

SOURCE: Japan
TITLE : Type 3 VLC optimization

1. Introduction

This document describes experimental results of the type 3 VLC optimization. The simulations are carried out to estimate statistics of Macro Block types in the Reference Model 8, and to compare coding efficiency of optimized type 3 VLC table with RM8.

2. Simulation

Table 1 to Table 3 show the probability of each macro block type using the Reference Model 8 for sequences "Claire", "Miss America", "Salesman" and "Swing" at q=1 CIF, q=1 QCIF and q=5 CIF respectively. The entropy of each Macro Block type at different conditions is listed in Table 4. The optimum type 3 VLC set is generated according to statistics of above four sequences at q=1 CIF (average probability in Table 1). Obtained code length for type 3 is also included in Table 4. Source entropy and average code length of type 3 are presented in Table 5 for adaptivity consideration purpose. Table 6 shows the comparison of the simulation results between optimized type 3 VLC and original RM8.

Probability of each Macro Block types depends on image contents, but that is considered to have almost the same characteristics. In q=1 QCIF and q=5, probability of no MC coded Macro Blocks increases compared with q=1 CIF. The reason is that small step size will cause decrease of Fixed (no MC not coded) MBs and that the MBs which were not coded at q=1 CIF become coded MBs at higher bit rate or QCIF. Though type 3 VLC were optimized, better coding performance was not obtained. Because number of coding bits for type 3 is small in total bit rate, and probability of no MC coded MBs is very large (more than half).

3. Conclusion

The optimized type 3 VLC does not give significant change in coding performance, because of large number of no MC coded Macro Blocks.

MB Type		Claire	Miss A.	Salesman	Swing	Ave.
no MC	Coded	0.5086	0.4527	0.5865	0.8620	0.6132
MC	Coded	0.3544	0.3840	0.2650	0.0336	0.2509
MC not	Coded	0.0530	0.1135	0.0468	0.0077	0.0483
Intra		0.0010	0.0002	0.0134	0.0076	0.0062
no MC	Coded + Q	0.0505	0.0287	0.0706	0.0862	0.0624
MC	Coded + Q	0.0325	0.0206	0.0169	0.0026	0.0186
Intra	+ Q	0.0001	0.0002	0.0008	0.0002	0.0004

Table 1. Probability of Macro Block type (q=1, FCIF, 10Hz)

MB Type		Claire	Miss A.	Salesman	Swing	Ave.
no MC	Coded	0.7514	0.6157	0.8186	0.9606	0.8187
MC	Coded	0.1620	0.2899	0.0890	0.0184	0.1119
MC not	Coded	0.0056	0.0140	0.0015	0.0013	0.0041
Intra		0.0001	0.0000	0.0032	0.0023	0.0016
no MC	Coded + Q	0.0727	0.0657	0.0837	0.0142	0.0576
MC	Coded + Q	0.0081	0.0146	0.0041	0.0030	0.0061
Intra	+ Q	0.0000	0.0000	0.0000	0.0002	0.0001

Table 2. Probability of Macro Block type (q=1, QCIF, 10Hz)

MB Type		Claire	Miss A.	Salesman	Swing	Ave.
no MC	Coded	0.7696	0.5853	0.6715	0.8233	0.7213
MC	Coded	0.1666	0.3163	0.2220	0.0451	0.1855
MC not	Coded	0.0034	0.0297	0.0129	0.0463	0.0171
Intra		0.0004	0.0001	0.0073	0.0070	0.0036
no MC	Coded + Q	0.0357	0.0441	0.0604	0.0741	0.0509
MC	Coded + Q	0.0243	0.0241	0.0252	0.0039	0.0212
Intra	+ Q	0.0001	0.0002	0.0007	0.0003	0.0003

Table 3. Probability of Macro Block type (q=5, FCIF, 10Hz)

MB type		Entropy			Code Length	
		q=1 FCIF	q=1 QCIF	q=5 FCIF	RM8	Opt.
no MC	Coded	0.71	0.29	0.47	1	1
MC	Coded	1.99	3.16	2.43	2	2
MC not	Coded	4.37	7.93	5.87	3	4
Intra		7.33	9.29	8.12	4	6
no MC	Coded + Q	4.00	4.12	4.30	5	3
MC	Coded + Q	5.75	7.36	5.56	6	5
Intra	+ Q	11.29	13.29	11.70	7	6

Table 4. Entropy and optimized code length

	q=1 FCIF	q=1 QCIF	q=5 FCIF
Source entropy	1.55	0.92	1.26
average code length (RM8)	1.71	1.39	1.54
average code length (optimum)	1.63	1.27	1.44

Table 5. Source entropy and average code length

ITEM	CLAIRE		Miss America		Salesman		Swing	
	RM8	Opt.	RM8	Opt.	RM8	Opt.	RM8	Opt.
SNR for Y	38.49	38.51	38.14	38.12	31.64	31.64	34.99	34.98
SNR for U	39.09	39.07	37.90	37.89	38.63	38.68	36.62	36.62
SNR for V	42.12	42.12	38.92	38.88	39.48	39.46	37.13	37.14
Step size	17.71	17.69	16.94	17.03	24.72	24.75	14.99	14.97

(a) q=1, FCIF, 10Hz

ITEM	CLAIRE		Miss America		Salesman		Swing	
	RM8	Opt.	RM8	Opt.	RM8	Opt.	RM8	Opt.
SNR for Y	39.18	39.16	39.46	39.39	34.47	34.64	40.25	40.30
SNR for U	40.29	40.01	39.19	39.13	40.11	40.33	40.81	40.82
SNR for V	43.13	42.95	39.33	39.24	40.98	41.11	41.47	41.49
Step size	10.31	10.09	10.43	10.63	12.91	13.20	8.69	9.09

(b) q=1, QCIF, 10Hz

ITEM	CLAIRE		Miss America		Salesman		Swing	
	RM8	Opt.	RM8	Opt.	RM8	Opt.	RM8	Opt.
SNR for Y	43.44	43.45	39.99	40.05	36.26	36.29	36.67	36.71
SNR for U	43.85	43.85	39.39	39.42	42.12	42.26	40.84	40.88
SNR for V	46.31	46.31	41.70	41.78	43.35	43.40	41.24	41.29
Step size	6.56	6.58	9.56	9.36	14.14	14.25	17.89	17.34

(c) q=5, FCIF, 10Hz

Table 6. Comparison between RM8 and optimized type 3 VLC