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Experts Group for ATM Video Coding

Document AVC-235

SOURCE : Japan
TITLE : Cell-loss compensation scheme
PURPOSE : Information

1. Introduction

Cell-loss resilience is regarded as one of the most important requirements for a next standard coding algorithm, taking the communication services over ATM networks into account. A detailed cell-loss experiment specification was proposed at this past meeting in Singapore (AVC-205, MPEG92/027). In this document, some cell-loss concealment methods at the decoder are investigated and evaluated according to the cell-loss experiment specification.

2. Computer simulation

Two experiments are carried out as follows, based on an idea that a lost macro block (MB) is concealed at the decoder using a motion vector estimated from the surrounding MBs.

(1) Experiment 1

Four different estimation methods are evaluated from the viewpoint of prediction error as possible concealment strategies at the decoder (see Annex 1).

(2) Experiment 2

In this experiment, the following three types of cell-loss concealment methods, which do not make use of the networks cell loss priority control, are evaluated according to the cell-loss experiment procedure.

- Method A

  The lost MB is replaced by a MB in the previous picture using the average of the motion vectors of the two adjacent MBs. The MB above and below are used, since horizontally adjacent MB's may be also lost (see Figure 1).

- Method B

  Method A with cyclic I-pictures (N=12). In the case of cell loss in I-pictures, motion compensation is done at the decoder using both the above and below adjacent MB together.

- Method C

Method A with leaky prediction for recovery (leakage factor = 0.9).

Computer simulation was performed using the above schemes installed in RM8, under the following conditions:

- Picture format : 4:2:0
- Coding control : a fixed quantizer step size of 8
- Mean cell-loss ratio : 10^{-3}
- Mean burst of cell loss : 2
- Overhead for cell assembly : 20 bits (see Figure 2)

A Macro Block Start Pointer (MSP) and an Absolute Block Address (ABA) are introduced, together with absolute motion vector coding of the first MB in a cell, to minimize the effect of cell loss. These items and the leakage factor used in Method C need to be standardized if adopted.

Table 1 shows the simulation results of each method. According to the result, Method C performs best in all four sequences. This means leaky prediction is superior to I-picture as an error recovery method. Subjective evaluation of the reproduced picture gives the same result and degradation due to cell loss is hardly noticeable by Method C, even in the severe cell-loss condition that was simulated. Some of the reproduced pictures will be demonstrated by VCR at the meeting.

4. Conclusion

Some cell-loss concealment methods are proposed and experimental results based on a detailed cell-loss experiment are reported. The results indicate that some concealment method may be sufficient to obtain acceptable picture quality, even in high cell-loss environments. However, the impact of adopting cell-loss resilience functions must also be considered, such as the compatibility issue between the conventional standard and the new standard.

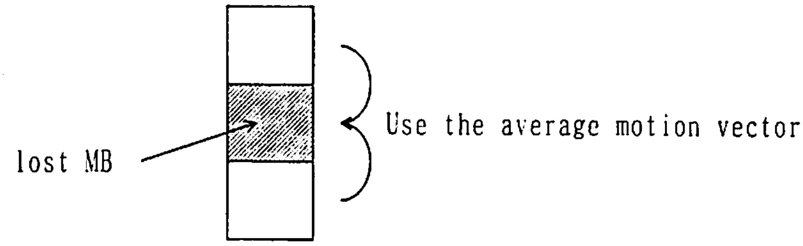
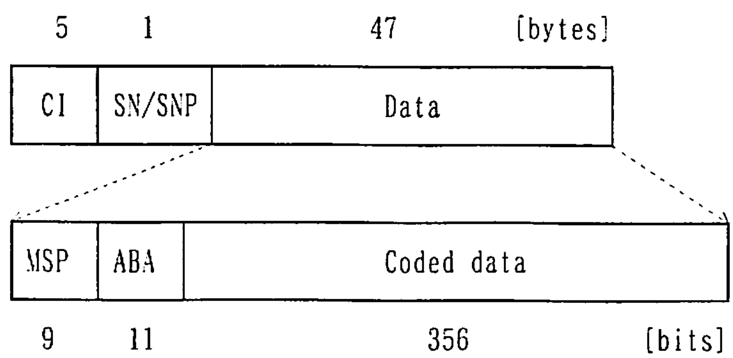


Figure 1 : Reference motion vector for lost MB



CI : Cell Identification byte (AVC-205, MPEG92/027)
SN : Sequence Number (AVC-205, MPEG92/027)
SNP : Sequence Number Protection (AVC-205, MPEG92/027)
MSP : Macro block Start Pointer
ABA : Absolute Block Address

Figure 2 : Adopted cell assembly scheme

leak predictor

Table 1 : Coding performance of the each cell-loss concealment method

	Average S/N [dB] (Bit rate [Mb/s])				
	No cell loss	With cell loss			
		No compensation	Method A	Method B	Method C
Mobile & Calendar	37.46 (24.12)	29.97 (24.12)	33.32 (24.12)	36.49 (25.22)	36.67 (24.86)
Flower garden	37.78 (19.13)	27.73 (19.13)	33.95 (19.13)	36.70 (20.33)	37.15 (19.56)
Popple	37.60 (18.47)	35.15 (18.47)	34.87 (18.47)	36.85 (18.72)	36.98 (19.42)
Football	38.06 (16.35)	33.71 (16.35)	35.26 (16.35)	36.86 (16.79)	37.04 (16.66)

ANNEX to AVC-235

The investigation on the presumption methods of the lost MV for cell loss concealment

1.Introduction

The presumption of the lost motion vector (MV) is one of the most important technique for cell lost concealment. In this annex, we investigate the several presumption methods of lost MV using MV of the surrounding macro blocks (MBs).

