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

Document AVC-79
August 1, 1991

SOURCE : JAPAN
TITLE : LOSS OF CODING EFFICIENCY BY USING SCIF
Purpose: Information

---

1. Introduction

One of the action points identified at the Paris meeting is to investigate how coding efficiency is affected by using a SCIF source coding format for CCIR 601 input television signals. One expectation is that we are coding "pictures" but not "pels" (see § 4.2/Doc. AVC-65R).

This document provides a coding efficiency comparison between when original CCIR 422 signals of the 525/60 system are directly coded and when they are converted to a progressive scan SCIF as proposed in Doc. AVC-29.

2. Configuration of the experiment system

Simulation experiments have been carried out according to the configuration in Figure 1.

The following two coding modes are used for the comparison:

- 422 mode: Coding unit is a field consisting of 720 pels by 240 lines for luminance. Motion compensated prediction is carried out referring to both the previous field (1/60 sec apart) and the further previous field (1/30 sec apart).

- SCIF mode: Coding unit is a frame consisting of 720 pels by 480 lines for luminance. Motion compensated prediction is carried out referring to the previous frame (1/60 sec apart) or both of the previous frame (1/60 sec apart) and the further previous frame (1/30 sec apart).

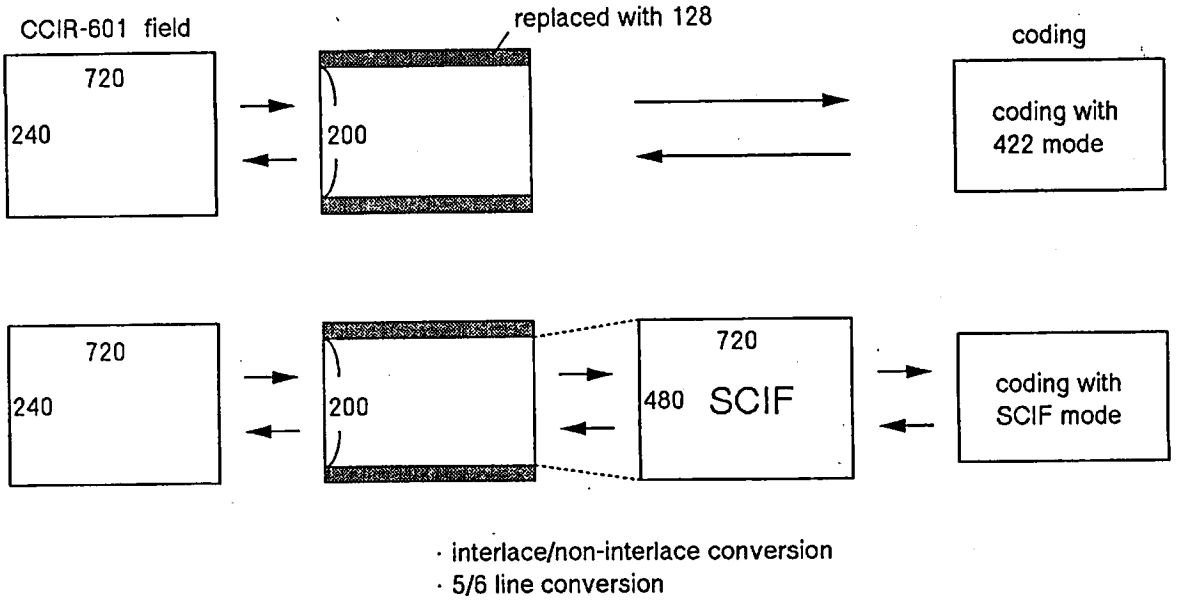


Figure 1 Simulation system

Due to the limitation of the coding program, only the center 5/6 part is encoded as illustrated in Figure 1. Furthermore, the SCIF used here has full vertical resolution in chrominance signals, namely 4:2:2 structure is used against 4:2:0 structure proposed in Doc. AVC-29.

3. Method to obtain SCIF signals

An original 240 line field is converted to a SCIF frame with the following two stages as detailed in the companion document AVC-80.

- Conversion to progressive scan format: 240 lines to 480 lines
- Line number conversion: 480 lines to 576 lines

4. Coding algorithm

A CCITT Reference Model based hybrid coding algorithm is used for the source coding format comparison purpose.

1) The first frame

The first two fields are coded with INTRA in the "422 mode" while the first frame is coded with INTRA in the "SCIF mode". All the following fields or frames are coded with INTER.

