CCITT Study Group XV
Working Party XV/1
Specialists Group on Coding for Visual Telephony

Doc.#160
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Source : NTT,KDD,NEC and FUJITSU

Title : Effect of Transmission Errors (For information)

1.Introduction

Simulation was carried out to study effect of transmission errors using Reference Model 2 (RM2). As an approximation , transmitted data was intentionally substituted for or changed by erroneous data before decoding at the receiver.

2.Simulated Transmission Errors

An experimental blockdiagram for studying effect of transmission errors is shown in Fig.1. Reference Model 2 (RM2) is used here. In Fig.1 , FCOD (Interframe Coder) sends the following data (1)-(5) as a GOB data through a transmission line.

(1) SYNC
(2) MCV (Motion Vector)
(3) BA (Relative Block Address)
(4) B DATA (Block Type,Classification Index)
(5) Q DATA (Quantized Coefficients)

These data are sent to VLC Coder (VLC-COD) to be entropy coded in accordance with a transmission format. Transmission errors in practice occur on a transmission line between VLC-COD (VLC-Coder) and VLC-DEC (VLC-Decoder). In this experiment , however , the transmission line was approximanted as shown in Fig.1 where only the effective bits from FCOD are sent directly to FDEC (Interframe Decoder). Transmission errors are assumed to occur on the approximated transmission line between FCOD and FDEC. Without transmission errors , the output from VLC-DEC would exactly coincide with the output of FCOD. When a transmitted code with error is provisionally decoded as a code with different magnitude or definition , decoding can be continued , though it may be incorrect. It can be called "provisionally decodable". In many cases it is impossible to decode , even if provisionally , data with error when variable word-length codes are employed. A countermeasure at the receiver is needed.

Example : Provisionally decodable case [1]

(1) Assuming that a code word 000010 (seventh code in Table 4/Doc.122) is changed to 000011 due to a bit error at the LSB , it can be decoded without increasing the number of samples in a GOB. No error would be detected at the

receiver. This is a typical "provisionally decodable" example.

(2) Assuming that a code word 000010 is transmitted and the third bit (0) is changed to 1 due to channel noise , it would be decoded as two code words i.e. 001 and 010 corresponding to the second and the third code , respectively.
Since the number of sample in a GOB will increase in this case , decoding will result in failure at the end of the GOB. A countermeasure is needed.

3.Experimental results

In transmission error effect study shown in this document and VTR demonstration , parameters were chosen so as to reproduce sequences with clearly visible distortion.

(1) Transmission error in MCV

If differential motion vectors are transmitted through a noisy transmission line , decoded motion vectors will have an off-set value after error has occurred. This is realized by adding a constant vector to motion vectors preceded by the error.

Miss America #71 start (Error frame #81)
(a) Block location : (22,23)
Error in horizontal component : (10, 0)
(b) Block location : (22,23)
Error in vertical component : (0,10)
(c) Block location : (22,23)
Error in horizontal
and vertical components : (10,10)

(2) Tramsmission error in BA

A relative block address code in error will result in a shorter or longer run of insignificat blocks. If a decoded BA code shows a 10 blocks shorter run , prediction error information would be added to samples in the blocks which are 10 blocks to the left. Here , transmission error is assumed to occur at the first block in a GOB. That is , every transformed prediction error information is shifted 10 blocks to the left and added to prediction signals.

Miss America #71 start (Error frame #81)
Block NO.1 , GOB NO.17

(3) Transmission error in B DATA (Block Type)

Simulation was carried out in the case when inter mode block was decoded as intra mode block at the receiver. An intra/inter mode flag showing interframe mode block was changed to a intraframe mode block.

Miss America #71 start (Error frame #81)
Block location : (24,29)

(4) Transmission error in Q DATA

To make the effect of transmission errors more visible than it really is , quantized coefficients (DC and AC components) were given wrong values.

Miss America start #71 (Error frame #81)
(a) DC/AC Block location : (18,18)/(18,18)
All DC and AC components in the block are set to zero.
(b) DC/AC Block location : (20,20)/(24,14)
All DC and AC components in the block are set to 25.

(5) Error concealment

Descriptions above is on the effect of transmission errors when VLC coded information can be provisionally decodable. Countermeasure examples to transmission errors are given here. If a GOB data is transmitted through noisy channel , the data is not always decoded correctly at the receiver. The following two measures can be easily employed at the receiver.

