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Title: Quantization of spatially scalable prediction errors
Purpose: Information

This contribution describes work done on the quantization of spatially scalable predicted macroblocks. The use of a step size of 8 for the DC term is compared with normal inter quantization and the relative performance of intra and inter weighting matrices is described.

1. Experiments

Base layer progressive SIF sequences were coded using MPEG-1 at 1.5Mbit/s. These were used as the compatible prediction for coding 25 CCIR 601 resolution source pictures with a further 2.5Mbit/s. The only spatial temporal weights allowed were those corresponding to pure spatial prediction and pure temporal prediction. This avoided the problem of what to do for the mixed macroblocks.

In order to keep the relative allocations of bits to each picture type the same for each run of a given sequence, the rate control complexity indicators were not updated during the coding of the sequences.

Four runs were performed for each sequence. The first was the normal case with normal quantization for all transform coefficients and the inter weighting matrix. The second run was the same as normal but with a step size of 8 for the DC term of spatially scalable macroblocks. The third run was the same as the normal except that the intra weighting matrix was used instead of the inter weighting matrix for spatially scalable predicted macroblocks. The fourth run included both changes: the DC term was quantized with a step size of 8 and the intra weighting matrix was used.

2. Experiments and Results

The average luminance SNR results are summarised below.

Sequence	Normal	DC-8	Intra Weight	DC-8 + Intra Weight
Susie	42.85	42.82	42.73	42.76
Susie@	39.84	38.76	39.57	38.73
Calendar	28.12	27.92	27.95	27.82
Cheer	29.25	28.63	29.01	28.55
Football	35.07	34.54	34.88	34.53
Football*	33.21	33.15	33.20	33.10

@ Starting at frame 24 rather than 0.

* Top layer bit rate of 1Mbit/s.

The results were judged just by looking at the statistics. No pictures were observed.

In all cases the normal scheme achieved the best SNR performance. Sometimes a DC step size of 8 caused little loss of performance and sometimes the intra weighting matrix caused little loss in performance. In general, when coding well, the DC step size of 8 caused little deterioration in quality and when coding poorly, that is, there are many transform coefficients, the intra weighting matrix caused little deterioration in quality.

Two runs were done for the football sequence. The first with a top layer bit rate of 2.5Mbit/s and the second with a top layer bit rate of 1Mbit/s. This was done to investigate the effect of coding more macroblocks in a compatible way. However, there were problems with the rate control for these runs as the quantizer was limiting at 31 in the interpolated pictures. This caused the average bit rate to be about 2.8Mbit/s in the top layer for the first run. For the second run, the top layer bit rate was 1.4Mbit/s when a step size of 8 was not used for the compatible DC coefficient and 2Mbit/s when it was used. Despite this increased bit rate for the step size of 8 runs, the SNR was still inferior to that obtained with normal quantization.

3. Conclusion

The various changes made to the spatially scalable quantization process all resulted in poorer SNR performance. There is little reason to suppose that these changes would have improved subjective picture quality.

It is therefore proposed that the changes to the quantization process for spatially scalable macroblocks as described in this contribution, should not be incorporated into the standard.