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TITLE: Experimental results with AC leaky prediction
PURPOSE: Informational

1 Introduction

We present the results of some experiments using AC leaky prediction. All results are presented using frame-based coding with frame-field motion vectors and field-frame DCT, coded at 4 Mbps using TM4. The SNR values are averaged over 148 frames.

We examine (i) quality without cell losses or channel changing, (ii) the speed of channel changing and (iii) quality with cell losses. The quality with cell losses is compared to that obtained when motion vectors are transmitted for every intra macroblock. We also discuss fast forward and fast reverse modes using AC leak. All results are demonstrated on D1.

2 No losses or channel changing

Table 1 shows the SNR for flowergarden and bus. 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. Results using transmitted motion vectors for every Intra macroblock are also shown.

The D1 tape indicates that the quality for M=1 with D=6 and N=15 are nearly equal for both bus and flowergarden.

	Flowergarden		Bus	
	M=3	M=1	M=3	M=1
N=15	29.36	27.70	31.26	30.03
N=15, I-mv	29.33	27.68	31.23	30.01
D=15	29.25	28.07	30.97	30.02
D=6	29.06	27.87	30.77	29.81

Table 1: SNR of sequences without cell losses or channel changes

3 Channel changing

Figure 1 shows the SNR as a function of time after a channel change for AC leak, with D=6 and D=15. As soon as the DC refresh is received, a reasonable representation of the image is available to the decoder. It takes approximately 15 more frames for the SNR to rise above 28 dB. This is true both for M=1 with LF=15/16 and for M=3 with LF=7/8. Furthermore, 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. (This is in comparison to intra-pictures, where in the worst case, the decoder does not receive a usable image until after 15 frames.) However, the image is still very recognizable in the worst case after only 6 frames.

While a limit cycle still exists because the arithmetic is finite precision, we have found it to be visually insignificant.

4 Fast forward/Fast reverse

It is possible to implement fast forward and fast reverse using AC leak. For example, to fast forward, only the frames with DC-refresh could be decoded and displayed.

The AC leaky prediction has the advantage over intraframes for fast forward and fast reverse in that fewer bits are necessary to decode for a picture with DC refresh than an intra-picture. For example, with N=15, frame 60 of flowergarden uses 357632 bits, while with D=6, frame 60 uses only 154728 bits.

5 Cell losses

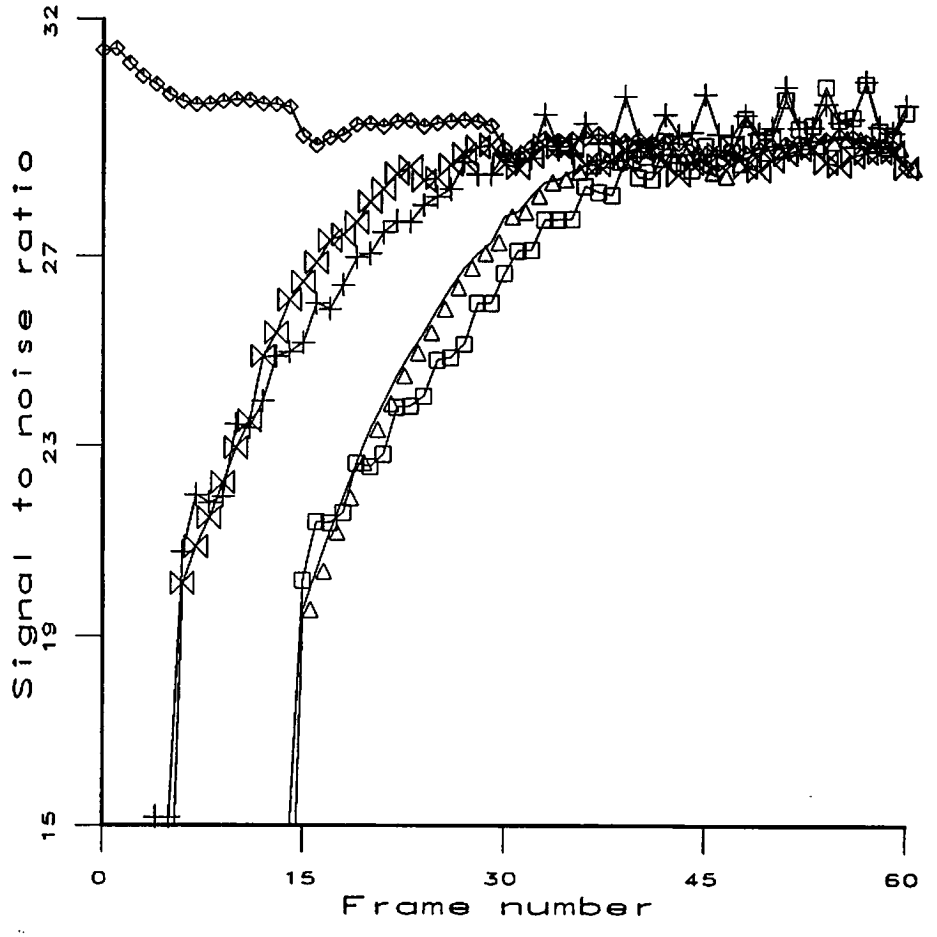
Next, we compare the effect of cell losses in sequences with and without leak. In each case, we compare the sequences given above. Cell losses are generated as described in MPEG92/494 (AVC-350), with cell losses in identical image locations between two sequences. The sequence with intraframes was subjected to cell losses according using the method of Appendix F in TM2, and equivalent errors were imposed on the sequence with leaky prediction. Missing blocks are filled in using the motion vector of the block above the missing block. This is true both for B and P pictures, as well as for I pictures when motion vectors are available.

