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SOURCE : NTT
TITLE : COMPARISON OF PREDICTION/CODING METHODS IN AN RM8-BASED SCHEME
PURPOSE: Information

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1. Introduction

This contribution provides simulation experiment results on the comparison of frame-based coding and field-based coding.

2. Coding algorithm used

CCITT RM8 has been modified to deal with CCIR-601 interlaced formats.

1) Source format	4:2:2
2) Data structure	4 blocks (Y1, Y2, Cr, Cb)/MB; 1MB line /GOB
3) Temporal redundancy	
- Prediction mode	I,P,P,P... (N >> 1)
- Motion compensation	+/-14 pels horizontal by +/- 10 pels vertical with half pel accuracy
4) Spatial redundancy	8x8 DCT
5) Quantization	without weighting matrix
6) Entropy coding	one 2-d VLC for non-intra DC components with 3 bit EOB

3. Simulation experiment method

The following three coding modes are used for the comparison of prediction and coding efficiency:

- Frame coding mode: Coding unit is a frame consisting of 720 pels by 480 lines and 29.97 frame/s with simple field merging.

- Field coding mode: Coding unit is a field consisting of 720 pels by 240 lines and 59.94 field/s. Motion compensated prediction is carried out referring to the previous coded field (1/60 sec apart).

- Adaptive coding mode: Coding unit is the same as the above field coding. Motion compensated prediction is carried out, however, referring to both the previous coded field (1/60 sec apart) and the further previous coded field (1/30 sec apart).

The first frame (frame mode) or two fields (field or adaptive mode) are coded with INTRA. All the following fields or frames are coded with INTER.

A motion vector is generated for a 16 pels horizontal by 8 pels vertical macroblock with a three stage searching method. When two preceding fields are used for motion compensation in the adaptive mode, the best four matches with 4 pel accuracy are searched among the 35x2 candidates in both

fields at the first stage. The second stage gives one best match with 1 pel accuracy among 25x4 candidates surrounding the first stage best matches. The third stage gives one best match with half pel accuracy among 9 candidates.

Open loop control is applied with fixed step size (8/14/20) as a parameter. Rate distortion curves are used for evaluation of prediction and coding efficiency.

4. Results

First 20 frames have been coded for Mobile & Calendar, Flower Garden and Football. For Table Tennis, 20 frames starting from the 41st frame are used to test a zooming scene.

Two examples of the rate distortion curve are shown in Figure 1 for Mobile & Calendar and Table Tennis. Necessary number of bits per frame to give 32 dB of SNR is shown in Figure 2.

We can obtain the following observations;

1) The most difficult sequence among the four is Mobile & Calendar, which is very detailed spatially but includes slow motion. Frame mode is significantly efficient for this sequence.

2) Field mode is better than frame mode for Football and Table Tennis which include rapid motion. However, these sequences are rather easy in terms of rate distortion characteristics. Advantage of field mode may not be outstanding in picture quality in the constant bit rate environment.

