

SOURCE : JAPAN

TITLE : BLOCK ADDRESSING METHOD FOR MACRO ATTRIBUTE

1. Introduction

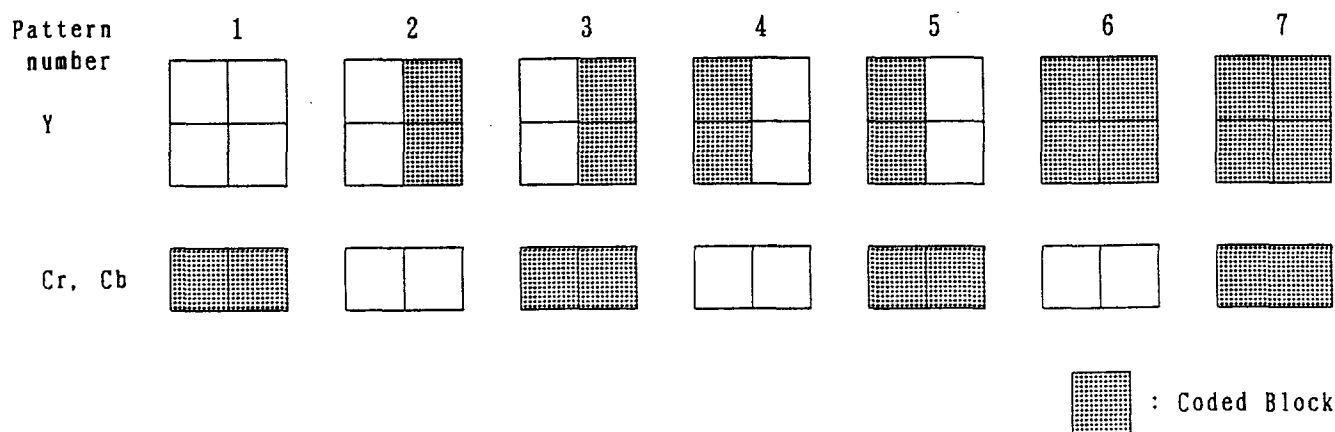
It is preferable for the improvement of prediction to send attribute block by block, but in that case, much side information is needed. By the introduction of Macro Block scheme in RM5, the amount of side information is much reduced, however the EOB code information increases (see Annex 1). As the first step to find out better coding scheme in Macro Block approach in predictiveness and efficiency, we try the method to send pattern information which indicates coded/not coded blocks in a Macro Block.

2. Coded/Not coded Patterns and Preliminary Experiment

As the pattern sets of coded/not coded blocks in a coded Macro Block, six methods are considered;

- Method 1 (2 patterns)
- Method 2 (3 patterns)
- Method 3 (7 patterns, horizontal split in luminance)
- Method 4 (7 patterns, vertical split in luminance)
- Method 5 (8 patterns)
- Method 6 (63 patterns)

The explanation of the methods are described in Annex 2. For example, the patterns of Method 4 are illustrated below.



Each method except Method 1 has both FLC and VLC code sets, and Method 6 has two VLC code sets according to the treatment of luminance and chrominance.

The next criterion function is defined for the scale of the coding performance in each method;

$$\text{Func.} = N_c * L_p + N_u * L_e$$

N_c : number of coded Macro Blocks per frame

L_p : average length of pattern codes

N_u : number of EOB codes for non coded blocks per frame

L_e : EOB code length

The values of N_c , L_p and N_u are calculated in Annex 3, supposing each method were used in RM5. By the data of Annex 3, the criterion function values are obtained, on condition that the value of L_e equals two bits (see Annex 4). The result of Annex 4 shows that about 390 bits per frame are saved maximally in case of Method 4 with VLC.