Table 2 shows the SNR of the sequences with and without leak when affected by cell losses. 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 better than the method that sends motion vectors for every intra-macroblock, 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.

	Flowergarden		Bus	
	M=3	M=1	M=3	M=1
N=15	26.47	26.77	30.34	29.00
N=15, I-mv	28.19	27.28	30.38	29.27
D=15	28.28	27.69	29.78	29.38
D=6	28.29	27.57	29.67	29.31

Table 2: SNR of sequences with 10^{-3} cell losses

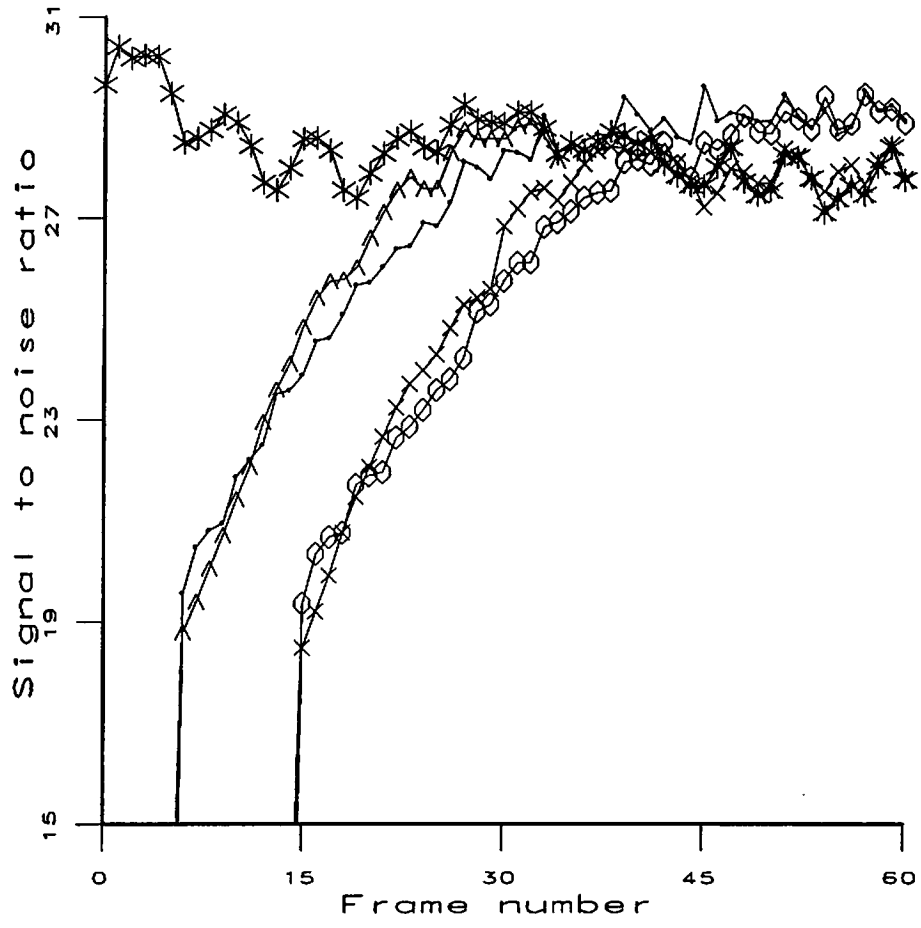
Figure 1: Channel changing SNR (Bus)



D=15 M=3 D=15 M=1 D=6 M=3 D=6 M=1

No channel change, D=6 M=1

Figure 1: Channel changing SNR (Flowergarden)



◇—◇—◇ D=15 M=3 ×—×—× D=15 M=1 •——• D=6 M=3 △—△—△ D=6 M=1
✳—✳—✳ No channel change, D=6 M=1