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SOURCE: A. Reibman, R. Aravind: AT&T Bell Laboratories
TITLE: Comparison of the Cell-Loss Resilience of MPEG-2 Main Profile and AC-leaky prediction
PURPOSE: Information

1 Introduction

We present a comparison of the cell-loss resilience of the MPEG-2 Main Profile and AC leaky prediction. All results are presented using frame-based coding with frame-field motion compensation and field-frame DCT, coded at 4 Mbps using the WD syntax. We use the nonlinear quantization table and the alternate scan. The intra DCT precision is 8 bits, and concealment motion vectors are sent for every intra macroblock. Intra macroblocks are allowed throughout all encoding processes.

The SNR values are averaged over 148 frames, and, in the case of cell-loss results, over 15 sequences.

We examine (i) quality without cell losses or channel changing, (ii) quality with cell losses, and (iii) the speed of channel changing. All results are demonstrated on D1.

2 No losses or channel changing

Table 1 shows the SNR for flowergarden and mobilcal, as well as for a sequence with a scene change, which starts with 50 frames of flowergarden and ends with 50 frames of mobilcal. Here, the slice length is 44 macroblocks. The AC leak uses LF=7/8 for M=3 and LF=15/16 for M=1. The symbol D is used to denote the number of frames between DC refreshes.

Table 2 shows similar results when the slice length is 11.

The D1 tape indicates that the quality for M=1 with D=6 and N=15 are nearly equal for all the sequences. We also found that the visual quality of D=6 and D=15 were indistinguishable when M=3; however, they both looked somewhat worse than N=15.

3 Cell losses

Next, we compare the effect of cell losses in sequences with and without leak. In all frames, missing blocks are filled in using the motion vector of the block above the missing block.

SNR results are produced by subjecting each bitstream to cell losses using the method in Appendix F in TM2. The experiment is repeated 15 times with different initial seeds for the random number generator, and the results are averaged.

Results on the D1 tape are illustrated when losses occur in the identical image locations, as described in MPEG92/494 (AVC-350). The sequence with intraframes was subjected to cell losses using the method of Appendix F in TM2, and equivalent errors were imposed on the sequences with leaky prediction.

Table 3 shows the SNR of the sequences with and without leak when affected by cell losses, when the slice length is 44 macroblocks. Table 4 shows similar results when the slice length is 11 macroblocks.

The D1 tape demonstrates that cell losses are less objectionable visually in sequences with leak. In particular, the AC leak with D=6 controls artifacts very well, because the errors from cell losses nearly disappear every 6 frames. In addition, because the leaky prediction is used in the AC coefficients, the errors also begin to gradually disappear even before a DC refresh is received.

4 Channel changing

Figure 1 shows the SNR as a function of time after a channel change for AC leak, with D=6 and M=1 for flowergarden, and with D=6 and M=3 for mobilcal. As soon as the DC refresh is received, a reasonable representation of the image is available to the decoder. It takes approximately 12 more frames for the SNR to rise within 1 dB of the original when M=1 with LF=15/16. When M=3 with LF=7/8, it takes approximately 20 frames.

A very clear image is available to the decoder after the second DC refresh when D=6. Therefore, in the worst case, the decoder has a very good image after 12 frames with a DC refresh of D=6 with M=1. (This is in comparison to N=15, where in the worst case, the decoder may not receive a usable image until after 15 frames.) However, the image is still very recognizable in the worst case after only 6 frames.

	Flowergarden		mobilcal		SceneChange
	M=3	M=1	M=3	M=1	M=1
N=15	29.64	28.16	28.23	26.03	26.89
D=15	29.48	28.55	27.74	26.06	27.00
D=6	29.33	28.36	27.61	25.89	26.84

