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SOURCE : France Télécom (CNET)

TITLE : Simulation results on a pel split compatible algorithm.

PURPOSE : Information

1. Introduction

CNET has been studying a "pel split" compatible algorithm which is in line with the reference compatible model as defined in (1). This work is carried out in cooperation with BT and Siemens which develop a similar algorithm, in order to have a candidate based on a "pel split" method for the MPEG2 Kurihama tests.

This document describes briefly the coding algorithm and gives simulation results on MOBCAL and FLOWER at 9 Mbit/s.

2. Description

The compatibility is ensured the same way as defined in (4). The input pictures are first down converted in a SIF25 format and encoded with a MPEG1 encoder to produce a core bitstream. The decoded MPEG1 pictures are then up converted to be used as a possible prediction for the coding of the enhanced picture (MPEG2 encoder). It has to be pointed out that if the bitrate devoted to the MPEG1 is "zero", the enhancement coder is a non-compatible MPEG2 scheme using the total bitrate.

A general diagram of the encoder is given in fig 1.

2.1 Processing of MPEG1 sequences

a) down conversion:

- skip even fields (50 Hz to 25 Hz)
- skip even lines of chrominance (4:2:2 to 4:2:0)
- pel subsampling (720 pels to 360 pels per line)
  7 tap filter = (-29,0,88,138,88,0,-29)

b) motion estimation :

- full search +/-7
- 1/2 pel accuracy

c) MPEG1 coder (modified SM3):

- format : SIF at 25 Hz.
- N = 10 ; M = 2
- Buffer 120 K (start at 30 K)
- bitrate: 2500 K (or 1150 K)
- same weighting on Y and C (see SM3 Y matrix) on INTRA only
- same quantizer stepsize on I, B and P pictures

d) upsampling:

- 6 tap filter = (-12,0,140,140,0,-12)

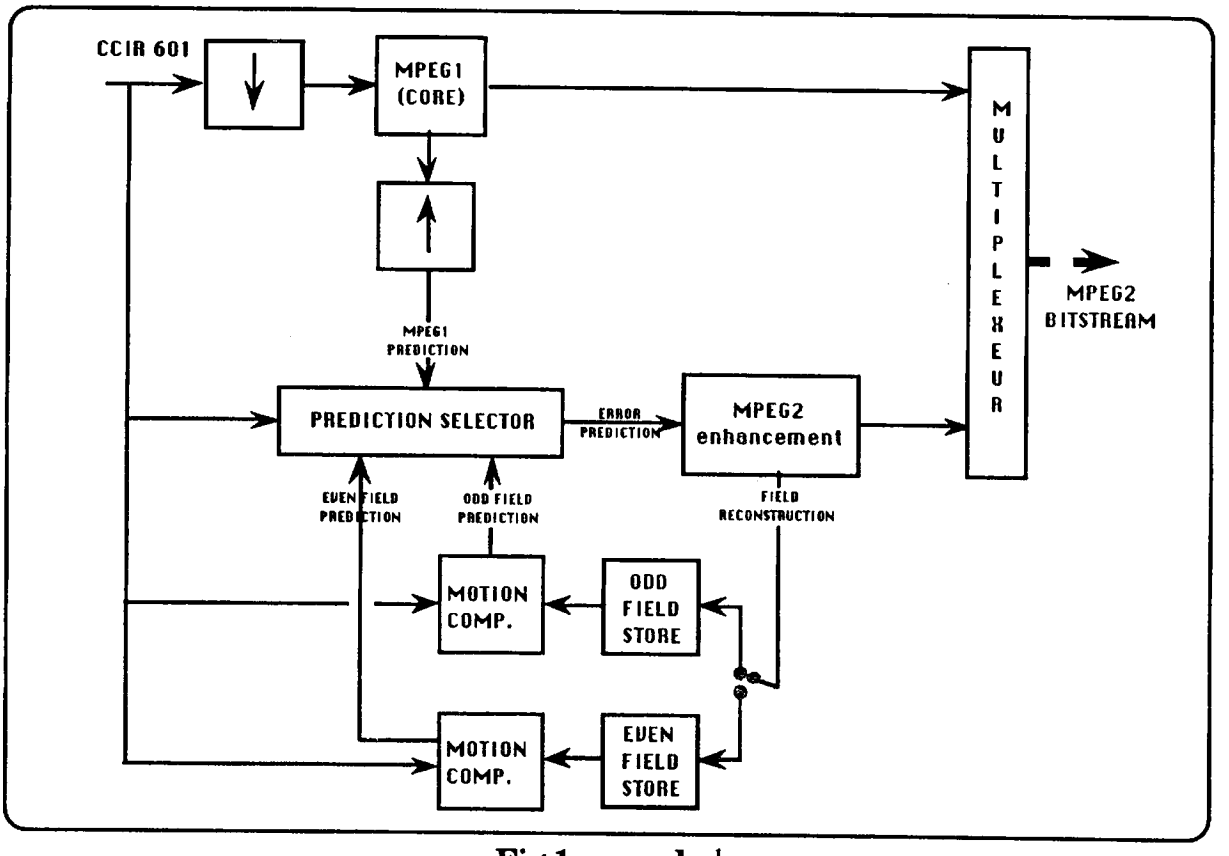

Fig 1 - encoder[1]