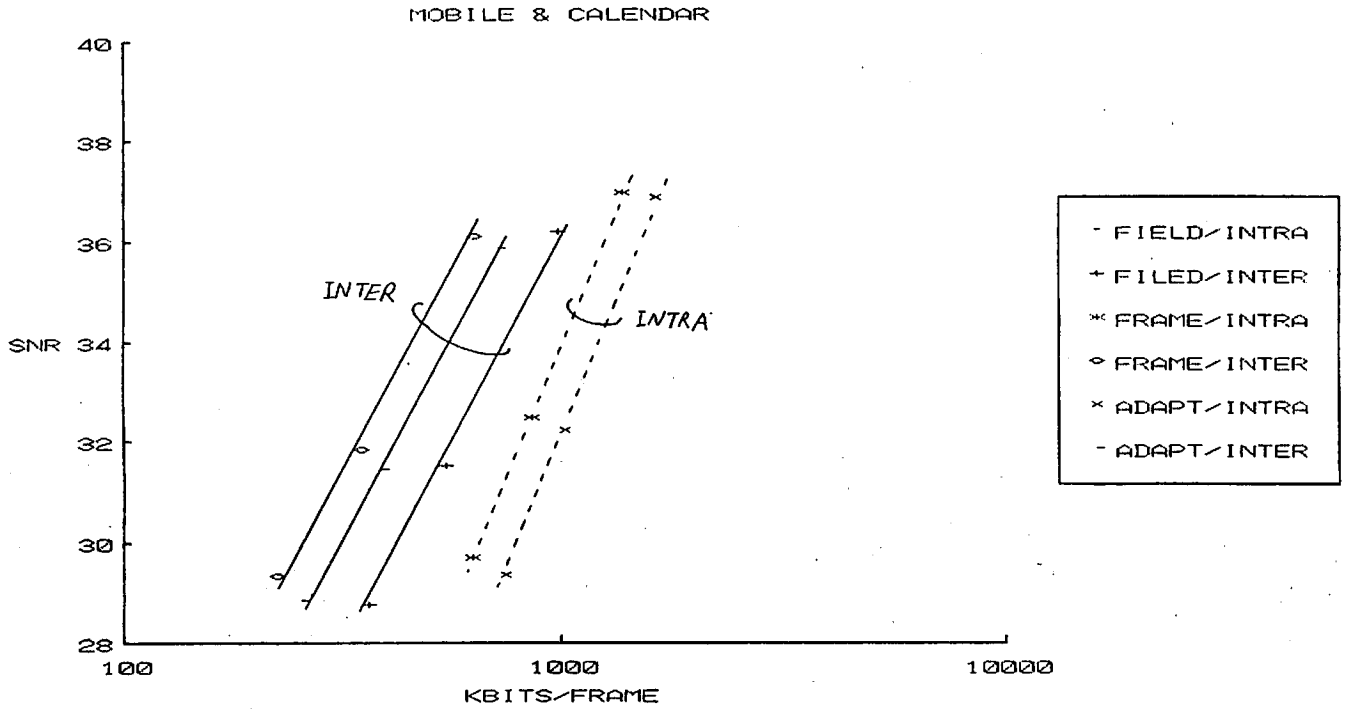
3) Adaptive mode performs the best except for Mobile & Calendar.

4) A question arises what would happen if we use a test sequence which is very detailed as Mobile & Calendar and includes rapid motion as Football. Adaptive mode may perform better than frame mode? Rapid camera motion may result in reduction of spatial resolution? More coding distortion may be allowed visually in this case?

5. Conclusion

As far as the test results for the four test sequences are concerned, we can conclude that frame coding with simple field merging is a reasonable starting point from prediction and coding efficiency point of view. If field mode is the choice from the coding/decoding delay and hardware simplicity point of view, two preceding fields should be used for motion compensated prediction.

