Telecommunication Standardization Sector
Study Group 15
Experts Group for ATM Video Coding
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SOURCE: Tektronix
TITLE: Results on TM4 Prediction Core Experiment on mod.SVMC-Prime
PURPOSE: Discussion

1. Introduction

MPEG Test Model 4 (TM4) proposes a Core Experiment in Appendix L in order to test the efficacy of the modified special prediction mode mod.SVMC-prime when it is added to a system already having the special prediction mode Dual-prime (which is now one of the standard TM4 prediction modes). These special modes seek to reduce the overhead of field motion vectors in certain commonly occurring cases where the vectors for the two fields do not greatly differ. This reduction is achieved by not coding both of the field vectors, but rather coding only one vector and a short differential motion vector (DMV) that can only take on the values 0, +1/2, or -1/2 pixel in each of the x and y components. SVMC-prime has been modified in the TM4 experiment to include averaging much like that which is done in Dual-prime. We performed TM4 Experiment mod.L.14 for both M=1 and M=3.

2. Simulation Conditions

TM4:	Frame Structure, $N = 15$, $M = 1$ and $M = 3$.
Chroma:	4:2:0
Rate:	4 Mbits/sec
Motion Vector:	(+-15, +-15)/frame, using original images for full-pel estimation with half-pel refinement on locally decoded images.
Sequences:	Flower1, Mobile1, Ftball1, Bus1, and Cheer1 in 4:2:0, 150 frames each.

3. Results

Average SNR is calculated by first averaging the MSE over all frames and then performing the logarithm. The SNR results are shown in Table 1. The Flower1, Ftball1, and Bus1 sequences (from fully decoded bitstreams) are demonstrated with a D1 tape for $M = 1$. Table 2 shows for $M = 1$ for four of the sequences the average number of macroblocks per P picture that a given prediction mode is chosen. Similarly, Table 3 shows for $M = 3$ for two of the sequences the average number of macroblocks per P picture or B picture that a given prediction mode is chosen. The following prediction tests are evaluated:

1. Fr/Fi8: adaptive Frame/Field motion with weighting in B pictures so that the field choice is only taken if MSE(Field) + 8 < MSE(Frame).

2. Fr/Fi8/D: Frame + Field + Dual_prime with weighting against Field Motion as in Fr/Fi8 and as described in TM4 Appendix L.8. Motion estimation is done with five candidate vectors (two field vectors, two scaled field vectors, and a vector scaled from the frame vector) combined with nine possible DMVs for Dual-prime as described in TM4 Section L.9.

3. Fr/Fi8/D/S: Frame + Field + Dual_prime + mod.SVMC_prime with weighting against Field Motion as in Fr/Fi8 and as described in TM4 Appendix L.8. Motion estimation is done with five candidate vectors (as in Fr/Fi8/D) combined with nine possible DMVs for each of Dual-prime, mod.SVMC-near, and mod.SVMC-same as described in TM4 Section L.9.

4. Conclusions

Care should be taken in drawing conclusions from only a few sequences. These five sequences suggest that Dual-prime might be helpful in some situations (producing more than 1 db improvement in two sequences with M=1). However, the sequences also suggest that mod.SVMC-prime does not really add much value to the prediction modes (producing no mor than 0.2 db improvement in all the sequences). Therefore we recommend that mod.SVMC-prime be dropped from further consideration.

Table 1: Comparison of SNR among Prediction Modes 4:2:0

Sequence		M = 1			M = 3		
		Fr/Fi8	Fr/Fi8/D	Fr/Fi8/D/S	Fr/Fi8	Fr/Fi8/D	Fr/Fi8/D/S
Mobile1	Y	26.42	26.89 (+0.47)	26.99 (+0.10)	28.04	28.56 (+0.52)	28.68 (+0.12)
	Cr	32.22	32.49	32.60	34.03	34.29	34.38
	Cb	32.30	32.56	32.65	34.02	34.28	34.35
Flower1	Y	27.96	29.25 (+1.29)	29.32 (+0.07)	29.19	30.11 (+0.92)	30.16 (+0.05)
	Cr	33.47	34.16	34.17	34.34	34.95	34.95
	Cb	31.43	32.30	32.33	32.49	33.23	33.25
Ftball1	Y	33.01	33.70 (+0.69)	33.90 (+0.20)	32.91	33.46 (+0.55)	33.64 (+0.18)
	Cr	38.58	39.17	39.18	38.58	39.01	39.04
	Cb	36.55	37.33	37.39	36.58	37.13	37.20
Bus1	Y	29.80	31.13 (+1.33)	31.23 (+0.10)	31.27	32.10 (+0.83)	32.17 (+0.07)
	Cr	39.40	40.10	40.11	40.38	40.95	40.96
	Cb	37.30	37.92	37.94	38.19	38.73	38.74
Cheer1	Y	28.90	29.21 (+0.31)	29.37 (+0.16)	28.90	29.11 (+0.21)	29.25 (+0.04)
	Cr	31.88	32.34	32.41	32.03	32.34	32.42
	Cb	30.59	31.00	31.10	30.78	31.05	31.13

Table 2: Average Number of Macroblocks per P-Picture per Prediction Type

	Mobile1 M=1					Bus1 M=1				
	frame	field	dual	svmc same	svmc near	frame	field	dual	svmc same	svmc near
Fr/Fi8	1085	229	0	0	0	566	731	0	0	0
Fr/Fi8/D	775	119	521	0	0	264	282	755	0	0
Fr/Fi8/D/S	468	47	297	416	86	170	175	594	153	208

	Flower1 M = 1					Ftball1 M = 1				
	frame	field	dual	svmc same	svmc near	frame	field	dual	svmc same	svmc near
Fr/Fi8	899	416	0	0	0	317	954	0	0	0
Fr/Fi8/D	492	168	656	0	0	144	559	577	0	0
Fr/Fi8/D/S	306	82	485	329	112	103	370	335	65	410

Table 3: Average Number of Macroblocks per P- or B-Picture per Prediction Type

	Flower1 M=3					Bus1 M=3				
	frame	field	dual	svmc same	svmc near	frame	field	dual	svmc same	svmc near
P-pictures										
Fr/Fi8	683	628	0	0	0	431	851	0	0	0
Fr/Fi8/D	252	225	836	0	0	200	429	657	0	0
Fr/Fi8/D/S	147	173	710	176	106	133	342	518	171	120
B-pictures										
Fr/Fi8	1072	240	0	0	0	975	337	0	0	0
Fr/Fi8/D	726	116	470	0	0	431	128	755	0	0
Fr/Fi8/D/S	581	94	369	185	106	361	105	629	89	128