

Title : 4/9CIF
Source : Japan

1. Introduction

In the last meeting in Paris, we recognized that the full CIF(10Hz) is better than the 4/9 CIF(10Hz) in the case of the full size display. At the same time, some points requiring further clarification were pointed out.(see Annex 4 to Doc. #395R.) We did experiments which were focused on the following two items.

- 1) Spatio-temporal trade-off (1st point in Annex 4 to Doc.#395R)
- 2) Format conversion filtering (4th point in Annex 4 to Doc.#395R)

We used the same decimation filter as in Doc.#354, and the same parameter values as RM6 in these experiments.

2. Simulation

1) Spatio-temporal trade-off

We have been expecting that the smaller format will give us better temporal resolution.

- (a) CIF -> (RM6) -> CIF
- (b) CIF -> (4/9CIF) -> (RM6) -> (Inverse 4/9CIF) -> CIF

- 1)-1 10Hz (a) vs 15Hz (b)
- 1)-2 15Hz (a) vs 15Hz (b)

simulated sequences : CLAIRE,MISS AMERICA,SALESMAN,BLUE JACKET

The results are shown in the table 1 to 3. The "snry" on the table 1 and 2 is calculated in the full CIF(288x360). The "snry" on the table 3 is calculated in the 4/9CIF(192x240).

2) Format conversion filtering

It was pointed out in Paris that the 4/9CIF is suffering from double filtering. So we tried single filtering simulation starting only odd-numbered NTSC fields. As we have only one original NTSC test sequence at hand(BLUE JACKET) which seems not so appropriate for the current purpose, we digitized another sequence similar to SALESMAN(nicknamed OSAKA).

- (c) NTSC -> (CIF) -> (RM6) -> (Inverse CIF) -> NTSC
- (d) NTSC -> (field(240)) -> (4/9CIF) -> (RM6)
-> (Inverse 4/9CIF) -> (field) -> NTSC

- 2)-1 10Hz (c) vs 10Hz (d)
- 2)-2 15Hz (c) vs 15Hz (d)

simulated sequence : OSAKA which has large motion.

The results are shown in the table 4. The "snry" on the table 4 is calculated in CCIR.Rec.601 format(480x720).

3. Conclusion

As far as we observe the processed pictures for experiments 1) and 2) above, we can summarize the subjective impressions as follows;

- For such complex scenes as SLAESMAN and BLUE JACKET, 4/9CIF gives similar impressions to those of FULL CIF, but it does not outperform FULL CIF.
- For such simpler scenes as CLAIRE and MISS AMERICA, FULL CIF gives better impressions than 4/9CIF in respect of sharpness and coding noise.

Numerical data certainly shows that we can obtain lower step sizes with 4/9CIF. A possible interpretation for the above observations may be that even with smaller step sizes coding noises (blocking, mosquito) are still visible and reduction of sharpness counts more.

Table 1: The results of spatio-temporal trade-off 10Hz(a)

Statistics	RM6	Date	: November 1, 1988
Sequence	: FULL_CIF	Bit-rate	: 59.4 kbps
Modification	:	Frame-rate	: 10 Hz

ITEM		CLAIRE	BLUE	MISS	SALES
SNR for luminance	Y	38.01	33.51	37.87	30.89
SNR for chrominance	U	39.01	38.90	37.89	38.43
	V	42.17	37.57	38.77	39.17
RMS for luminance	Y	3.21	5.39	3.26	7.28
RMS for chrominance	U	2.86	2.89	3.25	3.06
	V	1.99	3.37	2.94	2.80
Mean value of step size		18.79	22.98	19.65	26.64
Mean value of number of	Y	3.14	3.79	2.33	2.81
non-zero coefficients	C	1.66	1.55	1.39	1.48
	Y and C	2.94	3.28	2.00	2.74
Mean value of number of	Y	5.83	9.12	3.75	8.91
zeroes before the last NZ	C	2.81	3.42	1.99	1.45
	Y and C	5.41	7.87	3.13	8.54
Block type of MACRO	Intra	0	1	0	2
	Fixed	275	281	213	259
	Fixed MC	6	4	22	7
	Coded	68	89	87	94
	Coded MC	46	22	75	35
Block type of Y	Fixed	1267	1352	1122	1260
	Fixed MC	85	48	254	78
	Coded	108	126	77	151
	Coded MC	123	55	131	88
Block type of C	Fixed	754	738	681	776
	Coded	37	52	110	12
Number of bits	Macro attr.	795	811	1216	881
	EOB	765	684	1012	766
	MV	306	160	589	277
	Coeff. DC	0	4	0	14
	Coeff. Y	3764	3760	2369	3899
	Coeff. U	191	229	308	41
	Coeff. V	85	261	341	30
	TOTAL	5910	5912	5838	5910

Table 2: The results of spatio-temporal trade-off 15Hz(a)

Statistics RM6 Date : November 1, 1988
Sequence : FULL_CIF Bit-rate : 59.4 kbps
Modification : Frame-rate : 15 Hz

