CCITT Study group XV
Working party XV/1
Specialists Group on Coding
for Visual Telephony

Document # 131
June , 1986

Source : THE NETHERLANDS, SWEDEN

Title : MOTION VECTORS FOR THE CHROMINANCE.

1. INTRODUCTION

This paper describes an experiment on the basis of the Reference Model (104). An evaluation criterion has been applied in order to compare:

- Reference model; chrominance motion vectors are applied and obtained from the luminance vectors.
- Reference model; no chrominance motion vectors.

The chrominance motion vectors are derived from the luminance vectors in both encoder and decoder, thus no extra side information is required. The method of deriving the chrominance vectors is subject for standardization.

2. CHROMINANCE MOTION VECTORS

The motion vector for each 8 x 8 luminance block is divided by a factor of two in both horizontal and vertical direction, and then applied to the corresponding 4 x 4 C(u)- resp. C(v) block.

$$D(U) = \lfloor D(Y)/2 \rfloor$$

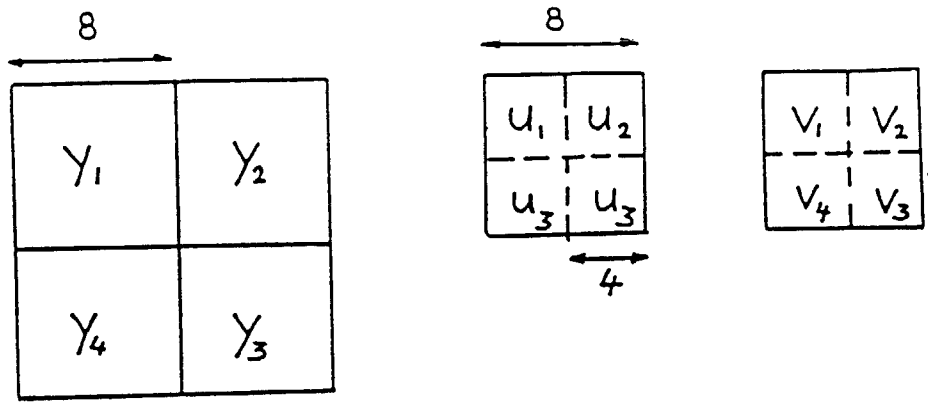

figure 1 Construction chrominance motion vectors

The result of the division is truncated with an entier function to the same resolution as for the luminance i.e. integer diplacement only. Example: D(Y)= (3,-2) D(u),D(v)= (1,-1)

2. CONCLUSION

Simulation results with the above described method show a little improvement on the reference model (1 - 3% bits saving), hardly visible picture quality improvement. However we propose to use it in the flexible hardware for future considerations.

3. HARDWARE CONSIDERATIONS.

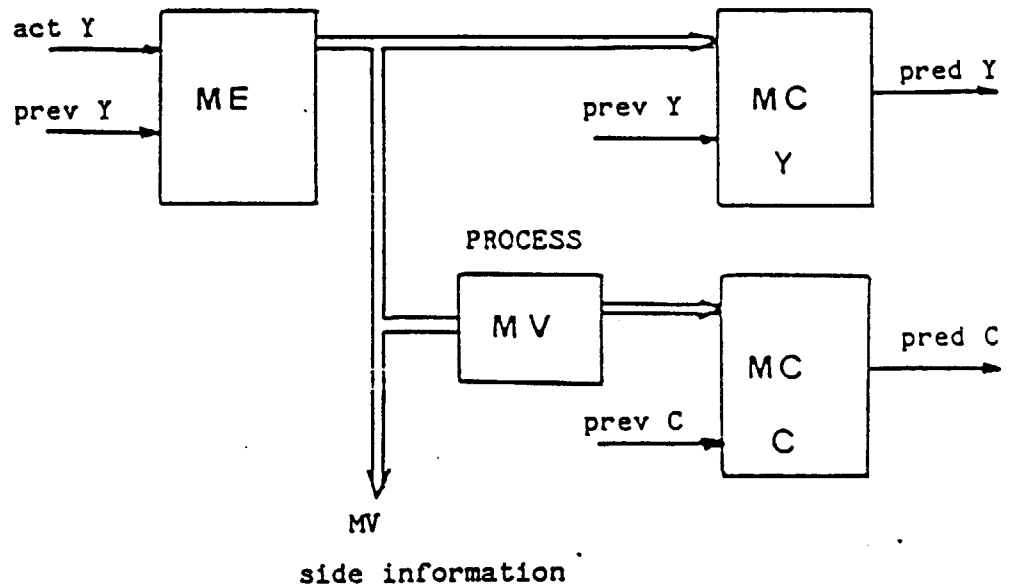

figure 2 The hardware implication.

