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CCITT SGXV
Working Party XV/1
Specialists Group on Coding for Visual Telephony
SOURCE : Japan
TITLE : The content of the quantizer selection table

1. INTRODUCTION

In this document, we discuss the content of the quantizer selection table, which is shown in figure 4 of Annex 4 to Doc. #540R.

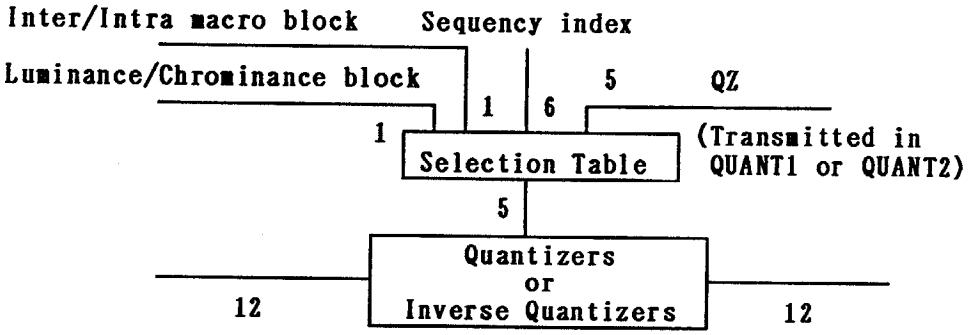


Figure 4 of Annex 4 to Doc. #540R

2.SIMULATIONS AND RESULTS

The following sumulations are performed under RM8 with q=1, 10Hz, and FCIF.

SIMULATION 1 (Luminance/Chrominance block bit [1 bit], Inter/Intra macro block bit [1 bit])

Figure 1 shows the average of absolute quantizer error of DCT blocks. The value of inter is the average from 3rd to 189th frame. The value of intra is the average from the frame zero to 30th frame on condition that the frame rate is 10Hz and quantizer step size is fixed to the mean step size under RM8 (Salesman:26, Claire : 18).

In figure 1, all of four distribution patterns are very similar except the DC values of intra mode, which are transmitted by fixed length codes. Judged from the similarity of those patterns, quantizer step size selection by luminance/chrominance block bit or inter/intra macro block bit may not be necessary.

As concerning the quantizer step size of the intra AC coefficients, it is possible to select it using QUANT2, so it is not necessary to select it by inter/intra bit. On the

other hand, we had investigated the intra DC coefficients in Document #457 (Oslo meeting). In Document # 457, the FLC bits of the intra DC coefficients were discussed, and we did not find differences between 6, 8, and 9 bit for the intra DC values (quantizer step size 24, 8, and 4 , respectively) under RM7. The number of transmitted DC coefficients per macro block are different in RM7(three: Y,Cr,Cb) and RM8(six: Y00,Y01,Y10,Y11,Cr,Cb), but the difference may not introduce different results. So we support 8bit FLC (step size 8) for the intra DC coefficients.

We have also investigated the selection by luminance / chrominance block bit in the reproduced image quality point of view. Quantizer step size is set as follows:

$$QSTEP(C) = QSTEP(Y) + DQSTEP,$$

where QSTEP(C) means the quantizer step size of chrominance block and QSTEP(Y) means the quanitzer step size of luminance block.

The result is shown in figure 2 and the video tape was prepared. When DQSTEP is greater than 0, more quasi-color is observed on the white shirt area in "Salesman". When DQSTEP is less than 0, less quasi-color appears, but more block shape noise is observed.

SIMULATION 2 (Sequency index bits [6 bit])

Figure 1 shows the following tendency about sequency index.
Quantizer error of low frequency coefficients is greater than that of high frequency coefficients.
This means that there is possibility of improving image quality using the quantizer step size selection by sequency index bits.

A simulation is carried out to find out the possibility with different quantizer step size over low frequency coefficients and high frequency coefficients:

$$QSTEP(33\text{-}64) = QSTEP(1\text{-}32) + DQSTEP,$$

where QSTEP(X-Y) means quantizer step size over the DCT coefficients whose sequency indices are form X to Y.

