CCITT SGXV
Working party XV/1 Document AVC-88
Experts Group for ATM Video Coding 1 August 1991

SOURCE : Japan
TITLE : The evaluation of subband coding efficiency
PURPOSE : Information

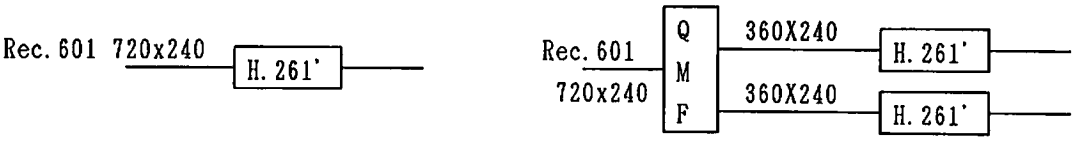
1. Introduction

The subband coding has various advantages for video coding. For the video communication in B-ISDN, a H.32X terminal has to be compatible with a existing terminal and tolerate cell loss. The subband coding is applicable for these purpose.

In this document, the performance of the subband coding is evaluated in comparison with that of the non-layered coding.

2. Simulation conditions and results

The evaluated coding algorithm is based on H.261 as shown in Figure 1, and the conditions of simulation are described below.



1) Non-layered coding 2) Subband coding

Figure 1 Block diagram of simulated scheme

Conditions for evaluation

1) Field coding
2) motion compensated inter frame prediction
   (Only second previous field from the predicted field is used for reference.)
   The specification of motion compensation is listed in Table 1.
3) 32 taps QMF(Quadrature Mirror Filter) for subband coding
4) Open feedback loop
5) The same Qstep (Quantizer step size) in each layer of subband coding
6) Different zig zag scan for each layer of subband coding as depicted in Figure 2

The efficiency is evaluated by the entropy which is calculated on field by field basis according to the distribution of events (RUN, LEVEL) in each field.

Table 1 The specification for motion compensation

	Non-layered coding	2 layered Subband coding
Spec. #1	Size * : 16(h)x16(v) Precision * : 0.5 pixel Range : ±7.5 X ±7.5 Interpolation filter : 2 taps	Size : 16(h)x16(v) Precision : 0.5 pixel Range : ±7.5 X ±7.5 Interpolation filter : 2 taps
Spec. #2		Size * : 8(h)x16(v) Precision * : 0.25 pixel Range : ±7.5 X ±7.5 Interpolation filter : 4 taps

*) Spec. #1 of non-layered coding and Spec. #2 of 2 layered subband coding have the same physical MC size and MC precision.

1	2	6	7	15	16	28	29
3	5	8	14	17	27	30	43
4	9	13	18	26	31	42	44
10	12	19	25	32	41	45	54
11	20	24	33	40	46	53	55
21	23	34	39	47	52	56	61
22	35	38	48	51	57	60	62
36	37	49	50	58	59	63	64

(a)lower frequency components

29	28	16	15	7	6	2	1
43	30	27	17	14	8	5	3
44	42	31	26	18	13	9	4
54	45	41	32	25	19	12	10
55	53	46	40	33	24	20	11
61	56	52	47	39	34	23	21
62	60	57	51	48	38	35	22
64	63	59	58	50	49	37	36

(b)higher frequency components

Figure 2 Adaptive zig zag scan

The simulation result for "Flower Garden" is shown in Figure 3.

3. Considerations

1)Even if the same Qstep is used for non-layered and subband coding, the SNR is not equal. This implies that the noise energy of each bands are summed at the reconstruction stage of subband coding.

Assuming that quantization with the same Qstep gives the same noise energy in each layer, the reconstructed image of N layered subband coding has the N times noise energy of non-layered coding image. This explains the SNR of 2 layered subband coding is approximately 3dB less than that of non-layered coding at the same Qstep.

To get the same SNR in N layered subband coding and non-layered coding, the Qstep of subband coding has to satisfy the following equation as the same reason described above.

$$\text{(Qstep of N layered subband coding)} = \text{(Qstep of non-layered coding)} / \sqrt{N}$$

2) In subband coding, the ajustment in MC size, MC precision and number of interpolation filter taps (Spec. #2) makes efficiency increase.

3) From the SNR-Entropy point of view , the efficiency of non-layered coding with Spec. #1 is slightly superior to that of 2 layered subband coding with Spec. #2. However, but from the image quality point of view, these are almost the same. The results are demonstrated by D1 tape.

