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Title: Results of Quantization Experiments

Purpose: Discussion

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1 Introduction

In this document, results of three quantization experiments are shown.

2 Result of Q.1.1 (Independent Scanning)

- M= 1 and 3, Frame structure,
- Prediction: Frame or Frame/Field
- DCT: Frame or Frame/Field (Rate Control Step 3)
- Each sequence : 0 - 149
- Decision: A Priori inverse scann (Detect longer zero-run in two inverse scanns)

Independent scanning results are summerized in Table 1 to 3. Table 1 shows M=1 result, and Table 2 shows M=3 result. The left half of the tables are compared with Frame prediction and Frame DCT and right half part is compared with Frame/field prediction and Frame DCT.

Relative gains of Frame/field DCT and Z/V scann from Frame prediction or Frame/field prediction are shown with luminance SNR. Generally Z/V gain is greater than the gain of Frame/field DCT except few sequences.

Table 3 shows relative gains of Z/V from TM2 (Frame/field prediction and DCT). The fact that the simple switching of scanning can extract some gain from TM2 (Frame/field Adaptive prediction and adaptive DCT) is not be ignored. The gain for M=1 is greater than for M=3.

Table 1. Luminance SNR (4Mb/s, M=1, N=15)

| | F pred | +F/f DCT | +Z/V | F/f pred | +F/f DCT | +Z/V |
|----|------------|----------------|----------------|------------|----------------|----------------|
| FL | 27.30(0dB) | 27.40(+0.10dB) | 27.81(+0.51dB) | 27.65(0dB) | 27.75(+0.10dB) | 28.13(+0.48dB) |
| MC | 25.82(0dB) | 25.89(+0.07dB) | 25.93(+0.11dB) | 26.05(0dB) | 26.12(+0.07dB) | 26.16(+0.11dB) |
| BC | 26.60(0dB) | 26.98(+0.38dB) | 27.13(+0.53dB) | 27.29(0dB) | 27.63(+0.34dB) | 27.77(+0.48dB) |
| BS | 28.32(0dB) | 28.86(+0.54dB) | 28.95(+0.63dB) | 29.44(0dB) | 29.97(+0.53dB) | 29.98(+0.54dB) |
| FT | 31.22(0dB) | 32.23(+1.01dB) | 32.01(+0.79dB) | 32.10(0dB) | 33.05(+1.05db) | 32.78(+0.68dB) |

Table 2. Luminance SNR (4Mb/s, M=3, N=15)

| | F pred | +F/f DCT | +Z/V | F/f pred | +F/f DCT | +Z/V |
|----|------------|----------------|----------------|------------|----------------|----------------|
| FL | 28.68(0dB) | 28.77(+0.09dB) | 29.10(+0.42dB) | 29.67(0dB) | 29.72(+0.05dB) | 30.00(+0.33dB) |
| MC | 28.09(0dB) | 28.14(+0.05dB) | 28.21(+0.12dB) | 28.45(0dB) | 28.51(+0.06dB) | 28.56(+0.11dB) |
| BC | 27.10(0dB) | 27.43(+0.33dB) | 27.55(+0.45dB) | 27.55(0dB) | 27.80(+0.25dB) | 27.91(+0.36dB) |
| BS | 30.16(0dB) | 30.69(+0.53dB) | 30.62(+0.46dB) | 31.04(0dB) | 31.52(+0.48dB) | 31.43(+0.39dB) |
| FT | 31.54(0dB) | 32.48(+0.94dB) | 32.21(+0.67dB) | 32.15(0dB) | 32.94(+0.79dB) | 32.69(+0.54dB) |

Table 3. Effect from F/f Pred., F/f DCT

| | M=3 F/f pred, F/dct | +Z/V | M=1 F/f pred, F/dct | +Z/V |
|----|---------------------|----------------|---------------------|----------------|
| FL | 29.72(0dB) | 29.98(+0.26dB) | 27.75(0dB) | 28.14(+0.39dB) |
| MC | 28.51(0dB) | 28.58(+0.07dB) | 26.12(0dB) | 26.19(+0.07dB) |
| BC | 27.80(0dB) | 27.97(+0.17dB) | 27.63(0dB) | 27.87(+0.24dB) |
| BS | 31.52(0dB) | 31.75(+0.23dB) | 29.97(0dB) | 30.31(+0.34dB) |
| FT | 32.94(0dB) | 33.11(+0.17dB) | 33.05(0db) | 33.28(+0.23dB) |

3 Results of Q.5 (8x1 DCT)

- M=3,Frame structure,
- Prediction: Frame/Field
- DCT: Frame/Field
- Rate Control step 2
- Each Sequence : 0 - 149
- 8x8 / 8x1 Decision: decision method (1)

The luminance SNR of 8x1 DCT is greater than TM2. The gain is comparable to switching of scanning.