2) Motion compensation

A motion vector is generated for a 16 pels horizontal and 8 pels vertical macro block with a three stage searching method. Tracking range is +/-14 pels horizontal by +/- 10 pels vertical with half pel accuracy. When two preceding fields (in "422 mode") or frames (in "SCIF mode") are used for motion compensation, the best four matches are searched among the candidates in both fields or frames at the first stage. Further two step search remains in the field or frame selected at the first stage.

3) VLC

DCT coefficients are zig-zag scanned both in "422 mode" and "SCIF mode". VLC for DCT coefficients is the one designed for "422 mode", EOB having three bits. The same VLC is used for both INTRA and INTRA regardless of the coding mode.

4) Coding control

Open loop control is applied with fixed step size (8/10/12/14/16/18/20) as a parameter.

5. Simulation results

The first 10 frames of the test sequence "Flower Garden" are coded with step sizes 8 - 20, meaning that 20 fields/frames are coded in "422 mode"/"SCIF mode". Number of bits per original field (1/60 sec) and SNR are shown in Figure 2, where SCIF_1 uses only one preceding frame for prediction while SCIF_2 uses two preceding frames for prediction. INTRA corresponds to the first field or frame, INTER indicates values averaged over 18 fields or 19 frames

Statistics for number of non-zero and zero coefficients and per block are shown in Figure 3.

6. Observations

From the simulation results summarized in Figures 2 and 3, we can point out the following observations:

1) For an SNR, the "SCIF modes" require more bits compared to the "422 mode" as follows:

	SNR = 33 dB		SNR = 37 dB	
	INTER	INTRA	INTER	INTRA
SCIF_2	24 %	29 %	40 %	36 %
SCIF_1	75 %	29 %	36 %	36 %

2) Drastic difference for INTER data between SCIF_2 and SCIF_1 suggests that two frames are required for better prediction if the SCIF progressive scan frames are derived from interlaced sources. Use of the non-interpolated pictures (namely, pictures with the same original field parity) for interframe prediction seems to be essential for reducing prediction error, particularly in still areas.

This point has been confirmed by the experiment using a test sequence produced with a progressive scan camera, where coding efficiency does not differ between SCIF_1 and SCIF_2 modes.

3) The SNR values for "SCIF mode" in Figure 2 consist of format conversion distortion and coding noise. Since the former is 43.4 dB (see the companion document AVC-80), we can estimate pure coding noise if we assume the format conversion and coding noises are uncorrelated. They are also indicated as dotted lines in Figure 2 (see also Annex 3 to Doc. AVC-46).

Coding efficiency due to pure coding noise decreases by 12% (INTER) and 18% (INTRA) with the use of SCIF. If we can find better conversion filters, the loss of coding efficiency may become close to those dotted lines in Figure 2.

4) The statistics for coefficients transmitted before EOB show different characteristics among combinations of "422 mode"/"SCIF mode" and INTER/INTRA. The current experiments use the same VLC table for the four cases. There may be possibility of improvements in using a separate VLC table for each combination.

5) The same step size does not give the same SNR if source coding input formats are different.

7. Conclusion

A simulation result has been reported which compares coding efficiency for the original·interlaced format and the progressive scan SCIF as source coding input. The loss of coding efficiency is found to be 25-30% for INTER and 35-40% for INTRA when "Flower Garden" is coded. Use of appropriate VLC and/or better format conversion filters may reduce the loss.

Further study is required to reach a firm conclusion.