(5-1) Previous frame substitution
Miss America #71 start (Error frame #81)
(a) GOB NO. 8
(b) GOB NO.14

(5-2) Previous GOB substitution
Miss America #71 start (Error frame #81)
(a) GOB NO. 8
(b) GOB NO.14

4.Discussion and Conclusion

Effect of transmission errors have been simulated to show how reproduced sequences are degraded. In some cases , transmitted data with transmission errors can be decoded provisionally. However , reproduced motion video sequences will be getting more and more degraded as time passes by or corresponding to object motion. Since commercial transmission lines can usually provide a quality (BER) of 10 , there will be three errors in a second provided that the transmission bit rate is 300kb/s for motion video. For a BER of 10 ,there will be an error in about 33 seconds. At a rate as low as 300 kb/s for video , it is difficult to periodically refresh a whole frame within a short time , for example within less than ten seconds.

Error cocealment demonstrated here is nothing but a temporarily effective countermeasure. An essential solution will be the use of forward error correction in conjunction with forced updating.

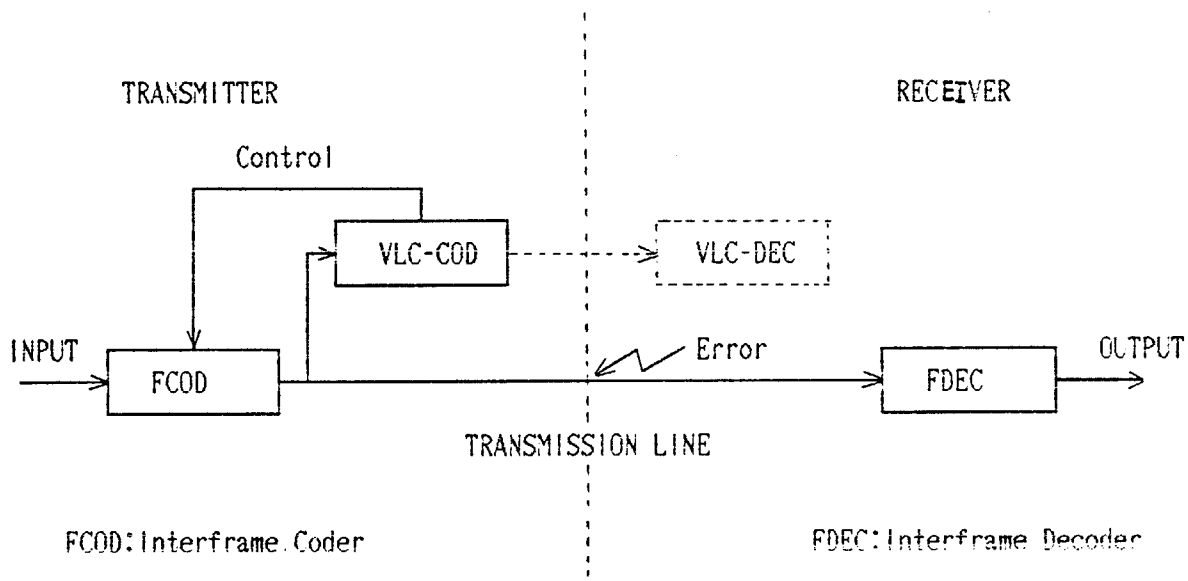

Fig.1 Experimental Blockdiagram

Effect of Transmission Errors
Annex to DOC.#160
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TITLE 1-1 : Channel Error in MCV
Miss America #71 start (Error frame #81)
Block Location : (22,23)
Error : (10, 0)

TITLE 1-2 : Channel Error in MCV
Miss America #71 start (Error frame #81)
Block Location : (22,23)
Error : (0,10)

TITLE 1-3 : Channel Error in MCV
Miss America #71 start (Error frame #81)
Block location : (22,23)
Error : (10,10)

TITLE 2 : Channel Error in BA
Miss America #71 start (Error frame #81)
Block NO.1 , GOB NO.17
First Ten Blocks Skipped

TITLE 3 : Channel Error in B DATA (Block Type)
Miss America #71 start (Error frame #81)
Block location : (24,29)
Intra/Inter Mode (Inter -> Intra)

TITLE 4-1 : Channel Error in Q DATA
Miss America #71 start (Error frame #81)
DC/AC Block location : (18,18)/(18,18)
All Components -> 0

TITLE 4-2 : Channel Error in Q DATA
Miss America #71 start (Error frame #81)
DC/AC Block location : (20,20)/(24,14)
All Components -> 25

TITLE 5-1 : Error Concealment
Previous Frame Substitution
Miss America #71 start (Error frame #81)
GOB NO.8

TITLE 5-2 : Error Concealment
Previous Frame Substitution
Miss America #71 start (Error frame #81)
GOB NO.14

TITLE 5-3 : Error Concealment
Previous GOB Substitution
Miss America #71 start (Error frame #81)
GOB NO.8

TITLE 5-4 : Error Concealment
Previous GOB Substitution
Miss America #71 start (Error frame #81)
GOB NO.14.