2. Simulation

The following presumption methods for MV are investigated. The presumption efficiency is evaluated on the power of motion compensated prediction error, which MV is presumed from the surrounding MVs, with NO DCT and NO quantization. The reference picture of motion compensation is the original picture.

Presumption Methods:

(1) NO lost (its own MV)
(2) mean value of 8 surrounding MV
(3) MV of upper MB
(4) major value of 8 surrounding MV — decision by majority
(5) weighted* major value of 8 surrounding MV
(6) weighted* major value of adaptive 8/14 surrounding MV.
(8 surrounding for local motion, 14 surrounding for global motion)
*:weighted coefficient is inverse proportion of MB distance.

(Simulation conditions)

MB structure: TM0 frame-base
Prediction distance: frame distance=1 Fig.1
MV detection: Telescopic search half pixel accuracy
Range of MVD: +-15.5 pixel/frame

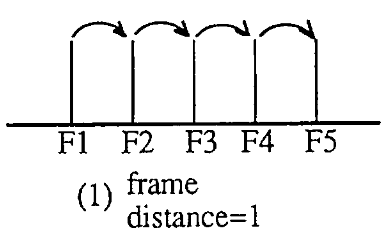
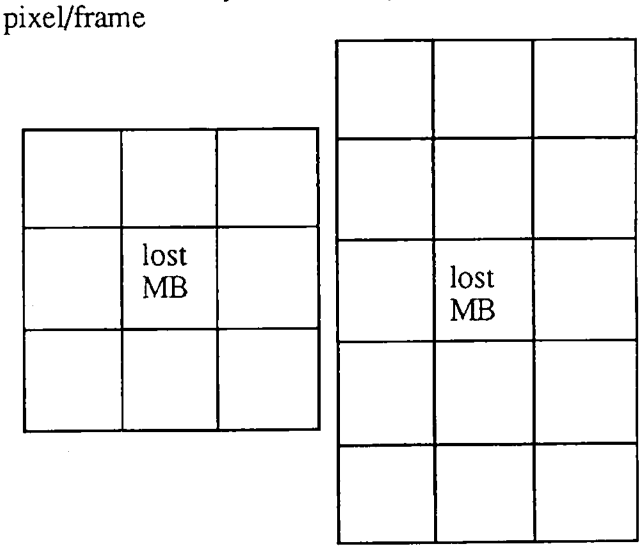


Fig.1 Motion compensated prediction



(1) 8 surrounding MB (2) 14 surrounding MB

Fig.2 surrounding macro block

3. Result

The simulation results are shown in Fig.3, and motion compensated prediction image are demonstrated by D1 tape.

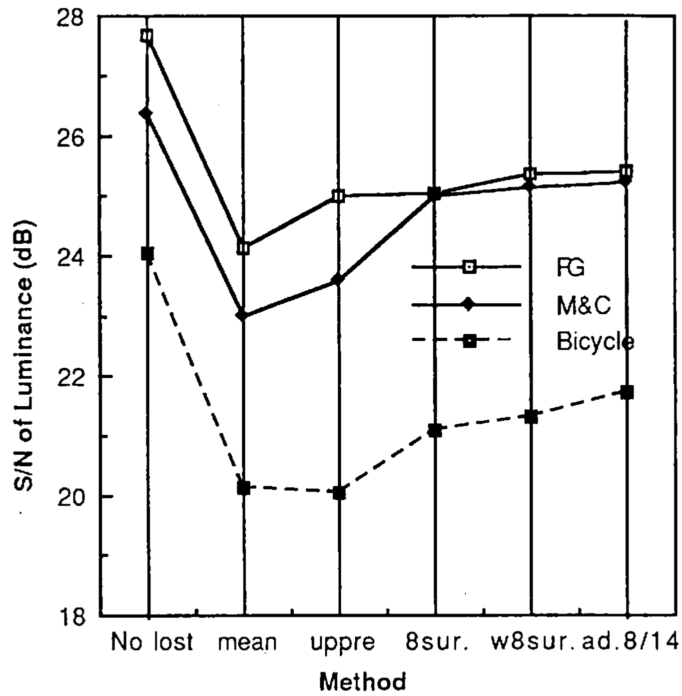


Fig.3 S/N of motion compensaton picuture

-For local motion area, weighted major value of 8 surrounding MV (Method 5) gives a good result.

-For global motion or still area, presumption of 8 surrounding MV is not enough, because sometimes detected(transmitted) MV is not exact. For that area, it is better to have wider surrounding area. The weighted major value of adaptive 8/14 surrounding MV (Method 6) can improve the global motion or still area.

4.Conclusion

Several presumption methods of lost MV are investigated. The weighted major value of adaptive 8/14 surrounding MV method gives a good result.

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