END



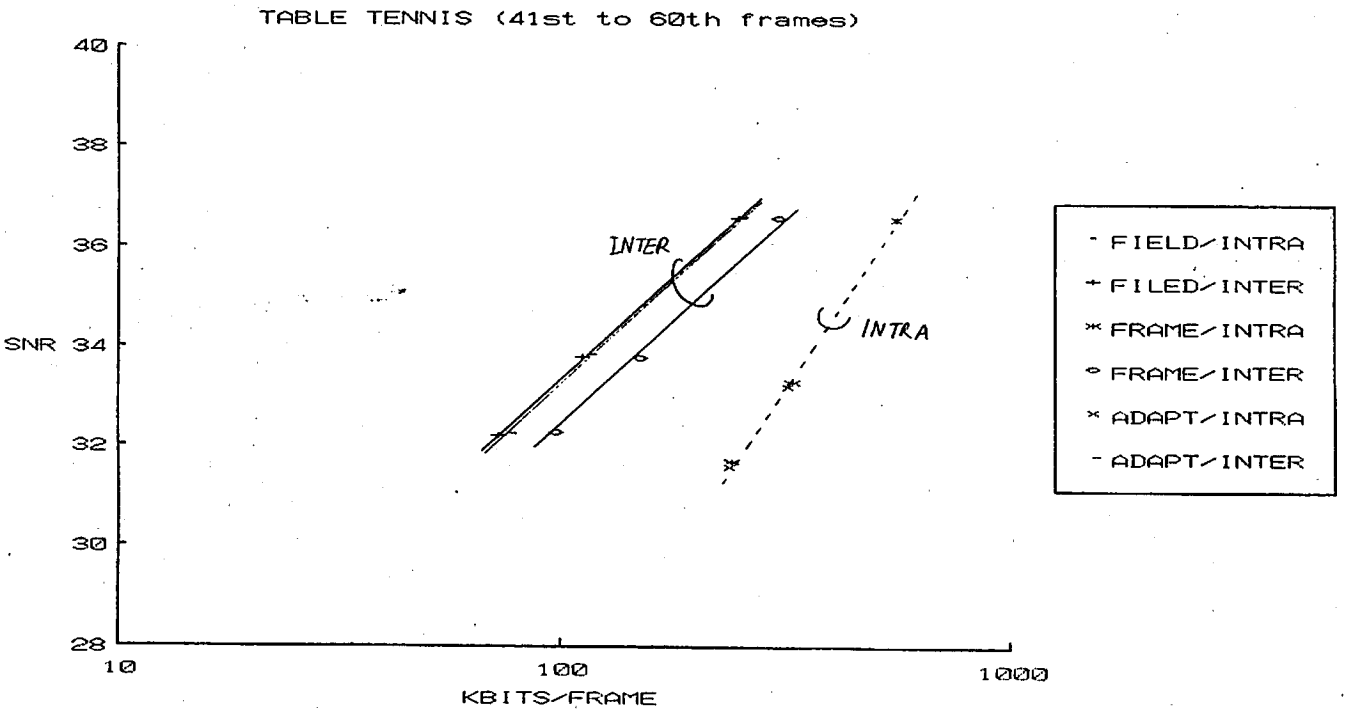
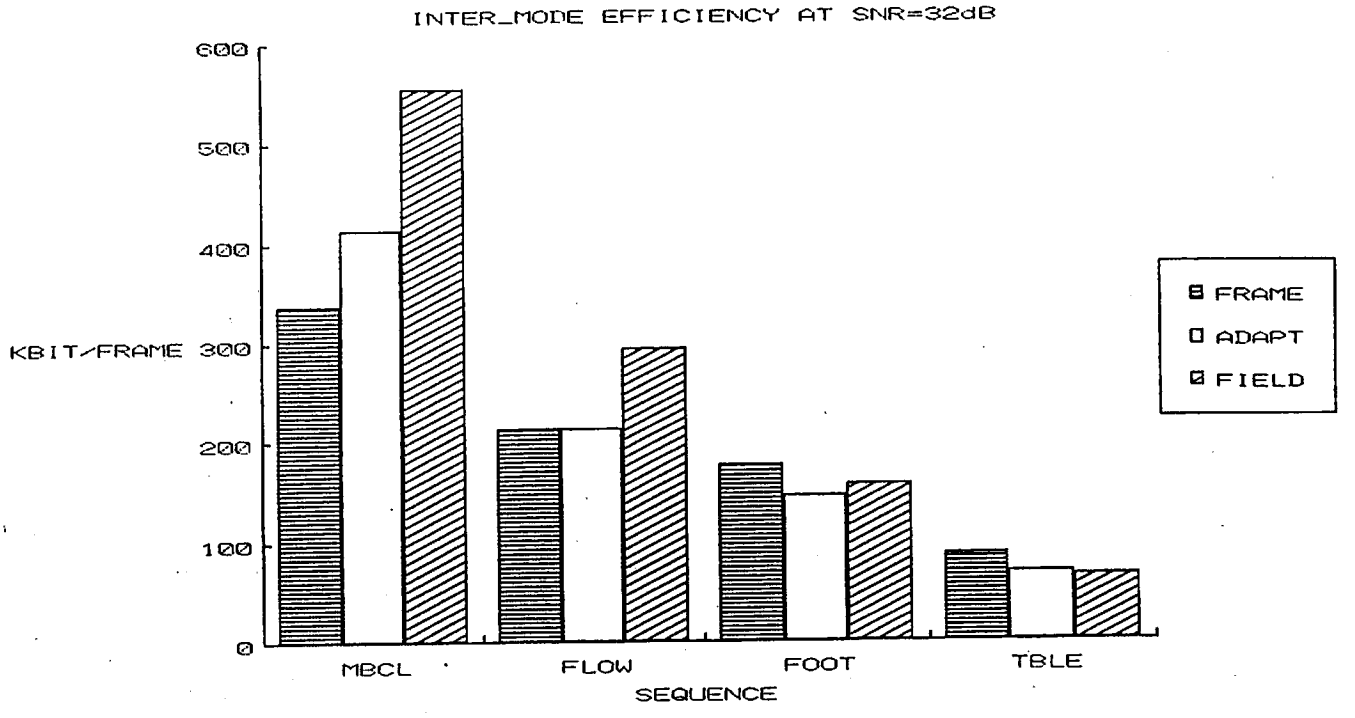