2.2 Processing of MPEG2 enhanced pictures

It operates on 50 Hz, 4:2:0 interlaced fields. The general structure (GOF, Frame Slice, MB, Block) is MPEG1 like.

a) processing of MV:

- on fields (odd/even)
- full search +/- 7
- 1/2 pel accuracy

[1] The first layer could also be a H.261 coder.

b) coding by enhancement MPEG2 coder:

*For INTRA pictures:

stepsize = Q/2

prediction = 0

*ODD fields:

stepsize = Q

prediction = MPEG1 or same parity previous picture. The method to select the prediction is based on the computation of the variance of the prediction error on a MB basis (odd previous decoded field or MPEG1 extrapolated field and then comparison with INTRA coding)

*EVEN fields:

stepsize = 2Q (the EVEN fields are coarsely encoded)

prediction = same or different parity previous decoded picture.

*Weighting of every field:same matrix as MPEG1 coder for Y and C

*Quantizer: Reconstruction = nG if $nG < X < (n+1)G$

*N = 20 fields (1 INTRA, 9 odd, 10 even)

*Buffer = 500 K, start at 125 K

*Bitrate : 9000 K - (BC)

BC = bitrate devoted to MPEG1 for compatibility - In case of BC=0, the MPEG2 coder works in a non-compatible mode.

BC = 0, 1150 K, 2500 K

3. Simulation results

This algorithm was applied on MOBILE & CALENDAR and FLOWER GARDEN. The following diagrams are related to the picture we have recorded on a D1 tape.

MPEG1 Coding

Sequence: MOBILE

Bitrate: 2500 K

Pictures[2]	I	P	B
SNR Y	27,33	29,06	28,8
SNR C	30,89	31,08	31,14
STEP SIZE	15,13	18,33	19,3
BITS/FIELD	213 K	112 K	67 K

Bitrate: 1150 K

Pictures	I	P	B
SNR Y	23,83	25	25,17
SNR C	28,55	28,69	28,82
STEP SIZE	27,53	32,98	33,06
BITS/FIELD	118 K	50 K	31 K

Sequence: FLOWER

Bitrate: 2500 K

Pictures	I	P	B
SNR Y	29,37	30,87	30,20
SNR C	31,45	31,74	31,87
STEP SIZE	11,87	17,52	19,66
BITS/FIELD	251 K	111 K	61 K

Bitrate: 1150 K

Pictures	I	P	B
SNR Y	26,92	26,79	26,48
SNR C	30	29,81	29,94
STEP SIZE	21,22	32,20	34,19
BITS/FIELD	152 K	48 K	26 K

MPEG2 COMPATIBLE Coding

Sequence: MOBILE

Bitrate: (1150 K) + 7850 K

Pictures[3]	I	O	E
SNR Y	30,96	30,28	26,79
SNR C	34,15	33,83	31,78
STEP SIZE	9,42	11,17	20,29
BITS/FIELD[4]	570 K	175 K	91 K

Bitrate: (2500 K) + 6500 K

Pictures	I	O	E
SNR Y	30,55	29,86	26,32
SNR C	33,79	33,38	31,43
STEP SIZE	10,22	12,21	22,24
BITS/FIELD	508 K	143 K	81 K

[2] I = INTRA, P= Predicted, B= bidirectional

[3] I= INTRA, O= ODD fields, E= EVEN fields

[4] for enhancement MPEG2

Sequence: FLOWER GARDEN

Bitrate: (1150 K) + 7850 K

Pictures	I	O	E
SNR Y	33,82	33,42	28,73
SNR C	35,37	34,70	31,88
STEP SIZE	5,93	9,76	21,31
BITS/FIELD	596 K	173 K	86 K

Bitrate: (2500 K) + 6500 K

Pictures	I	O	E
SNR Y	33,76	33,24	28,72
SNR C	35,15	34,39	31,87
STEP SIZE	6,20	10,55	21,64
BITS/FIELD	568 K	131 K	85 K

MPEG2 NON COMPATIBLE Coding

Sequence: MOBILE

Bitrate: 9000 K

Pictures	I	O	E
SNR Y	31,82	31,34	27,72
SNR C	35,01	34,68	32,35
STEP SIZE	7,82	9,34	17
BITS/FIELD	771 K	213 K	114 K

Sequence: FLOWER GARDEN

Bitrate: 9000 K

Pictures	I	O	E
SNR Y	33,92	33,64	29,57
SNR C	35,57	35,13	32,57
STEP SIZE	5,56	8,84	20,08
BITS/FIELD	625 K	205 K	114 K

4. Conclusion

The quality obtained at this stage of the work seems promissing and has to be compared with the results of other algorithm. Even if this two layer scheme which allows direct compatibility with MPEG1 does not provide as good picture as non compatible schemes it is always possible to switch off the compatible mode (it can be seen that there is a 1 dB gain).
Further studies are needed (MPEG1 upsampling, re-interlace, criterion to choose the prediction...).

References.

1- Compatible reference model - WG2 MPEG91
2 - Improvements of hybrid DCT coding - CCITT AVC-30 (source: Norway)
3 - Description of a compatible coding approach for MPEG1 and MPEG2 - CCITT AVC-45 (source: UK)
4 - CCITT AVC-65R