END

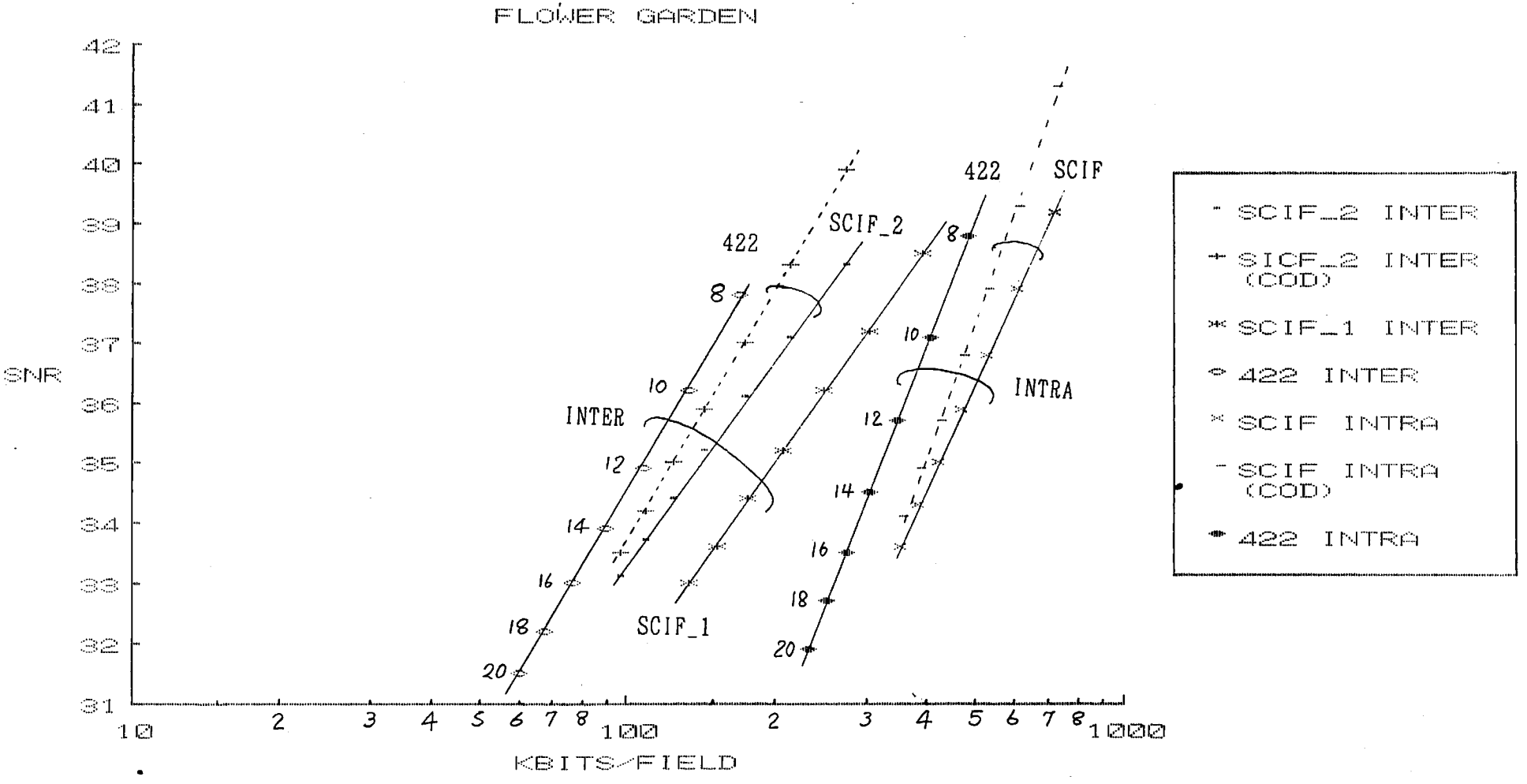
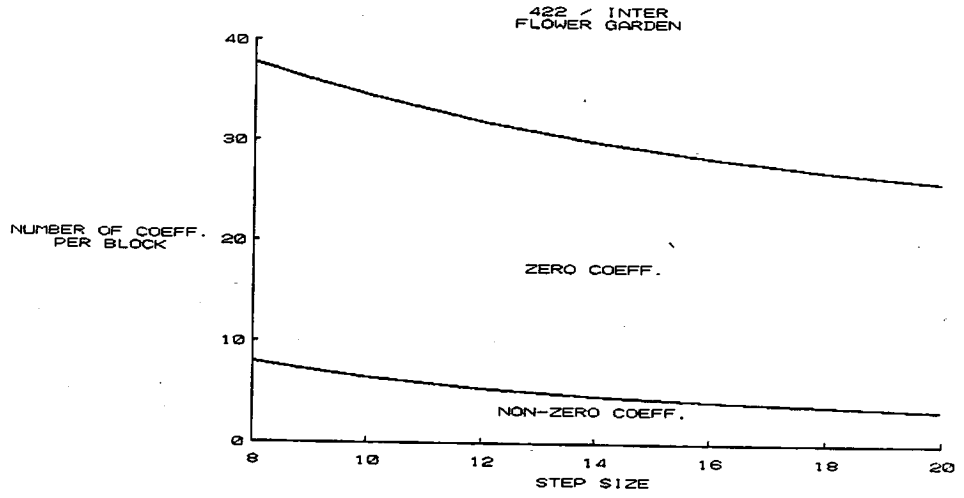
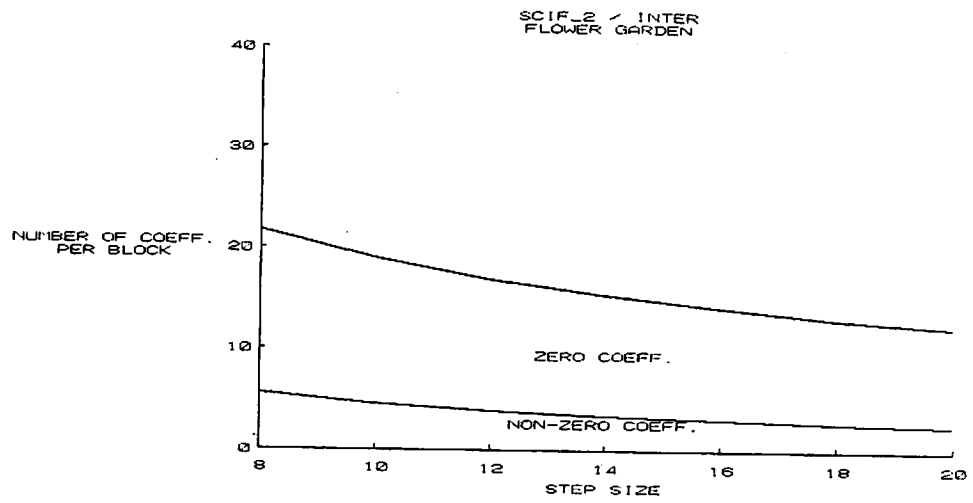
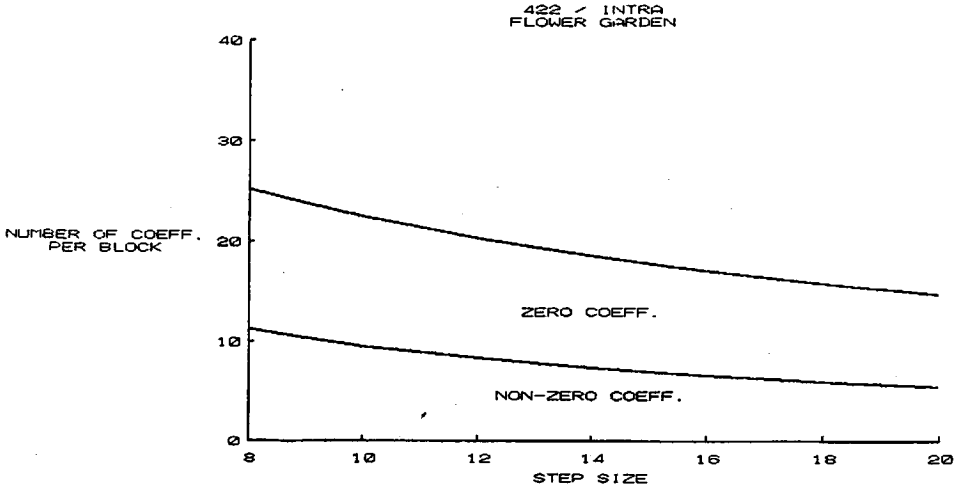


