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Purpose: for discussion

Title: TM2 Simulations at 4 and 2 MBit/s compared with MPEG_1

Performed Simulations

The scenes "Mobile and Calendar" and "Flower Garden" with interlaced pictures in the 4:2:0 625-format (CCIR 601 with half chrominance resolution, 50 field frequency) are coded according to the ISO-IEC TM2 Draft, with following specifications:

- the group of pictures (GOP) consists of 12 frames, 1 I-picture, 3 P-pictures, 8 B-pictures, as proposed by TM2 draft for 50Hz scenes,
- I-pictures start with 18500 bits/slice, P-pictures with 7500, and B-pictures with 1500 bits/slice, update of these values after each GOP,
- no scalable extension was used, no compatibility experiments were performed,
- motion vectors are estimated for frames and fields, for full pel accuracy by a coarse-fine search algorithm saving a lot of computing time, half pel refinement for all vectors according to the TM2 draft, full_pel_flag is never set,
- the selected ranges in half pixels for motion vectors are 32, 64, and 128, forward/backward_f_code is 2, 3, and 4, for frame-to-frame distances of 1, 2, and 3 time periods, respectively,
- the Inter/Intra-, MC/no MC-, forward/backward/interpolation- and field/frame-decisions are made according to the TM2 draft,
- field/frame DCT-decision according to TM2 draft,
- quantizer and quantizer weighting matrices according to TM2 draft,
- range of AC and DC spectral coefficients [-2048,2047], range of quantized coefficients [-255,255],
- rate control and quantizer stepsize adaptation for each slice.

D1-tape demonstration of the above mentioned scenes coded at 4 MBit/s and at 2 MBit/s has been prepared. Additionally the scenes have been compared at 2 MBit/s with MPEG_1-coded material, 25 Hz SIF format. All recorded material is output of the decoder side.

Discussion of results

Mean SNR values for "Calendar" and "Flower Garden" for 3 GOP's (37 frames), at 4 MBit/s and at 2 MBit/s, the latter with corresponding MPEG_1-SNR-curves, are depicted below. Our observation is, that coding of natural scenes

at 4 MBit/s, e.g. "Flower Garden", gives good results with really acceptable visual quality. In more artificial scene material like "Calendar", with slow motions, however, some residuals of motion compensated prediction error are just visible, e.g. a slight corona of high frequency artifacts around the digits of the calendar.

We are hopeful to reduce further some visible coding errors by refinements of quantizer stepsize adaptations, and/or using some additional options of TM2. Our opinion is, in general, that coding of CCIR 601 material at 4 MBit/s will give results absolutely acceptable for a wide area of video storage, exchange and distribution.

Another interesting aspect for our simulation work was to compare MPEG_1 with MPEG_2 coding at 2 MBit/s. The compared results for "Calendar", presented in a split screen mode, demonstrate the effects of reducing the picture format (to SIF 25 Hz, according to MPEG_1) before starting with coding. The loss of resolution in space and time is evident, e.g. in the scene "Flower Garden" motion jerkiness is very annoying, and we think it would be preferable not to reduce the picture format before coding at higher rates. At 2 Mbit/s transmission rate, coding of CCIR 601 pictures with MPEG_2 is significant superior to coding of SIF pictures with MPEG_1. On the other side, MPEG_1 has much lower implementation cost and may be really acceptable for coding uncritical material at lower rates up to 1.5 MBit/s. At these lower rates the overhead data of full 4:2:0 format pictures, as header information and motion vectors, would not further allow to transmit any error signal.

table of SNR's, mean value for 37 frames (3 GOP's)			
scene	TM2 4Mbit/s 4:2:0	TM2 2Mbit/s 4:2:0	MPEG1 2Mbit/s 2:1:0
flower	31.6 db	28.4 db	31.8 db
calendar	30.6 db	27.8 db	30.5 db

Conclusion

We presented some TM2 and MPEG_1 simulation results at 4 resp. at 2 MBit/s, the latter for comparison between coding the CCIR 601 4:2:0 format following the TM2 draft, and coding after reduction of the picture format down to SIF, as proposed in MPEG_1 SM3. Even with better SNR's, the MPEG_1 coded scenes show significant loss of spatial resolution and heavy motion jerkiness, especially "Flower Garden" with its rapidly moving tree in the foreground. At 2 Mbit/s transmission rate, the only advantage of MPEG_1 coding compared to MPEG_2 is the much lower complexity of an implementation.

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