ITEM		CLAIRE	BLUE	MISS	SALES
SNR for luminance	Y	37.09	33.27	36.96	30.52
SNR for chrominance	U	38.47	38.67	37.39	38.16
	V	41.60	37.47	37.83	38.99
RMS for luminance	Y	3.56	5.53	3.62	7.60
RMS for chrominance	U	3.04	2.97	3.45	3.15
	V	2.12	3.41	3.27	2.87
Mean value of step size		21.78	25.70	24.38	28.69
Mean value of number of non-zero coefficients	Y	2.62	3.36	2.02	2.62
	C	1.38	1.36	1.32	1.28
	Y and C	2.46	3.19	1.80	2.56
Mean value of number of zeroes before the last NZ	Y	5.24	9.23	3.45	6.43
	C	2.03	2.04	1.94	1.23
	Y and C	4.83	8.59	2.97	6.19
Block type of MACRO	Intra	0	0	0	1
	Fixed	298	313	252	291
	Fixed MC	7	3	26	6
	Coded	56	64	66	73
	Coded MC	35	16	52	26
Block type of Y	Fixed	1324	1400	1208	1338
	Fixed MC	84	36	230	65
	Coded	93	109	63	117
	Coded MC	83	38	82	61
Block type of C	Fixed	766	777	726	782
	Coded	26	15	66	9
Number of bits	Macro attr.	661	575	943	694
	EOB	590	488	694	573
	MV	233	112	468	200
	Coeff. DC	0	1	0	6
	Coeff. Y	2301	2674	1398	2416
	Coeff. U	101	34	152	23
	Coeff. V	46	51	210	19
	TOTAL	3935	3939	3869	3933

Table 3: The results of spatio-temporal trade-off 15Hz(b)

Statistics RM6 Date : November 1, 1988
 Sequence : 4/9_CIF Bit-rate : 59.4 kbps
 Modification : Frame-rate : 15 Hz

ITEM		CLAIRE	BLUE	MISS	SALES
SNR for luminance	Y	38.50	35.36	38.83	33.32
SNR for chrominance	U	39.51	40.30	38.12	39.25
	V	43.04	39.13	38.50	40.27
RMS for luminance	Y	3.03	4.35	2.92	5.50
RMS for chrominance	U	2.70	2.46	3.17	2.78
	V	1.80	2.82	3.03	2.47
Mean value of step size		14.01	16.93	15.03	17.84
Mean value of number of	Y	4.07	5.19	2.99	4.44
non-zero coefficients	C	2.04	2.04	1.63	1.51
	Y and C	8.53	4.70	2.57	4.20
Mean value of number of	Y	4.66	12.65	5.71	11.28
zeroes before the last NZ	C	0.00	5.82	3.40	2.85
	Y and C	119.00	11.61	4.98	10.59
Block type of MACRO	Intra	1	0	0	0
	Fixed	47	126	91	121
	Fixed MC	13	0	3	1
	Coded	578	49	59	49
	Coded MC	14	5	27	10
Block type of Y	Fixed	89	610	524	583
	Fixed MC	40	6	60	12
	Coded	337	90	78	95
	Coded MC	23	13	58	29
Block type of C	Fixed	419	341	299	349
	Coded	418	19	60	10
Number of bits	Macro attr.	62	383	630	397
	EOB	0	356	594	382
	MV	2808	25	139	56
	Coeff. DC	156	0	0	1
	Coeff. Y	75	2965	2074	3019
	Coeff. U	3941	76	198	42
	Coeff. V	3941	123	265	35
	TOTAL	3941	3931	3902	3937

Table 4: The results of format conversion filtering

STATISTICS RM6		DATE : 1988.11.22			
SEQUENCE :Osaka(1-164)					
MODIFICATION :None		SNR in 720*480			
FRAME		4/9CIF	CIF	4/9CIF	CIF
RATE		10Hz	10Hz	15Hz	15Hz
RMS for Y		7.62	6.43	7.91	7.09
SNR for Y		30.49	31.96	30.16	31.11
SNR for U		37.99	38.58	37.69	38.26
SNR for V		36.36	36.76	36.07	36.39
SNR for C		37.10	37.58	36.81	37.22
MEAN STEP SIZE		18.89	27.27	22.09	33.73
MEAN Numb. of	Y	5.10	3.13	3.96	2.50
NONZERO Coeff.	C	1.76	1.30	1.47	1.17
MEAN Numb. of	Y	12.98	7.64	12.24	6.69
ZERO Coeff.	C	3.24	1.52	2.90	1.24
Block	INTRA	0	2	0	1
Type	FIXED	108	271	116	285
of	CODED MC	26	56	21	41
MACRO	FIXED MC	2	14	3	17
	CODED	42	54	40	52
Block	FIXED	522	1207	551	1266
Type	CODED MC	75	127	53	81
of	FIXED MC	41	151	41	150
Y	CODED	82	99	75	87
Block Type	FIXED	340	770	348	778
of UV	CODED	20	22	12	14
MACRO ATTRIB.		438	729	397	662
End of Block		484	711	399	551
Motion Vector		180	475	136	391
INTRA	DC	4	14	2	7
Coeff.	Y	4604	3820	2900	2217
Coeff.	UV	176	134	86	67
Coeff.	TOTAL	5886	5884	3920	3895
Buffer Count		1720	2772	2164	3468