The result is shown in figure 3 and the video tape was prepared. S/N is improved slightly with DQSTEP = 2, but by observing the reproduced image, we can find no improvement using quantizer step size selection by sequency index bits.

3.CONCLUSION

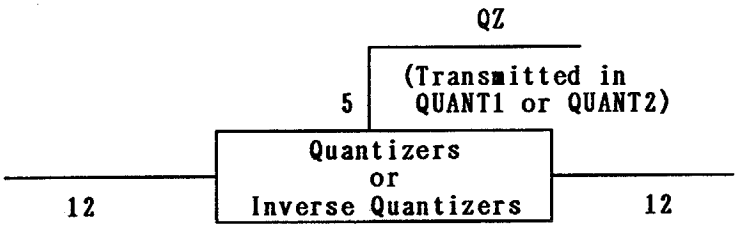
(1) Instead of selection quantizer step size by inter/intra macro block bit, it is possible to select it using QUANT2.

(2) As concerning the quantizer step size of the intra DC coefficients, step size 8 would be adequate.

(3)Any decisive improvement was not observed by using quantizer step size secection by luminance/chrominance block bit or sequency index bits.

(4) Judged from the similarity of the absolute quanitzer error patterns on DCT blocks, the quantizer step size selection by luminance/chrominance block bit or inter/intra macro block bit may not be necessary.

We propose to finalize figure 4 of Annex 4 to Doc. #540R as follows:



+ Quantizer step size for intra DC coefficient is 8.

5.17	3.23	2.73	2.56	1.96	1.85	1.31	1.27
3.94	2.51	2.13	1.93	1.56	1.36	1.11	.90
2.46	2.08	1.76	1.62	1.38	1.20	.99	.86
2.04	1.58	1.47	1.26	1.15	.95	.80	.66
1.67	1.41	1.24	1.14	.94	.79	.69	.59
1.45	1.14	1.02	.91	.78	.70	.58	.50
1.15	.93	.89	.75	.63	.56	.50	.45
.88	.74	.69	.63	.54	.47	.43	.39

Luminance (CLAIRE)

6.04	7.92	6.92	6.65	5.73	5.34	4.72	4.46
8.13	7.27	6.76	6.18	5.29	4.88	3.97	3.82
7.54	6.73	6.44	5.48	4.87	4.18	3.17	2.88
7.42	6.19	5.37	4.61	3.97	3.27	2.24	2.39
6.72	4.96	4.15	3.47	2.97	2.40	1.42	2.28
5.91	3.94	3.19	2.58	2.00	1.79	1.01	2.26
6.28	3.34	2.28	2.20	1.52	2.18	.97	4.85
5.23	2.50	1.77	1.76	1.30	1.68	.87	3.42

Luminance (SALESMAN)

3.60	2.95	2.94	3.00	1.57	1.89	1.62	1.32
2.43	2.33	2.06	1.64	1.40	1.02	.69	.56
1.91	1.84	1.60	1.27	.99	.81	.68	.58
1.53	1.44	1.13	.93	.82	.70	.58	.52
1.25	1.08	.94	.78	.63	.58	.53	.51
1.02	.89	.85	.70	.61	.59	.53	.49
.89	.72	.70	.65	.57	.51	.50	.49
.85	.76	.70	.65	.58	.54	.48	.48

Chrominance (CLAIRE)

4.64	5.88	4.31	2.43	1.44	.80	.48	.41
6.79	4.35	2.86	1.68	.98	.54	.37	.28
5.08	3.03	2.05	1.29	.80	.45	.34	.30
3.86	2.23	1.41	.93	.67	.41	.32	.28
3.05	1.73	1.11	.78	.56	.37	.31	.29
2.14	1.22	.91	.67	.48	.35	.29	.27
1.53	1.01	.79	.55	.43	.36	.31	.28
1.35	.89	.67	.52	.43	.33	.31	.29

Chrominance (SALESMAN)

INTER

1.92	3.03	2.54	2.34	1.87	1.67	1.37	1.25
3.84	2.39	2.14	1.90	1.65	1.42	1.17	.98
2.60	2.23	2.03	1.76	1.54	1.34	1.03	.82
2.08	1.72	1.63	1.45	1.20	1.09	.90	.75
1.69	1.51	1.38	1.22	1.05	.95	.76	.64
1.47	1.30	1.18	1.00	.86	.75	.64	.53
1.18	1.08	.96	.79	.70	.58	.54	.46
.97	.77	.75	.62	.54	.49	.44	.39

