CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-338
21 Sept 1992

SOURCE : Japan
TITLE : Simulation results on S-FAMC and Dual'
(Core Experiment No.1 and No.3 on prediction modes)
PURPOSE : information

This document just informs the content of the contribution from Matsushita that will be submitted to CCITT/MPEG joint session at Tarrytown on 29 Sept. - 1 Oct.

1. Abstract

This document addresses Simplified FAMC (S-FAMC) and Dual' prediction, which are core experiment No.1 and No.3 on prediction modes.

S-FAMC defined in TM2 has no interpolation mode for B-picture. However no interpolation causes the less improvement of coding efficiency. This document proposes the introduction of frame base averaged macro block as interpolation mode of S-FAMC. This introduction makes the coding efficiency high with keeping memory band width same as field or frame prediction.

We have had the comparison of S-FAMC with Fr_intp and adaptive field/dual', and the image quality looks very similar. Dual' seems to need the combination of field and frame prediction for the high coding performance. In order to provide the possibility for users as wide as we can, I think we have to remain the high performed single mode prediction among prediction modes in MPEG2. As reported in MPEG92/246 (SVMC), S-FAMC has the possibility to improve the image quality with combination of other modes, too. From these considerations, we propose to remain S-FAMC with Fr_intp in the Test Model.

2. Simulation on S-FAMC

S-FAMC defined in Test Model 2 has no averaged macro block (interpolation) mode. To investigate the efficiency of interpolation mode, we have simulated S-FAMC with several interpolation schemes. These are;

- S-FAMC (There is no interpolation mode for B-picture.)
- S-FAMC + FAMC_intp
- S-FAMC + SPFi_intp
- S-FAMC + Fr_intp

FAMC_intp = S-FAMC averaged interpolation mode
SPFi_intp = SVMC_same_parity_field averaged interpolation mode with quarter pel accuracy
Fr_intp = Frame base averaged interpolation mode with integer pel accuracy

Note)
The motion vectors detected for S-FAMC are also used for SPFi_intp and Fr_intp. For SPFi_intp, motion vectors with half pel accuracy, which are detected in the second stage of ME for S-FAMC, are used. For Fr_intp, motion vectors with 2(V)x1(H) accuracy, which is detected in the first stage of ME for S-FAMC, are used.

The simulation conditions are follows;

- Picture format = 4:2:0
- Bit rate = 4Mb/s with Step 2 rate control
- Coding structure = frame structure with M=12, N=3
- ME = Telescopic ME for S-FAMC on original image with half pel accuracy.
  (Appendix H in TM2)
- Sequence 0-59 frames (2 seconds)

3. Simulation results on S-FAMC

The simulation result is shown in Table 1 and it will be demonstrated by D1 tape.

Table 1 SNR for Luminance (dB)

	Adaptive Field/Frame	S-FAMC	S-FAMC+ FAMC_intp	S-FAMC +SPFi_intp	S-FAMC +Fr_intp
Flower Garden	30.47	30.64 (+0.17)	31.21 (+0.74)	31.00 (+0.53)	31.03 (+0.56)
Mobile & Calendar	28.88	28.73 (-0.15)	29.14 (+0.26)	28.75 (-0.13)	28.89 (+0.01)
Football	32.01	32.14 (+0.13)	32.34 (+0.33)	32.17 (+0.16)	32.20 (+0.19)
Bicycle	27.96	28.29 (+0.33)	28.47 (+0.51)	28.33 (+0.37)	28.37 (+0.41)

In Rio meeting, averaged FAMC interpolation mode had been rejected by implementation group, because it needs twice memory band width than field/frame adaptive prediction. However, from coding efficiency point of view, no interpolation causes the decrease of SNR and the degradation of image quality on S-FAMC as shown in table 1. We believe S-FAMC needs some kinds of interpolation mode with keeping the memory band width same as field or frame prediction.

"SPFi_intp" and "Fr_intp" can keep the memory band width same as field or frame prediction. Concerning to coding efficiency, the introduction of "Fr_intp" into S-FAMC improves SNR and image quality for all sequences. From our viewing of simulation results, the introduction of "Fr_intp" improves the smoothness of motion and reduces the noise in the high resolution area.(e.g., flower in the "flower garden", calender in the "Mobile & Calendar".)

Therefore we propose to introduce the frame base averaged mode as the interpolation mode of S-FAMC.

4. Comparison of S-FAMC and Fi/Dual'

Dual' prediction was introduced as the core experiment in Rio meeting. We have compared S-FAMC+Fr_intp and adaptive field/dual' in term of coding efficiency. The simulation condition of S-FAMC+Fr_intp is the same as Secession 2. The simulation condition of adaptive field/dual' is follows.

- Picture format = 4:2:0
- Bit rate = 4Mb/s with Step 2 rate control
- Coding structure = frame structure with M=12, N=3
- ME = Telescopic search on local decoded image
- Sequence 0-59 frames (2 seconds)

The simulation result is shown in Table 2.

Table 2 SNR for Luminance (dB)

	Adaptive Field/Frame	S-FAMC +Fr_intp	Adaptive Field/Dual'
Flower Garden	30.47	31.03 (+0.56)	30.75 (+0.28)
Mobile & Calendar	28.88	28.89 (+0.01)	28.97 (+0.09)
Football	32.01	32.20 (+0.19)	31.90 (-0.11)

- In Flower Garden, S-FAMC + Fr_intp has 0.18 dB higher SNR than Field/Dual', however the image quality of two schemes looks very similar. By close viewing, more noise is recognized in the trunk of the tree in Field/Dual'.
- In Mobile & Calendar, Field/Dual' has 0.08dB higher SNR, however the image quality of Field/Dual' is not stable and it gives the bad impression. It seems dual' should be used with combination of both field and frame prediction for high coding performance.

S-FAMC with Fr_intp has a high coding performance without combination of other prediction mode. Several prediction modes will be defined in MPEG2 and user will select and implement the prediction mode to meet their requirement. I think we have to provide the possibility as wide as we can. From this reason, we propose to remain the high performed single mode prediction. It will provide wider user freedom on hardware implementation.

If S-FAMC is used with combination of other prediction, the image quality can be improved more. SVMC (MPEG92/246) is one example of the combination of S-FAMC and other predictions. This combination improves the image quality for the rapid sequence.

Another point is simple syntax. The syntax of S-FAMC with Fr_intp is it as the frame prediction and they are very simple. S-FAMC needs only one motion vector pre macro block per one direction. We believe simple syntax leads easy understanding and less hardware.

From these considerations, we propose to remain S-FAMC with Fr_intp in the Test Model.

5. Conclusion

(1) No interpolation mode on S-FAMC causes the decrease of SNR and degradation of image quality. S-FAMC needs some kind of interpolation mode. The introduction of frame base averaged interpolation increases the SNR and improves the image quality, and its memory band width is the same as field or frame prediction. Therefore we propose the introduction of frame base averaged mode as the interpolation mode of S-FAMC.

(2) The image quality of S-FAMC with Fr_intp looks very similar. Dual' seems to need the combination of field and frame prediction for the high coding performance. In order to provide the possibility for users as wide as we can, I think we have to remain the high performed single mode prediction among prediction modes in MPEG2. S-FAMC with Fr_intp has a high coding performance without combination of other modes. As reported in MPEG92/246 (SVMC), S-FAMC has the possibility to improve the image quality with combination of other modes, too. From these considerations, we propose to remain S-FAMC with Fr_intp in the Test Model.