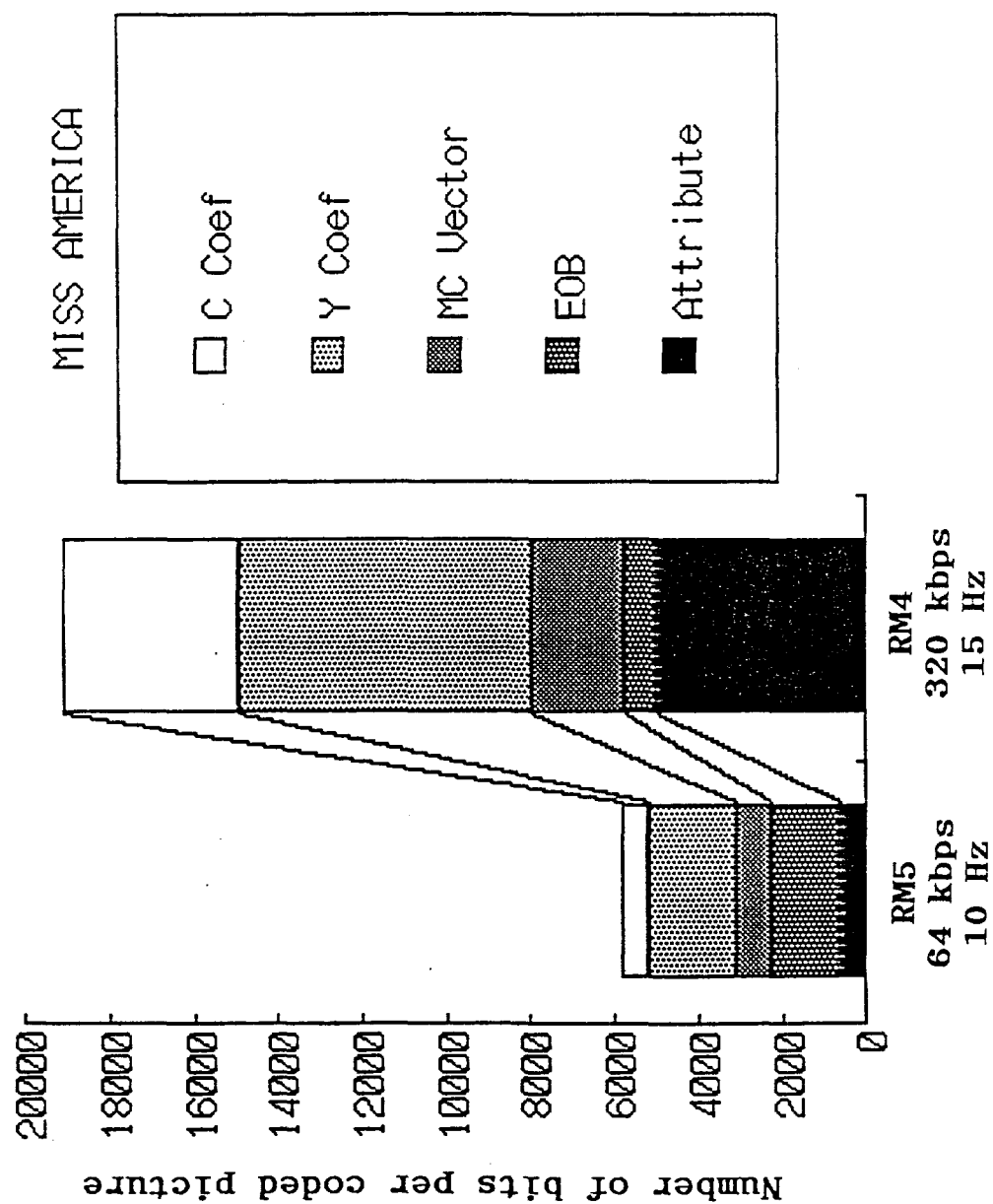
3. Simulation Results

The simulation results in which each method is actually used are described in Annex 5. There seems to be same tendency in the coding performance between the results of Annex 4 and Annex 5.

4. Conclusion

As the results of Annex 4 and 5, we propose Method 4 with VLC to send the patterns of coded/not coded blocks in a coded Macro Block. Some methods to improve predictiveness with other information are for further study.

Annex 1: The number of assigned bits in RM4 and RM5

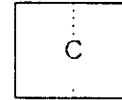


Annex 2 : Explanation of Methods

Variables described below(Y, Y1, CR etc.) are set 1 when they are decided to be coded, and have 0 value when not coded.

Method 1 (Pattern 1~2)

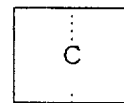
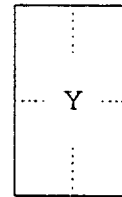
$$\text{Pattern number} = C + 1$$



In this case , all luminance blocks are assumed to be coded.

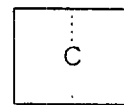
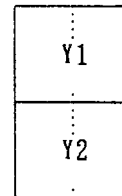
Method 2 (Pattern 1~3)

$$\text{Pattern number} = Y \times 2 + C$$



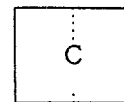
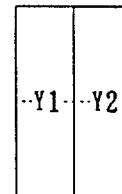
Method 3 (Pattern 1~7)

$$\text{Pattern number} = Y1 \times 4 + Y2 \times 2 + C$$



Method 4 (Pattern 1~7)

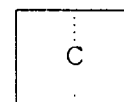
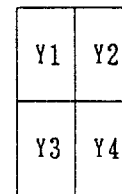
$$\text{Pattern number} = Y1 \times 4 + Y2 \times 2 + C$$



Method 5 (Pattern 1~8)

Pattern: coded blocks

- 1 : Y1
- 2 : Y2
- 3 : Y3
- 4 : Y4
- 5 : Y1, Y3
- 6 : Y2, Y4
- 7 : Y1, Y2, Y3, Y4
- 8 : Y1, Y2, Y3, Y4, C



Method 6 (Pattern 1~63 , or Pattern(Y) 1~16 and Pattern(C) 1~4)

