

CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-415
January 1993

SOURCE :Japan
TITLE :Results of Non 8x8 DCT Core Experiment(Q.5) in low delay mode
PURPOSE :Information

1. Introduction

Speaking generally, the low delay coding with IPP... structure lowers coding efficiency and increases noises mainly referred to as "mosquito noises". On the other hand, as reported in the past, adaptive 8x1/8x8 DCT produces good coding performance and reduces mosquito noises around edge part of images. (refer to MPEG92/444, 445.) Therefore the adaptive 8x1/8x8 DCT will work effectively in the low delay coding. This document describes experimental results of the adaptive 8x1/8x8 DCT coding in low delay mode(Core Experiment Q.5).

2. Experiment

2.1. General condition

TM2
-GOP: M=1(IPP..),Fr structure,NO forced intra
-Prediction: Frame/field adaptive
-MV search: +/-15 pel/frame
-Picture format: 4:2:0
-Sequences: Flower Garden(FLG), Mobile&Calendar(MBC),
Mobile&Calendar+Horizontal text(MBC+H),
Popple+Vertical text(PPL+V)
(30 frame/sequence; 1sec.)
-Bit rate: 4Mbps(FLG,MBC,MBC+H), 9Mbps(PPL+V)
-Rate control: Step 1-2

8x1 DCT
-Definition, Quantization matrix,
Scan order of DCT coefficients,
Coding of DCT coefficients: These are specified in TM3 Q.5
-8x1/8x8 DCT decision: See ANNEX1.

2.2. Experimental results

Table1. SNR of the Luminance Signal(dB)

	FLG	MBC	MBC+H	PPL+V
TM2	30.16	27.29	25.15	34.91
TM2+8x1/8x8DCT (Decision method 1)	30.71(+0.55)	27.75(+0.46)	25.78(+0.63)	35.31(+0.40)
TM2+8x1/8x8DCT (Decision method 2)	30.66(+0.50)	27.52(+0.23)	25.28(+0.13)	35.05(+0.14)

Thus the adaptive 8x1/8x8 DCT with decision method 1 produces good results in SNR and betters subjective image quality significantly, while the adaptive 8x1/8x8 DCT with decision method 2 does not reduce the mosquito noises very much particularly around the text.

3. Syntax simplification

3.1. Modification to simplify syntax

As mentioned above, the adaptive 8x1/8x8 DCT with decision method 1 improves coding performance. However, it should complicate the bit stream syntax in block layer because it codes the 8x1 DCT coefficients with the different scheme from for 8x8 DCT coefficients. i.e.,

Code the 8x1 DCT coefficients as follows;

a) In case of Intra block

DC: Calculate the difference from upper one in a 8x8 block, and code them using DC-VLC. The top one is representative value for taking inter-8x8 block DC difference.

AC: Use the same coding scheme as for the 8x8 DCT coefficients.

b) In case of non-Intra block

Use the same coding scheme as for the 8x8 DCT coefficients.

The syntax simplification is achieved by coding the 8x1 DCT coefficients with the same scheme as for the 8x8 DCT coefficients. i.e., in case of Intra block, the differential DC values of 8x1 DCT coefficients are coded using AC-VLC except the left-top one (See ANNEX2.). The simplified syntax can be shown as follows. The underlined part is added to the original TM3 syntax.

```

block(i){
    if (pattern_code[i]){
        one_dimensional_DCT                                1          uimsbf
    if (macroblock_intra){
        if (i<4){
            dct_dc_size_luminance                        2-7          vlclbf
            if (dct_dc_size_luminance != 0)
                dct_dc_differential                      1-8          uimsbf
        }
        else{
            dct_dc_size_chrominance                        2-8          vlclbf
            if (dct_dc_size_chrominance != 0)
                dct_dc_differential                      1-8          uimsbf
        }
    }
    else{
        dct_coef_first                                    2-28          vlclbf
    }
    if (picture_coding_type != 4){
        while (nextbits() != '10')
            dct_coeff_next                                3-28          vlclbf
        end_of_block                                       2              "10"
    }
}
}

```

3.2. Experimental results

Table2. shows the experimental results in case of applying modification mentioned above. For all sequences, the coding efficiency reduction due to the modification is negligible and it is difficult to recognize the difference of the image quality.