Luminance (CLAIRE)

2.00	8.15	7.73	6.74	6.51	5.75	5.02	4.68
8.35	7.91	7.28	6.72	5.69	5.47	4.28	4.02
8.33	7.45	6.51	5.60	5.08	4.29	3.23	3.12
8.18	6.40	5.76	4.79	3.94	3.30	2.14	2.44
7.17	5.33	4.33	3.59	2.79	2.35	1.40	2.26
6.86	4.22	3.31	2.56	1.90	1.71	.94	2.18
7.16	3.36	2.32	2.21	1.46	2.23	.95	4.88
5.82	2.66	1.84	1.77	1.32	1.68	.82	3.42

Luminance (SALESMAN)

1.86	2.84	2.97	3.28	1.64	1.98	2.03	1.46
2.50	2.57	2.08	1.67	1.32	.94	.75	.62
1.93	1.87	1.69	1.36	1.05	.88	.69	.57
1.63	1.56	1.33	1.03	.84	.67	.62	.57
1.21	1.10	.92	.80	.67	.63	.59	.54
1.07	.96	.86	.77	.63	.59	.53	.50
.96	.80	.80	.64	.63	.54	.53	.49
.88	.77	.74	.66	.60	.56	.50	.49

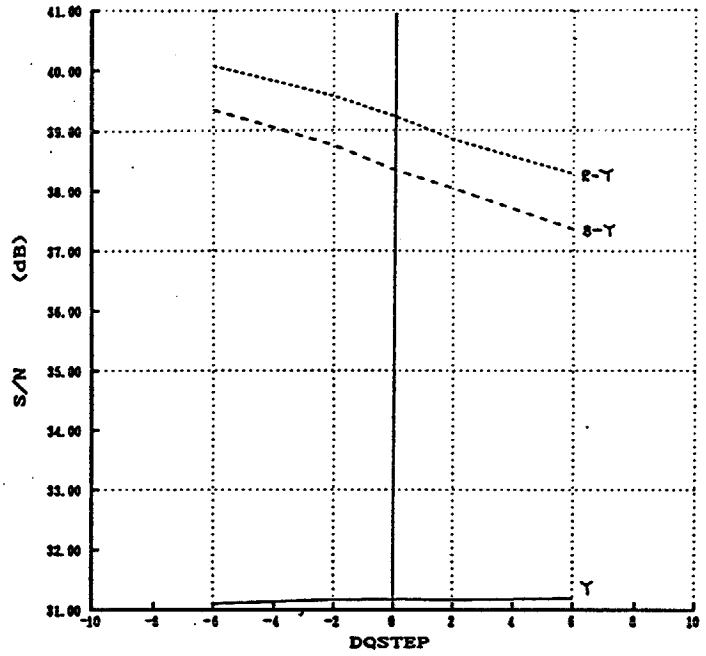
Chrominance (CLAIRE)

2.02	6.48	4.26	2.18	1.34	.72	.42	.31
7.72	4.39	2.74	1.50	.88	.53	.34	.27
5.68	3.06	1.89	1.22	.73	.46	.32	.28
3.90	2.16	1.31	.93	.65	.43	.30	.27
2.86	1.59	1.07	.80	.52	.37	.28	.27
2.42	1.24	.92	.60	.47	.33	.28	.25
1.85	1.05	.76	.58	.42	.34	.29	.26
2.51	.88	.70	.53	.43	.33	.28	.26

