C C I T T
Question 4/XV
Specialist group on coding for visual telephony

Document # 210
March 87
San Jose

Title : VARIABLE BLOCKSIZE CODING ON THE REFERENCE MODEL N° 3

Source : France

1 - Introduction

This contribution describes an attempt to incorporate the variable block size concept in the hybrid coding scheme defined by the reference model n° 3.

Actually, the comparisons have been made with an improved reference model n° 3 combining :

- a new VLC for the block attributes (see # 204)
- a VLC for the scanning class indexes (see # 204)
- a modification of the threshold of the quantiser
  T = g instead of T = 1.5 g (see # 206)

Two ways have been investigated depending on the location of the detection sub-block : after the motion estimation process (model A) or before the motion estimation process (model B).

2 - Main features of the variable block size technique

The variable block size scheme has been depicted in # 93, # 94 and has been applied to small block sizes (8 x 8, 8 x 4, 4 x 8, 4 x 4) in # 156.

To decide whether a sub-block is moving or not, the sum of the absolute difference values over the sub-block is compared to a threshold (which is a function of the quantiser step).

In order to maintain the extra overhead at a reasonable level, it has been decided to only take into account the rectangle sub-blocks 4 x 8 and 8 x 4. Let be S0, S1, S2, S3 the four 4 x 4 sub-blocks, the simple following rule has been employed to eliminate the 4 x 4 sub-blocks :

4 x 4 moving sub-blocks			extension to 4 x 8 or 8 x 4
S0	S0	S1	S0 + S1
S1			S1 + S2
S2	S3	S2	S2 + S3
S3			S3 + S0

Model A : sub-block detection after motion compensation

In this approach, the block matching motion compensation technique is performed on the 8 x 8 blocks. The sub-block detection is then applied and according to the previous rule, the following configurations are allowed :

(1) All the block is moving
(2) All the block is fixed
(3) The half block located on the left hand side is moving
(4) The half block located on the right hand side is moving
(5) The half block located at the bottom is moving
(6) The half block located at the top is moving.

When there is an 8 x 8 moving block the coding is performed according to the improved reference model n° 3. Otherwise, the technique depicted in # 93 consists in completing the 8 x 4 block by zero-pixels to obtain an 8 x 8 block and applying the 8 x 8 transform. When scanning the coefficients in the transformed domain, one has to eliminate one row out of two (or one column out of two).

Only one scanning class has been used for the sub-blocks, and the same quantizer has been employed as for normal blocks (same value of the step g).

Addressing

Luminance

There are 8 different cases for the luminance blocks (four scanning classes for the 8 x 8 blocks and four 8 x 4 or 4 x 8 sub-blocks) for inter or compensated coded blocks (intra coding mode is never used for sub-blocks). A 3 bit fixed length code has been employed for transmitting the overhead information :

FLC		
0 0 0	block type (1) with scanning class 1	8 x 8
0 0 1	" " " " " " 2	8 x 8
0 1 0	" " " " " " 3	8 x 8
0 1 1	" " " " " " 4	8 x 8
1 0 0	half block (5) corresponding to sub-block	8 x 4
1 0 1	" " (6) " " "	8 x 4
1 1 0	" " (7) " " "	4 x 8
1 1 1	" " (8) " " "	4 x 8

Chrominance

As there is only one scanning class for the chrominance blocks, only five cases are possible, and a variable length code has been used for the overhead information :

VLC			
1	block type (1)	zig-zag scanning	8 x 8
0 0 0	half block (5)	corresponding to sub-block	8 x 4
0 0 1	" " (6)	" " " "	8 x 4
0 1 0	" " (7)	" " " "	4 x 8
0 1 1	" " (8)	" " " "	4 x 8

Model B : sub-block detection before motion compensation

In this second approach, the sub-block detection is first performed. The block matching motion compensation technique is then carried out on either 8 x 8 blocks, 4 x 8 or 8 x 4 sub-blocks.

Because of inter/MC/not coded sub-blocks the sub-block side information cannot be combined with the scanning class indexes : a new attribute is then necessary.

3 - Conclusion

Model A performs better than model B.
The variable blocksize scheme gets better coding performance, in terms of SNR, for "checked Jacket" sequence only.

Sequence	RM3 + modification	Variable blocksize Model A
C.T.	37.99 DB	38.23 DB
COST	37.45 DB	37.46 DB
M.A.	39.88 DB	39.87 DB

If in the past, we had demonstrated the interest of the variable block size technique in the case of 16 x 16 transform coding, it does not stand to reason for 8 x 8 blocks.

Actually, the bits saved by coding the transformed coefficients by means of a N/2 length DCT are lost in addressing (this point is less critical when the transform size is larger). Moreover, when there is a moving sub-block in the pel domain, very often the coefficients are concentrated in a sub-block in the transformed domain and the adapted scanning classes technique can cope with this problem.

However, the subjective picture quality seems better, for the three sequences, even if there is no gain in terms of SNR : the pictures look sharper when using the variable block size scheme than when using the improved RM3. Further study sems necessary.

It is not suggested to include the variable block size technique in the first flexible hardware prototype.

[Ref.]

(1) CCITT SG XV, Document # 93 "The use of a N-DCT device to perform a N/2-DCT", FRANCE

(2) CCITT SG XV, Document # 94 "Variable blocksize hybrid coding scheme", FRANCE

(3) CCITT SG XV, Document # 156 "Block type identification method, variable block size and overall performance", NTT, KDD, NEC and FUJITSU