CCITT SG XV
Specialists Group on Coding for Visual Telephony

Document #151
November 1986

Source: NTT, KDD, NEC and FUJITSU

Title: Effect of plural variable word length code

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1. Introduction

This document treats "plural variable word lenth code (P-VWLC) set" which possibly improves coding efficiency in the framework of "future inclusion." It describes configuration of the code set and shows that P-VWLC is more efficient than "single VWLC (S-VWLC)" when we compare coding efficiency.

The following configuration is proposed:

(1) One VWL code set is assigned to all coefficients other than previous-to-EOB coefficients

(2) The other VWL code set in which codes have the same code set but are arranged in a different order, is assigned to the previous-to-EOB coefficients.

2. Comparison of coding efficiency

We compare the following four sets:

Code set (1) S-VWLC set used in the "reference model"
Code set (2) S-VWLC set designed as optimum code set
Code set (3) Two-VWLC sets designed as optimum
Code set (4) Two-VWLC sets designed based on "reference model" code set (proposed method).

Here, for the "code set (3)", first, previous-to-EOB coefficients are separated from the other coefficients, then, an optimum code set is designed to each of them. The "code set (4)" has the same code set with "reference model" for coefficients other than previous-to-EOB, as well as another VWL code set in which codes are the same but in a different order for previous-to-EOB coefficients.

2.1 Design of code set

(1) Design of "Code set (1)" (optimum S-VWLC)

To design an optimum S-VWLC, first, histogram of quantizing levels is calculated based on the coding algorithm of "reference model", then an optimum (Huffman) code set is designed using this histogram.

(2) Design of "Code set (3)" (Two optimum VWLC set)

Two optimum code sets are designed here. To design an optimum VWLC for coefficients of previous-to-EOB, histogram of quantizing levels is calculated first, then Huffman code set is designed using this histogram. To design a code set for coefficients other than

previous-to-EOB, the same procedure described above is introduced.

2.2 Simulation results

Table 1 shows code length for the four code sets. Table 2 shows information generation rate of the four VWLC sets obtained by simulation, in which above four code sets are applied to reference model simulation." Here, information generation rate is normalized by the rate of reference model. All the test sequences, Miss America, Checked Jacket and Split-Trevor are used. Table 2 shows that:

(1) The coding efficiecy of code set (1) and code set (2) is almost the same. The code set (1) is then quite reasonable if we use S-VWLC set.

(2) If we introduce two independently designed code set (code set 3), coding efficency is improved by 6.5 percent comparing code set (1) which correspond to 1.5 bit/coded-block gain.

(3) If we introduce code set (4) which is a sigle code set arranged in different order for previous-to-EOB coefficients, we have 4.2 percent (1 bit/coded-block) gain.

Overall simulation is performed by using obtained code sets. Figure 1 shows the simulation results for each test sequence.

3. Configuration of two-VWLC set

Experience shows that code set (3) using two optimum code sets gives the best efficiency. Considering implementation of code set (3), there exists difficulty. In the receiving side, the code set table for previous-to-EOB coefficients has to be changed, however, it cannot be detected because the position of previous-to-EOB code can be identified only after EOB is detected.

Three countermeasures are studied:

(a) Replacing the code of "previous-to-EOB coefficient" after EOB code

(b) Replacing the code of "previous-to-EOB coefficient" on top of the sequence in the block

(c) Introduction of the same code system for both "previous-to-EOB coefficients" and "the other coefficients" which corresponds to code set (4).

Although the coding efficiency of (c) is lower by 2 percent than (a), or (b), we propose (c) because of its hardware simplicity.

3. Conclusion

The following P-VWLC is proposed considering coding efficiency and hardware simplicity.

(1) One VWL code set is assigned to all coefficients other than previous-to-EOB coefficients

(2) The other VWL code set in which codes have the same code set but are

arranged in a different order, is assigned to the previous-to-EOB coefficients.

In addition, the DC coefficients for Intra-mode block can be assumed that the level distribution is uniform, then, it can be suggested that fixed length code is assigned for intra dc coefficients. As to the introduction of VWLC for Inter-mode DC coefficients, we need further study related to quantizing characteristics.

Table 1 The code length of VWLCs

INDEX	Code set number					
	(1)	(2)	(3)		(4)	
	RM	One optim. code	2 optim. code		2 code set	
			Before EOB	else	Before EOB	ELSE
-9	16	11	14		16	
-8	16	11	13		16	
-7	16	10	12		9	
-6	9	9	10		8	
-5	8	9	10	Same	7	
-4	7	8	8		6	
-3	6	6	7		5	
-2	5	5	5	with	3	Same
-1	3	3	1		1	
0	1	1	15		16	
1	3	3	2	one	3	with
2	5	5	4		5	
3	6	6	7		6	
4	7	7	8	optim.	7	RM
5	8	8	10		8	
6	9	9	11		9	
7	16	10	12	code	16	
8	16	10	14		16	
9	16	11	14		16	
EOB	3	3	-		-	

Table 2 Information generation rate using VWLCs (%)

Code set number					
(1)	(2)	(3)		(4)	
RM	One optim. code	2 optim. code		2 code set	
		Before EOB	else	Before EOB	ELSE
100	99.3	93.5		95.8	