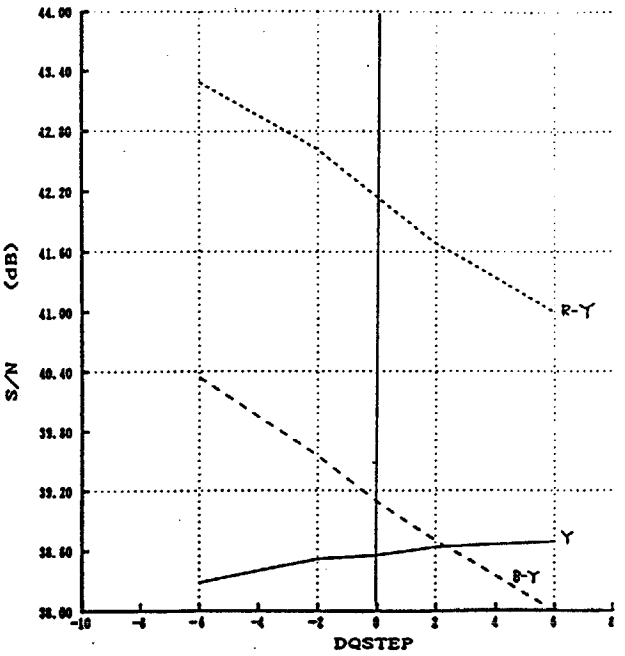
Chrominance (SALESMAN)

INTRA

Figure 1 Quantization error of 8x8 DCT coefficients

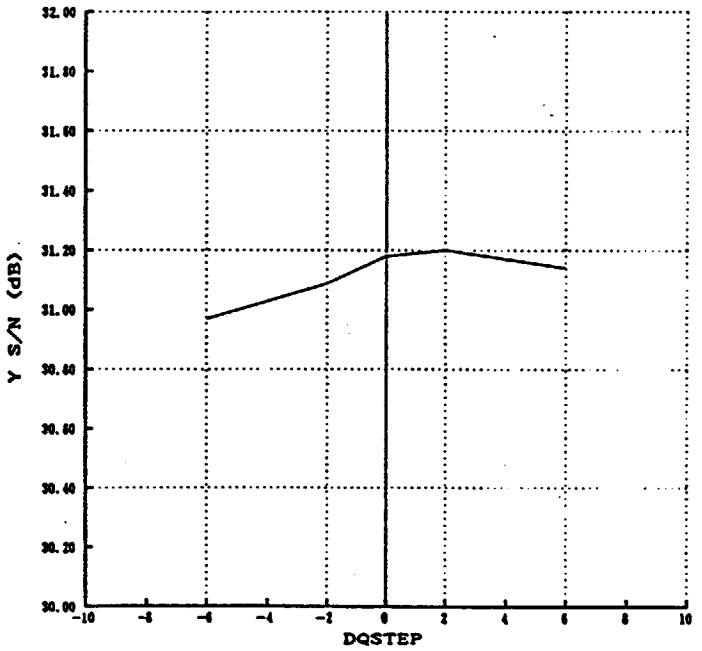


Selection by Y/C bit (SALESMAN)

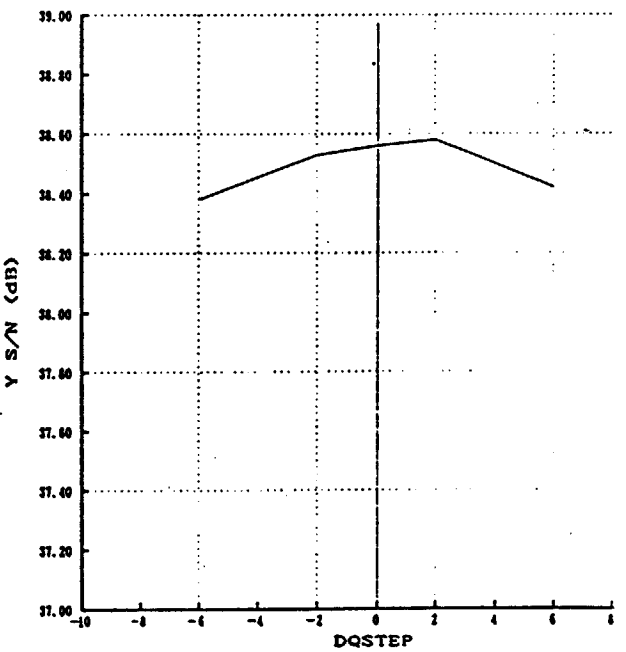


Selection by Y/C bit (CLAIRE)

F i g 2



Selection by INDEX bits (SALESMAN)



Selection by INDEX bits (CLAIRE)

F i g 3