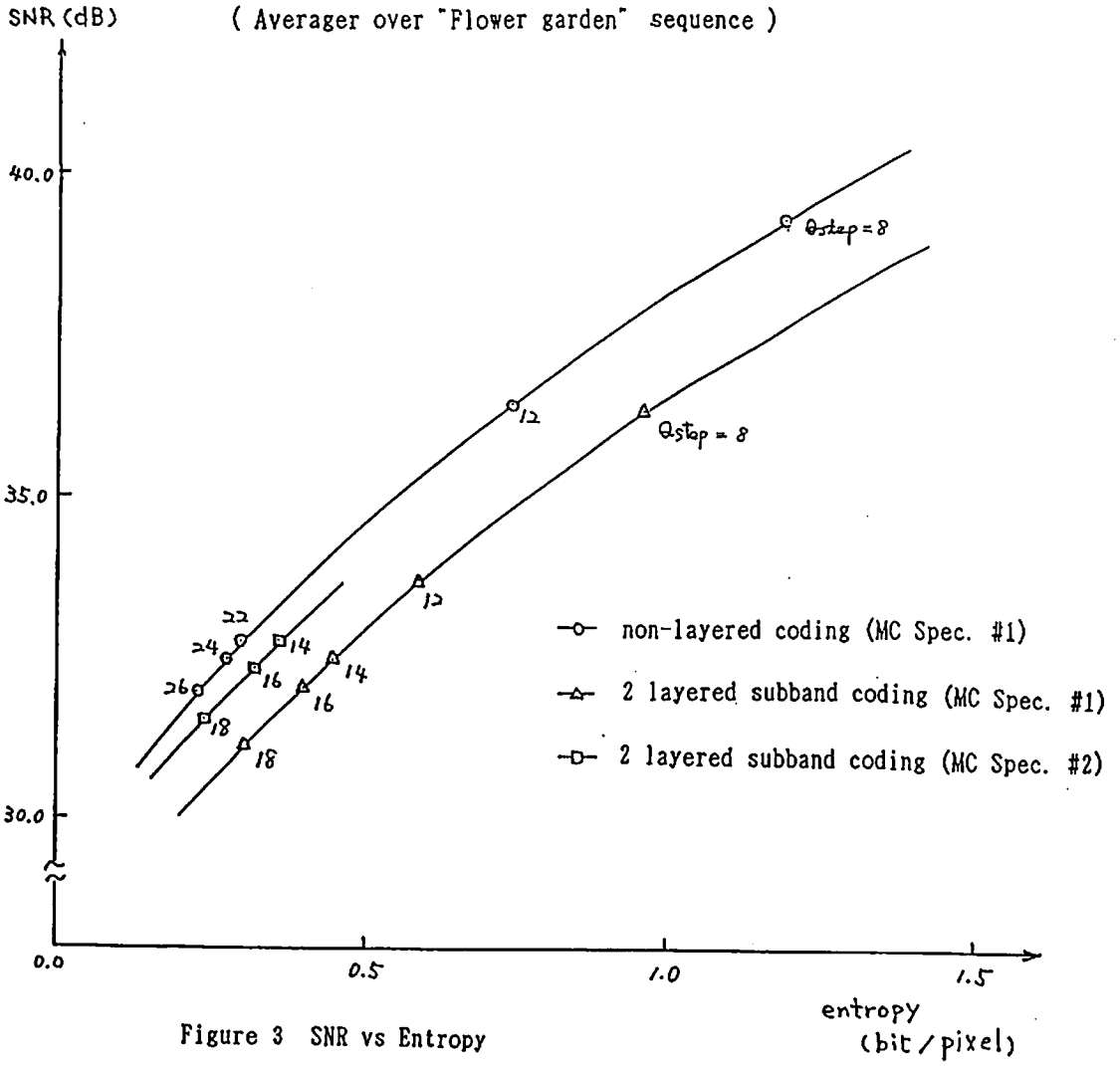


Figure 3 SNR vs Entropy

4. Conclusion

The efficiency of subband coding is discussed in comparison with that of non-layered coding. By ajusting in MC size, MC precision and number of interpolation filter taps, the efficiency of subband coding is increased. The non-layered coding is superior to subband coding in SNR-Entropy relation, but the subjective image quality are almost the same.

REFERENCE

(1) T. Takishima and M. Wada : "A study on Quantity Evaluation and Statistic Analysis of the Subband Coding" IEICE, Technical Report, IE 91-4 (In Japanese)

END