① Mixed treatment case of Luminance and chrominance

$$\text{Pattern number} = Y1 \times 32 + Y2 \times 16 + Y3 \times 8 + \\ Y4 \times 4 + CR \times 2 + CB$$

Y1	Y2
Y3	Y4

CR

CB

② Separate treatment case of Luminance and chrominance

$$\text{Pattern(Y) number} = Y1 \times 8 + Y2 \times 4 + Y3 \times 2 + Y4 + 1$$

$$\text{Pattern(C) number} = CR \times 2 + CB + 1$$

Code Length of Side Information

(bit)

	FLC	VLC(average)	
Method 1	1.0	—	
Method 2	2.0	1.24	
Method 3	3.0	2.42	
Method 4	3.0	2.43	
Method 5	3.0	2.75	
Method 6	6.0	①	4.80
		②	5.27

VLC Code Table

METHOD 2

PATTERN NUMBER	CODE LENGTH	CODE
1	2	11
2	1	0
3	2	10

METHOD 3

PATTERN NUMBER	CODE LENGTH	CODE
1	4	0100
2	2	10
3	5	01010
4	2	11
5	5	01011
6	2	00
7	3	011

METHOD 4

PATTERN NUMBER	CODE LENGTH	CODE
1	4	0100
2	2	10
3	5	01010
4	2	11
5	5	01011
6	2	00
7	3	011

Annex 3 : Basic Data in RM5

All data are obtained as if each method were used in RM5, and average data are those of 486 coded frames.

Number of Coded Macro Blocks

	Coded MB	Coded Frames
Claire	16772	164
Miss America	6737	49
Salesman	19109	149
Swing	14803	124
Total	57421	486
Total/Frame	118.2	

Number of EOB codes for non coded blocks

	RM5	Method 1	Method 2	Method 3	Method 4	Method 5	Method 6
Claire	59150	34932	33156	18576	16084	14795	0
Miss America	26833	20901	13545	7821	7591	15295	0
Salesman	77717	41695	40971	19253	18663	11105	0
Swing	60532	39202	34610	16358	17360	18163	0
Total	224232	136730	122282	62008	59698	59358	0
Total/Frame	461.4	281.3	251.6	127.6	122.8	122.1	0.0

METHOD 5

PATTERN NUMBER	CODE LENGTH	CODE
1	4	1011
2	3	100
3	3	111
4	3	110
5	5	10100
6	5	10101
7	2	00
8	2	01

METHOD 6 ①

PATTERN NUMBER	CODE LENGTH	CODE
1	5	01101
2	5	10110
3	7	0110011
4	3	110
5	8	00111010
6	8	01100100
7	9	101111011
8	3	111
9	7	1011100
10	8	01110100
11	9	011001011
12	5	00110
13	7	1011111
14	9	010010110
15	8	10111100
16	3	100
17	8	00111000
18	8	01110101
19	10	0100100111
20	5	00000
21	7	0111011
22	9	000011000
23	9	010011111
24	6	001111
25	9	010011011
26	10	0000111011
27	11	01001001100
28	5	10100
29	8	00111011
30	9	001110011
31	9	000011001
32	4	0001
33	8	00001111
34	8	01110010
35	9	011100111
36	6	001001
37	9	010010010
38	10	0000111010
39	11	01001001101
40	5	00101
41	7	1011101
42	9	000011100
43	9	010011001
44	5	10101
45	8	01001010

46	9	010011110
47	9	001110010
48	5	01000
49	8	01001110
50	9	011001010
51	9	101111010
52	5	01111
53	8	01001000
54	9	011100110
55	9	010011000
56	6	000010
57	8	00001101
58	9	010011010
59	9	010010111
60	4	0101
61	6	001000
62	7	0111000
63	6	011000

METHOD 6 ② (Y)

PATTERN NUMBER	CODE LENGTH	CODE
1	6	110011
2	3	000
3	3	001
4	4	0110
5	3	010
6	4	0111
7	5	10000
8	5	10001
9	3	111
10	6	110010
11	4	1011
12	4	1010
13	5	11011
14	5	11010
15	5	11000
16	4	1001

METHOD 6 ② (C)

PATTERN NUMBER	CODE LENGTH	CODE
1	1	0
2	2	10
3	3	111
4	3	110

Annex 4: The Value of Criterion Function

The criterion function values are calculated by the data of Annex 3, on condition that EOB code length is 2 bit.

(bit/frame)

	FLC	VLC	
RM5	922.8		
Method 1	680.8	————	
Method 2	739.6	649.8	
Method 3	609.8	541.2	
Method 4	600.2	532.8	
Method 5	598.8	569.3	
Method 6	709.2	①	567.4
		②	622.9

Annex 5: The Simulation result by Each Method

The simulation results using each method are described below. Each value means the average except the 1st frame.

