CCITT Study Group XV
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Specialists Group on Coding for Visual Telephony

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Source: France, FRG, Italy, Netherlands, Sweden, UK

Title: Reduced Chrominance Resolution

At the Ipswich meeting of Specialists Group it was agreed that the Common Intermediate Format has 144 lines of 180 pels for each colour difference component. It was accepted that this represents the maximum resolution attainable.

At the Tokyo meeting in April 1986 there was some discussion of lower chrominance resolution by reducing the number of pels. Such an approach is not desirable for the following reasons.

1. The decoder must accept 144 by 180 per line since coders must be entitled to use the full capability of the CIF. Some picture material, especially still pictures, does require such resolution even at 384kbit/s. It is also likely that one would wish to exploit the full resolution at primary rates.

Therefore, if a reduced chrominance sampling mode is introduced it must be additional at the decoder, not an alternative.

2. As compatibility would not be affected, it would be optional at the encoder whether to have only reduced sampling or only full 144 by 180 or both. Coder hardware complexity is unchanged if 144 by 180 only is implemented, increased if both are available and slightly less if only the reduced mode is implemented, but this possible saving incurs the penalty of never being able to handle more demanding source material.

3. A reason behind the wish to have a lower chrominance resolution is presumably to save bits. However, simulation results for the reference model indicate only 10% to 25% of total bits are needed for 144 lines by 176 pels chrominance. Therefore even adopting 2:1 chrominance subsampling in both horizontal and vertical directions will reduce the bit rate by only 8% to 19% at best. In fact the reduction will not be as much as this as can be seen by considering the two areas where the bits are expended.

The first is the transform coefficients. Since energy is higher at low spatial frequencies, a reduction of sampling density will not give a proportional reduction of significant coefficients, nor will it be possible to quantize them as coarsely.

The second contribution to bit consumption is block overhead. If the reduced chrominance sampling mode retains the same spatial relationship of 4 to 1 area between luminance and chrominance blocks, then the number of blocks will be unchanged and the overhead unaltered. (In this case the transform hardware will become a little more complex because chrominance blocks will not contain the same number of pels as luminance ones.) Alternatively, the chrominance block may be kept at 8 by 8, thereby reducing the number of blocks and consequently the overhead, but the chrominance blocks become large with an adverse effect on transfom coding efficiency. Further, the number of significant chrominance blocks will not reduce in direct proportion to the reduction in sampling density because larger blocks are more likely to include moving areas.

Conclusion

Considering that the introduction of lower sampling density mode for colour components:

1. allows the option of a slightly simpler encoder to be constructed but with no capability for highly detailed colour input picture

2. always makes the decoder more complex by an amount more then the optional simplification of the encoder

3. permits only a limited reduction of the bit rate.

the addition of such a mode is not supported.