Figure 1 Rate distortion curves



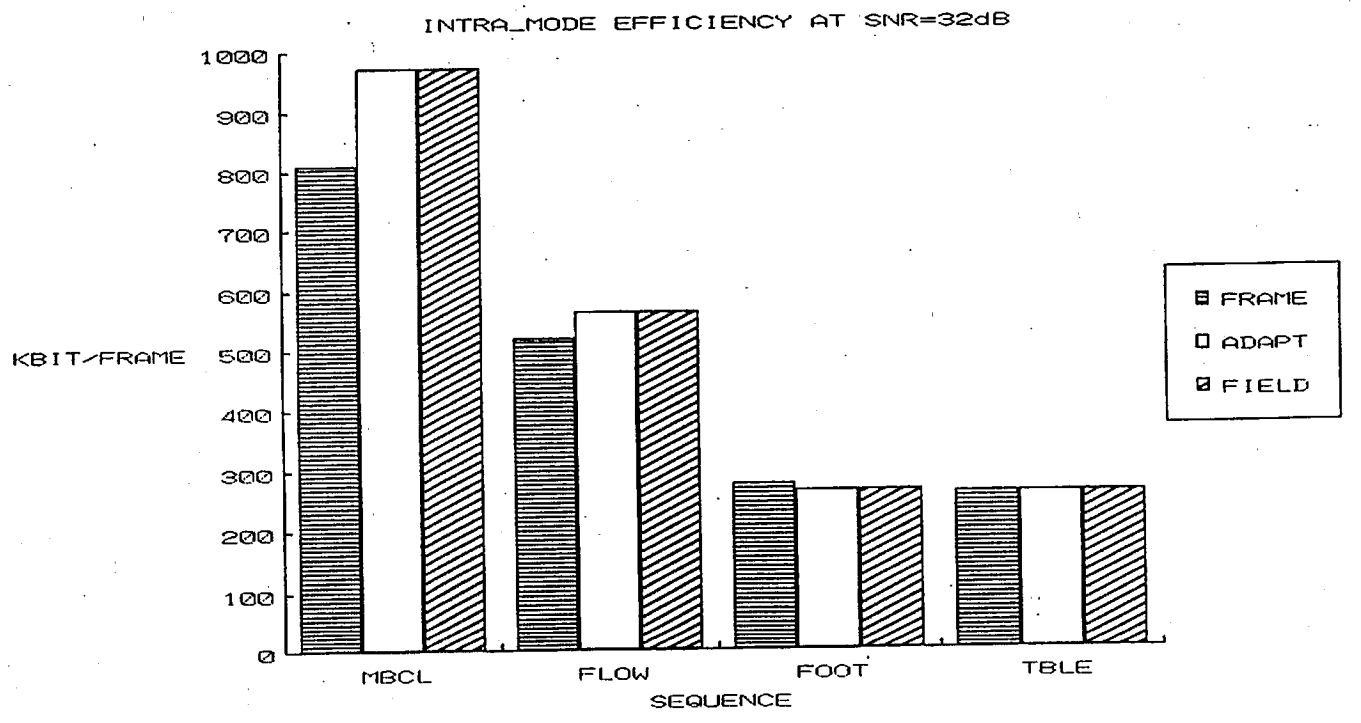


Figure 2 Prediction and coding efficiency