The Performance of Each Method Using FLC

		RM5	Method 1	Method 2	Method 3	Method 4	Method 5	Method 6
Claire	SNR (Y)	37.68	37.83	37.75	37.78	37.84	37.83	37.71
	SNR (U)	38.59	38.65	38.67	38.68	38.65	38.71	38.59
	SNR (V)	41.64	41.66	41.67	41.71	41.69	41.75	41.54
	MACRO ATTRIBUTES	512	622	725	830	835	835	1142
	END OF BLOCK	1228	954	929	750	723	706	512
	SUM OF UPPER TWO	1740	1576	1654	1580	1558	1541	1654
Miss America	SNR (Y)	37.62	37.66	37.72	37.74	37.74	37.65	37.69
	SNR (U)	37.69	37.67	37.75	37.77	37.78	37.71	37.74
	SNR (V)	38.40	38.45	38.51	38.57	38.56	38.42	38.51
	MACRO ATTRIBUTES	626	771	933	1084	1081	1052	1516
	END OF BLOCK	1667	1453	1164	939	933	1202	585
	SUM OF UPPER TWO	2293	2224	2097	2023	2014	2254	2101
Salesman	SNR (Y)	29.75	29.97	29.86	29.95	30.00	30.06	29.87
	SNR (U)	37.35	37.52	37.47	37.57	37.55	37.59	37.49
	SNR (V)	38.28	38.28	38.27	38.30	38.34	38.33	38.27
	MACRO ATTRIBUTES	599	751	873	1019	1023	1028	1415
	END OF BLOCK	1545	1114	1081	799	798	699	520
	SUM OF UPPER TWO	2144	1865	1954	1818	1821	1727	1935
Swing	SNR (Y)	29.25	29.37	29.30	29.49	29.37	29.36	29.28
	SNR (U)	32.01	32.14	32.06	32.19	32.17	32.15	32.13
	SNR (V)	33.41	33.52	33.43	33.55	33.53	33.51	33.50
	MACRO ATTRIBUTES	580	714	838	977	981	969	1342
	END OF BLOCK	1440	1129	1051	766	788	794	479
	SUM OF UPPER TWO	2020	1843	1889	1743	1769	1763	1821

The Performance of Each Method Using VLC

		RM5	Method 2	Method 3	Method 4	Method 5	Mtd. 6 ①	Mtd. 6 ②
Claire	SNR (Y)	37. 68	37. 86	37. 82	37. 84	37. 84	37. 77	37. 77
	SNR (U)	38. 59	38. 64	38. 69	38. 72	38. 72	38. 68	38. 62
	SNR (V)	41. 64	41. 61	41. 75	41. 81	41. 74	41. 66	41. 67
	MACRO ATTRIBUTES	512	654	771	783	807	1043	1073
	END OF BLOCK	1228	936	752	728	710	519	518
	SUM OF UPPER TWO	1740	1590	1523	1501	1517	1562	1591
Miss America	SNR (Y)	37. 62	37. 74	37. 73	37. 74	37. 67	37. 72	37. 69
	SNR (U)	37. 69	37. 75	37. 78	37. 78	37. 75	37. 75	37. 75
	SNR (V)	38. 40	38. 56	38. 55	38. 58	38. 46	38. 50	38. 51
	MACRO ATTRIBUTES	626	873	1106	1105	981	1455	1548
	END OF BLOCK	1667	1173	938	924	1219	593	580
	SUM OF UPPER TWO	2293	2046	2044	2029	2200	2048	2128
Salesman	SNR (Y)	29. 75	29. 98	30. 08	30. 07	30. 06	30. 02	30. 00
	SNR (U)	37. 35	37. 47	37. 58	37. 56	37. 59	37. 54	37. 56
	SNR (V)	38. 28	38. 23	38. 37	38. 34	38. 33	38. 29	38. 29
	MACRO ATTRIBUTES	599	759	905	908	1018	1223	1276
	END OF BLOCK	1545	1107	814	810	702	538	531
	SUM OF UPPER TWO	2144	1866	1719	1718	1720	1761	1807
Swing	SNR (Y)	29. 25	29. 37	29. 42	29. 46	29. 46	29. 41	29. 32
	SNR (U)	32. 01	32. 13	32. 24	32. 18	32. 22	32. 20	32. 13
	SNR (V)	33. 41	33. 54	33. 59	33. 54	33. 54	33. 62	33. 53
	MACRO ATTRIBUTES	580	758	914	925	934	1211	1265
	END OF BLOCK	1440	1073	767	788	800	487	485
	SUM OF UPPER TWO	2020	1831	1681	1713	1734	1698	1750