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TITLE : PERFORMANCE OF F-CODER IN DCT-BASED ALGORITHM

1. Introduction

F-coder is expected to efficiently encode impulsive or spatially high-passed signal which is not suitable for transform coding. This document describes the experimental results on picture quality improvement by the F-coder for motion video as well as graphics sequences.

2. Picture Quality Improvement by F-coder

(a) Motion Video Sequence (See Fig.1.)

Application of F-coder reproduced better picture quality and higher SN ratio than DCT-based algorithms without F-coder. The improvement was by about 0.3 dB for Checked Jacket sequence for a given information rate. With respect to generated information rate, about 10 % reduction was achieved while retaining the same SN ratio. It seems that improvement is smaller for other test sequences than for Checked Jacket.

(b) Graphics Image Sequence (See Table 1.)

Two similar but different black-and-white document sequences (1 sec each) were used for encoding graphics image sequence at the moment. These two sequences were connected in turn and processed as a motion video sequence. Six quantizing characteristics were used. According to the result shown in Table 1, a DCT-based algotithm with F-coder reproduced 2-3 dB better picture quality. In particular, when the finest quantizing characteristic with step-size=1 and dead-zone=1 is used, F-coder successfully results in reproducing the original input sequence at the decoder ~~without distortion by compression . On the other hand, slight but~~ visible distortion still exists in the reproduced sequence even if the finest quantizing characterstic (truncation of coefficient values to integer) is applied to DCT coefficients.

3. Hardware Implementation of F-coder

(a) Scalar Quantization

Negligible.

(b) Entropy Coder/Decoder

Hardware complexity heavily depends upon selection of entropy coding methods. Similar code conversion methods can be employed in representing DCT coefficients and F-coder output. The hardware complexity for F-coder will be a little smaller than that of code converter of DCT coefficients.

4. Conclusion

It is confirmed that picture quality can be improved by applying F-coder. However, remarkable improvement is not shown at present for prepared sequences.

Further study is necessary due to the following reasons.

(1) Effectiveness of F-coder should be investigated for color graphics images scheduled to be distributed by British Telecom.

(2) F-coder will be effective for large n's (n x 384 kbit/s) eg. 4 or 5. As long as F-coder is implemented in the subrate codec even as an option, the same picture quality as Part-1 or Part-3 /H.120 codecs will be easily retained for document-like images.

(3) Without F-coder, slight distortion is visible in sharp edge parts due to quantization of DCT coefficients. This kind of distortion will be more visible and sometimes annoying when it is reproduced in real time processing by hardware than in simulation. Only limited number of sequences are investigated in simulation study.

In conclusion, further study is still necessary even at present, taking into account the first two reasons above. In order to finalize the specification of the subrate coding algorithm at the earliest possible time, it can be agreed that F-coder should not affect the essential coding part.

Table 1 Simulation Results for Graphics Image Sequence

Simulation study results are shown here for DCT-based algorithm with and without F-coder. The graphics image sequence employed in this experiment was black-and-white. A quantizing characteristic was switched to a finer one at frame numbers 1, 2, 3, 4, 5 and 11, respectively.

Quantizing Characteristics;

(Dead-zone, Step-size)

DC compomemt: x 1/2048
AC component: x 1/256
SQ : x 1/256 for F-coder

Frame #	1	2	3	4	5-10	11-30
DC	32.32	16.16	8.8	4.4	4.4	4.4
AC	32.32	16.16	8.8	4.4	2.2	1.1
SQ	32.32	16.16	8.8	4.4	2.2	1.1

Generated Information Rate and SN Ratio;

Frame #	without F-coder		with F-coder (DCT+SQ)	
1	34Kbit	27.9dB	34+13=47Kbit	29.3dB
2	26Kbit	30.9dB	19+15=34Kbit	32.1dB
3	69Kbit	35.3dB	47+25=72Kbit	36.9dB
4	89Kbit	40.0dB	55+31=86Kbit	41.8dB
5	90Kbit	43.1dB	50+46=96Kbit	45.3dB
6	16Kbit	43.3dB	3+ 6= 9Kbit	45.3dB
7	11Kbit	43.3dB	3+ 6= 9Kbit	45.3dB
8	9Kbit	43.4dB	3+ 5= 8Kbit	45.3dB
9	8Kbit	43.4dB	2+ 3= 5Kbit	45.3dB
10	7Kbit	43.4dB	2+ 3= 5Kbit	45.3dB
11	104Kbit	45.5dB	47+95=142Kbit	48.9dB
12	30Kbit	45.8dB	4+ 5= 9Kbit	48.9dB
13	20Kbit	46.0dB	3+ 5= 8Kbit	48.9dB
14	17Kbit	46.0dB	3+ 4= 9Kbit	48.9dB
15	15Kbit	46.1dB	3+ 4= 7Kbit	48.9dB
16	15Kbit	46.1dB	3+ 3= 6Kbit	48.9dB
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↑ Information Rate by F-coder

