variable N using a low delay mode "IP(M=1)" of frame based TM0 including "MQUANT". This figure shows that the coding performance can be improved by means of increasing N.

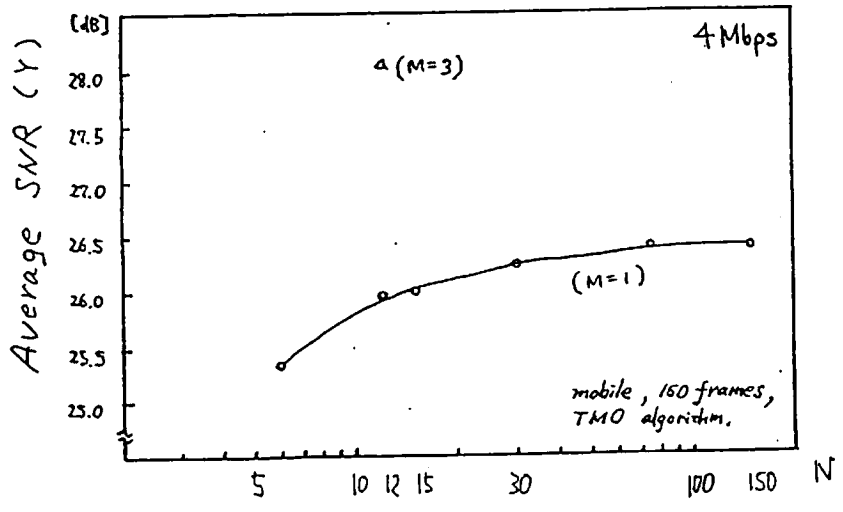

Figure.1 Coding performance of TM0 (M=1).

Experiment 3

To implove coding performance of "IP(M=1)", we periodically interleaved "p"-pictures , which had poor quality, among "P"-picture sequences. In this method, the "p"-pictures use the rate control prepared for the use of "B"-pictures in TM0. Figure 2 illustrates SNR at each frame and table 2 summarizes average SNR over 150 frames.

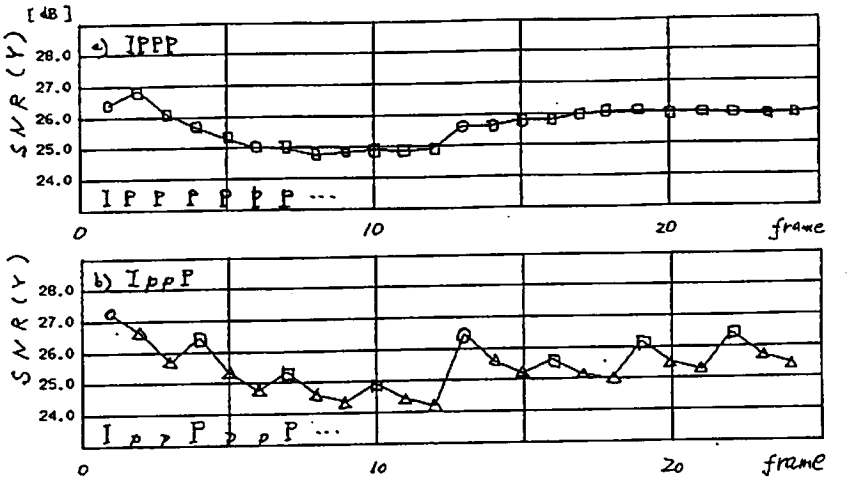

Figure 2. SNR with low delay mode for "mobile" at 4 Mbps.
(a) Original TM0. (b) Modified TM0.

Table 2. Average SNR (150 frames) of luminance.

	mobile		popple	
	4Mbps	9Mbps	4Mbps	9Mbps
Original TM0	25.97	30.36	30.58	33.63
Modified TM0 (period:3)	26.06	30.23	30.47	33.36
Modified TM0 (period:6)	25.90			

[dB]

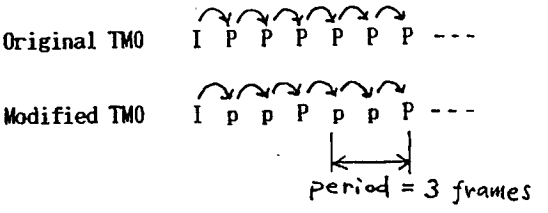

Fig.3 Prediction structures.

End.