Figure 2 Coded results







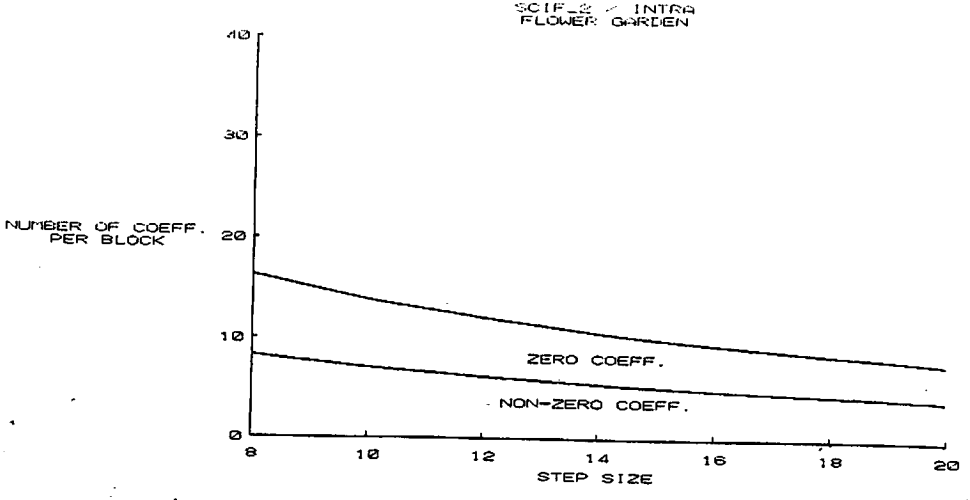


Figure 3 Statistics for transmitted coefficients