I have one question to 8x1 DCT, which is the quantization step, for example, Intra DC 8x8 DCT and 8x1 DCT have not the same value even if on the same luminance area. The DC prediction from 8x1 to 8x8 (and vice vasa) will not have good result. The same question is for AC coefficients. Quantize Matrix value will not have equal meaning between 8x1 and 8x8.

Table 4. 8x1 DCT Results (4 Mb/s)

| | | |
|---------|-------|-----------------|
| Flower | 30.37 | 30.56 (+0.19dB) |
| Mobile | 29.40 | 29.71 (+0.31dB) |
| Bus | 32.34 | 32.67 (+0.33dB) |
| Bicycle | 28.56 | 28.77 (+0.21dB) |
| Ftball | 33.69 | 33.68 (-0.01dB) |

Table 5. 8x1 DCT Results (9 Mb/s)

| | | |
|---------|-------|-----------------|
| Flower | 34.77 | 34.99 (+0.22dB) |
| Mobile | 33.53 | 33.97 (+0.34dB) |
| Bus | 36.68 | 37.01 (+0.33dB) |
| Bicycle | 33.22 | 33.57 (+0.35dB) |
| Ftball | 37.97 | 38.03 (+0.06dB) |

4 Result of Q.4 NTC

NTC (without Option) is tested and the resulting Demo tape is prepared for the comparison with TM2, 8x1 DCT, Rate Control Change, and Rate Control Change and Z/V. Test sequences are Mobile.h(0-149) and Pople.v(0-149) those are with text.

NTC provides big SNR gains for the sequences(Table 6), but NTC decreases SNR for the normal sequences(Table 7).

Subjective results from Tape Demo are described in Table 6. The main effect of NTC will be "flat halo", but the quantization problem can be find. The big luminance changes of the edge of characters are not to be desired. The qp value near 31 will cause this effect because NTC values are in +-255.

Rate Control Change:

Frame DCT only, $K_b=2$, initial values of $\{X_i, X_p, X_b\} = \{200, 50, 32\} * \text{Bitrate} * 1000 / 115$, Activity measurements "act" and " N_{act} " are as follow:

$$act = (MIN_{blk}(1 + var_{blk}))^{\frac{1}{4}}, \quad N_{act} = \frac{10 * act + avg_act}{act + 10 * avg_act}$$

Rate Control Change and Z/V:

Same rate control condition as R.C. and use the bit for Frame/field DCT is for Zigzag/Vertical scannig.

Table 6. Effect of NTC, 8x1DCT and Rate Control Change etc.

| Algorithms | mob.h | pop.v | Noise Shape | Noise Amount |
|------------|----------------|----------------|--------------|--------------|
| TM2 | 24.48(0db) | 27.89 (0dB) | | |
| NTC | 25.58(+1.10dB) | 29.17(+1.28dB) | Big change | Not Small |
| 8x1 | 24.92(+0.44dB) | 28.03(+0.14dB) | Small change | Small |
| R.C. | 24.66(+0.18dB) | 28.04(+0.15dB) | No change | Small |
| R.C.& Z/V | 24.75(+0.27dB) | 28.10(+0.21dB) | No change | Small |

Table 7. SNR results of NTC for the Normal Sequences.

| | | |
|----|------------|----------------|
| FL | 29.72(0dB) | 29.59(-0.13dB) |
| MC | 28.51(0dB) | 28.43(-0.08dB) |
| BC | 27.80(0dB) | 27.54(-0.26dB) |
| BS | 31.52(0dB) | 31.25(-0.27dB) |
| FT | 32.94(0dB) | 32.74(-0.20dB) |