Table2. SNR of the Luminance Signal(dB)

	FLG	MBC	MBC+H	PPL+V
TM2	30.16	27.29	25.15	34.91
TM2+8x1/8x8DCT (Decision method 1)	30.71(+0.55)	27.75(+0.46)	25.78(+0.63)	35.31(+0.40)
TM2+8x1/8x8DCT (Decision method 1 with simplified syntax)	<u>30.69(+0.53)</u>	<u>27.73(+0.44)</u>	<u>25.75(+0.60)</u>	<u>35.31(+0.40)</u>

4. Conclusion

The experimental results on the adaptive 8x1/8x8 DCT in low delay mode show that

- 1) Applying the adaptive 8x1/8x8 DCT to the low delay coding produces good performance especially in terms of the mosquito noise reduction.
- 2) The decision method 1 is preferable on the 8x1/8x8 DCT adaptation.
- 3) The syntax simplification can be achieved without significant coding efficiency reduction.

END

ANNEX1. 8x1/8x8 DCT decision

The 8x1/8x8 DCT decision is performed on a block basis.

Decision method 1:

a) Non-Intra block

1. Perform 8x1 and 8x8 DCT.
2. Calculate the summation of all absolute coefficients of 8x1 and 8x8 DCT.
3. Select the smaller one.

b) Intra block

1. Perform 8x1 and 8x8 DCT.
2. Take the difference of DC coefficient from the upper one in 8x1 DCT block.
3. Calculate the summation of all absolute coefficients of 8x1 and 8x8 DCT except the left-top one. This operation is shown as follows.

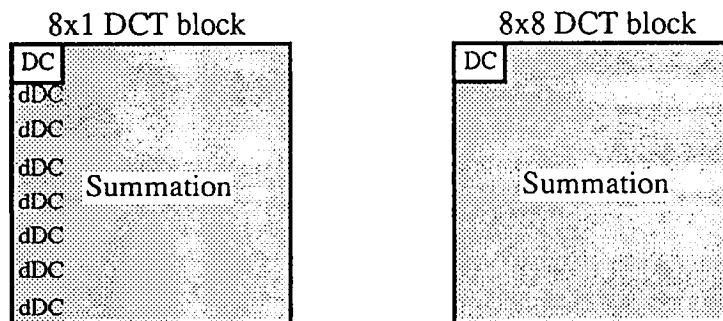


Fig A1.1. Decision method1 for Intra block

4. Select the smaller one.

Decision method 2:

Calculate vertical correlation within a 8x8 block.

```
VAR = COR = 0
for (Pix=0; Pix<8; Pix++){
    for (Line=0; Line<7; Line++){
        VAR += O(Pix,Line)*O(Pix,Line);
        COR += O(Pix,Line)*O(Pix,Line+1);
    }
}
if (COR<VAR*p/q)
    perform_8x1DCT();
else
    perform_8x8DCT();
```

where p=1, q=3

ANNEX2. Modification of VLC coding to simplify syntax

To simplify syntax, VLC coding for 8x1 DCT coefficients should be modified as follows.

- AC coefficients in Intra block and all coefficient in non-Intra block
Code them in the same manner as for 8x8 DCT coefficients.
- DC coefficients in Intra block
Take the difference of DC coefficient from the upper one, and code them with AC-VLC except the left-top one.

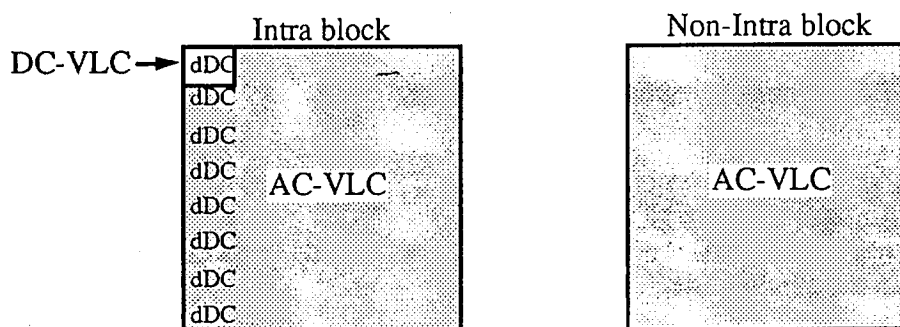


Fig A2.1. VLC coding for 8x1 DCT coefficients to simplify syntax