Table 1: SNR of sequences without cell losses or channel changes, slicelen=44

	Flowergarden	mobilcal
	M=1	M=1
N=15	27.98	25.88
D=6	28.16	25.73

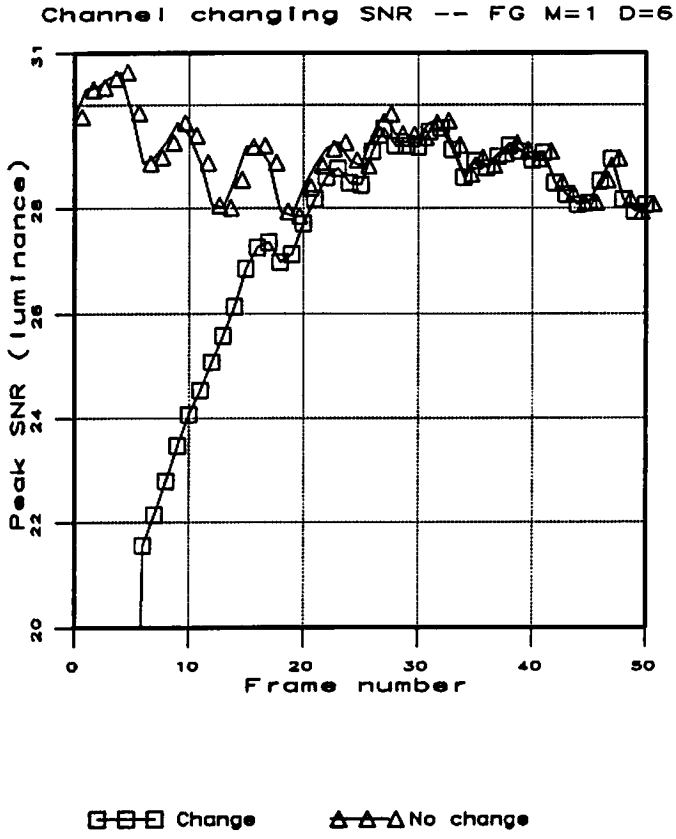
Table 2: SNR of sequences without cell losses or channel changes, slicelen=11

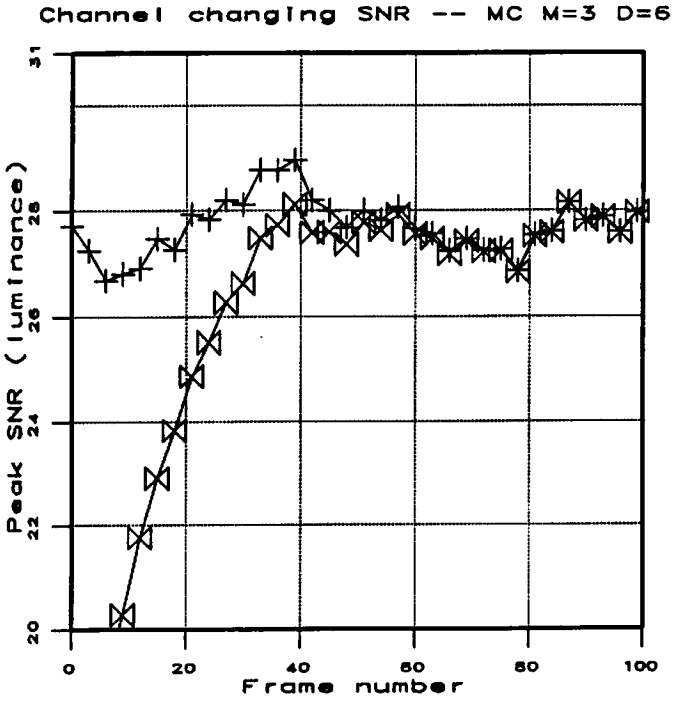
	Flowergarden	Mobilcal
	M=1	M=1
N=15	26.74	25.51
D=15	27.02	25.46
D=6	27.23	25.39

Table 3: SNR of sequences with 10^{-3} cell losses, slicelen=44

	Flowergarden	Mobilcal
	M=1	M=1
N=15	26.68	25.59
D=6	27.55	25.38

Table 4: SNR of sequences with 10^{-3} cell losses, slicelen=11


Channel changing SNR -- FG M=1 D=6
Peak SNR (luminance)
31
28
26
24
22
20
0
10
20
30
40
50
Frame number
Change
No change


Channel changing SNR -- MC M=3 D=6
Peak SNR (luminance)
31
28
26
24
22
20
0
20
40
60
80
100
Frame number
Change
No Change