used abbreviations:
Y = luminance
C = chrominance
ME = motion estimation
MV = motion vector
MC = motion compensation (prediction)
act = actual
prev= previous
pred= prediction

4. USED EVALUATION CRITERION

The energy of the prediction is used as an evaluation criterion.

$$SE(U/fd) = \sum_{i=1}^{8} \sum_{j=1}^{8} [\,(U(i,j,t) - U(i,j,t-1))]^2$$

For one quarter of a physical chrominance block (see figure 1) the error becomes:

$$SE(U/Y) = \sum_{i=1}^{4} \sum_{j=1}^{4} [(U(i,j,t) - U(i+D/2,j+D/2,t-1))]^2$$

SE(U/fd) = error for U component in the case that no motion vector has been used.
SE(V/fd) = error for V component in the case that no motion vector has been used.
D = motion vector luminance
SE(U/Y) = error for U component in the case that scaled motion vector has been used.
SE(V/Y) = error for V component in the case that scaled motion vector has been used.

5. RESULTS

48 frames of the splitscreen/Trevor White are used.

	DISTORTION U			DISTORTION V		
TRACK	REF MOD	UV -> Y	DIFF	REF MOD	UV -> Y	DIFF
1	5085974	5085974	0	5327516	5327516	0
2	835632	705013	130619	711249	625886	85363
3	495944	408876	87068	491122	442441	48681
4	558535	450606	107929	603120	530361	72759
5	703058	608422	94636	548398	517864	30534
6	735863	643161	92702	634783	540217	94566
7	726033	647876	78157	579569	517265	62304
8	639697	586348	53349	605082	531082	74000
9	578902	546121	32781	554084	495089	58995
10	653272	544598	108674	595306	500850	94456
11	738573	659575	78998	675552	567309	108243
12	608673	532616	76057	663257	603861	59396
13	519143	496619	22524	706100	595135	110965
14	500276	458971	41305	746356	623448	122908
15	499625	448328	51297	742827	617762	125065
16	483034	473383	9651	711946	616868	95078
17	517599	461372	56227	712968	601435	111533
18	493879	442246	51633	646292	507618	138674
19	450416	431220	19196	578180	470162	108018
20	3139626	3139626	0	619903	619903	0
21	134014	125475	8539	97277	80331	16946
22	123708	122610	1098	74769	81020	-6251
23	115580	119584	-4004	74503	82969	-8466
24	173172	156205	16967	114850	104590	10260
25	223784	175319	48465	160179	123885	36294
26	211730	157184	54546	153188	121573	31615
27	195248	158176	37072	132661	124706	7955
28	259424	247565	11859	241210	241471	-261
29	226361	219944	6417	166966	177385	-10419
30	156385	168814	-12429	110540	120783	-10243
31	148639	161415	-12776	92713	107818	-15105
32	150208	156331	-6123	102038	111436	-9398
33	163739	150917	12822	118406	107008	11398
34	152369	151570	799	98847	106283	-7436
35	146408	157131	-10723	100571	120011	-19440
36	150926	157630	-6704	106935	112339	-5404
37	158799	161999	-3200	102712	112963	-10251
38	162466	176435	-13969	116530	119150	-2620
39	189159	195525	-6366	150086	158079	-7993
40	251855	252003	-148	216728	220429	-3701
41	211423	217278	-5855	193626	190458	3168
42	198076	209536	-11460	193974	199919	-5945
43	214815	205181	9634	241909	224021	17888

44	183012	183177	-165	249057	236814	12243
45	256183	239102	17081	296470	275912	20558
46	290083	255756	34327	232150	214910	17240
47	175012	169640	5372	150528	139382	11146
48	147383	169875	-22492	98985	128592	-29607

The distortion for the U and V components are calculated separately. The table can be interpretated as follows:

column one the energy in the case no chrominance motion vector has been applied

column two the energy in the case a chrominance motion vector has been applied derived from the luminance motion vector.

column three the difference between the first and second approach