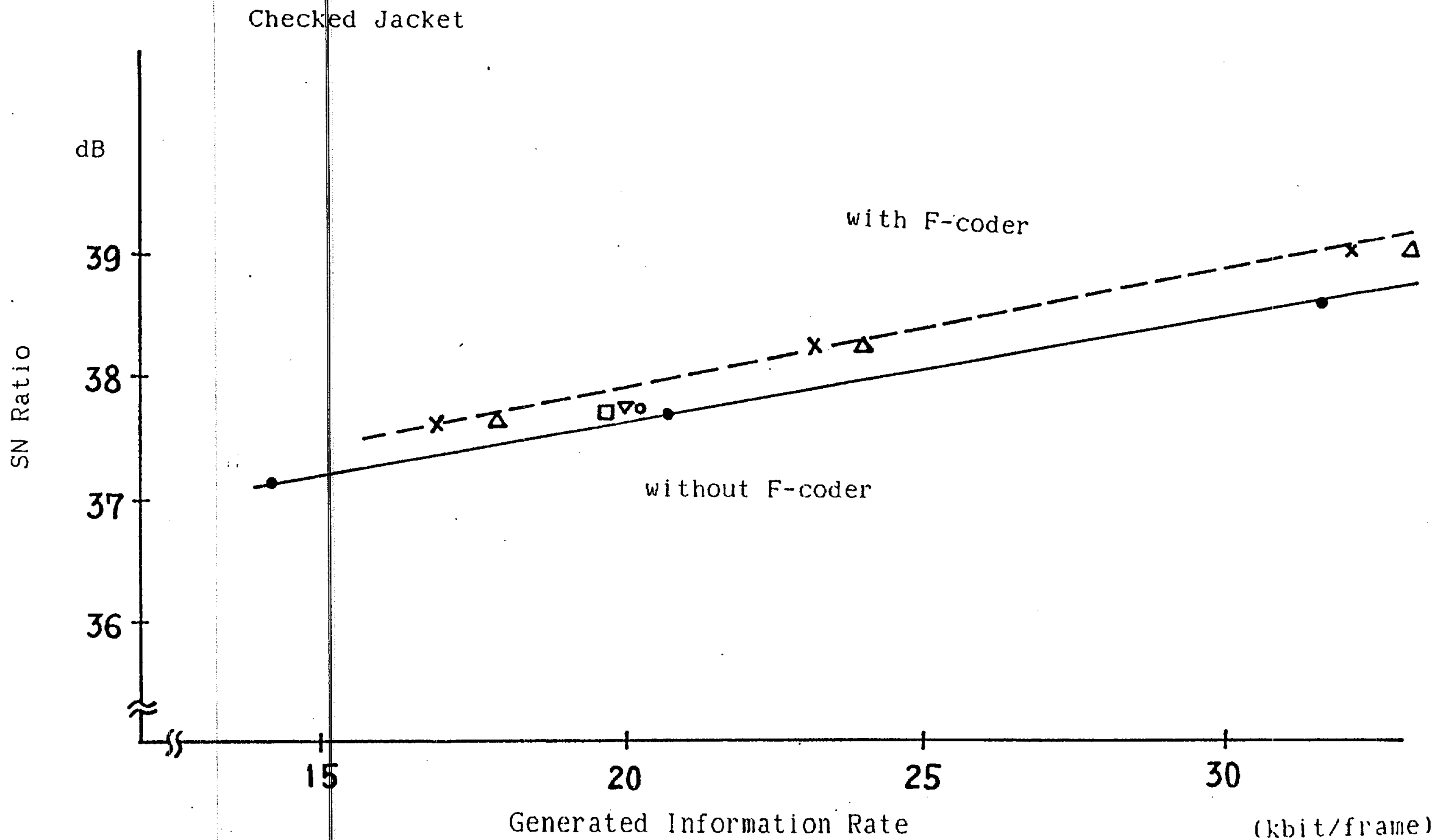

Fig. 1 Coding Performance Comparison of DCT-based Algorithm with and without F-coder