CCITT SGXV
Working Party XV/1
Specialist Group on Coding
for Visual Telephony

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Title: Adaptive zonal scanning for a 64kbit/s video codec
Source: UK

Examination of statistics generated from a 64kbit/s hybrid coding model indicates that the ratio of non zero to zero coefficients transmitted is typically 1:3. This large number of transmitted zero coefficients constitutes a significant percentage of the overall bit-stream generated. A method which attempts to reduce the ratio of non-zero to zero coefficients is described here.

One may conceive several sources of zero coefficients. These could be:

1] Inappropriate scanning of the block.

2] Spurious high sequency coefficients.

3] Genuine data which could be caused by either a bad prediction or wideband input data.

It was thought that sources 1 and 2 were often responsible for excessive numbers of zeros transmitted, therefore some method could be devised to reduce their number .

Examination of a number of quantised transform blocks revealed that the majority of coefficient energy was close to the DC coefficient, but small coefficients were often randomly distributed in the block. Transmitting these few high sequency coefficients would cost heavily in terms of zero coefficients transmitted. Further it was considered that very high sequency coefficients would be undesirable if generated with very coarse quantisation.

An adaptive zone was developed. This zone would adapt as a function of quantiser step size thus requiring no additional overhead information to be transmitted. In order to develop the zones correctly a coder was run open loop with several different buffer status values (or quantiser step sizes). The buffer status was kept fixed throughout the coding of a whole frame of data. For coded blocks the effect of placing sub scanning zones upon those blocks was examined. These sub zones consisted of all possible rectangular zones extending from the DC coefficient within the original block. The number of excluded zeros and the energy of the excluded non-zero coefficients for the differing sub-zones were examined.

The scanning classes indicated in Figure 1 were produced from this data.

Simulations were performed with RM4 with the modified scanning procedure. A significant and visually noticeable improvement in image quality was present on the Clair sequence. In particular a reduction in block edge artifacts. A reduction in the number of zeros transmitted was produced.

Conclusion

The adaptive scanning process would appear to improve the subjective and objective performance of the codec.

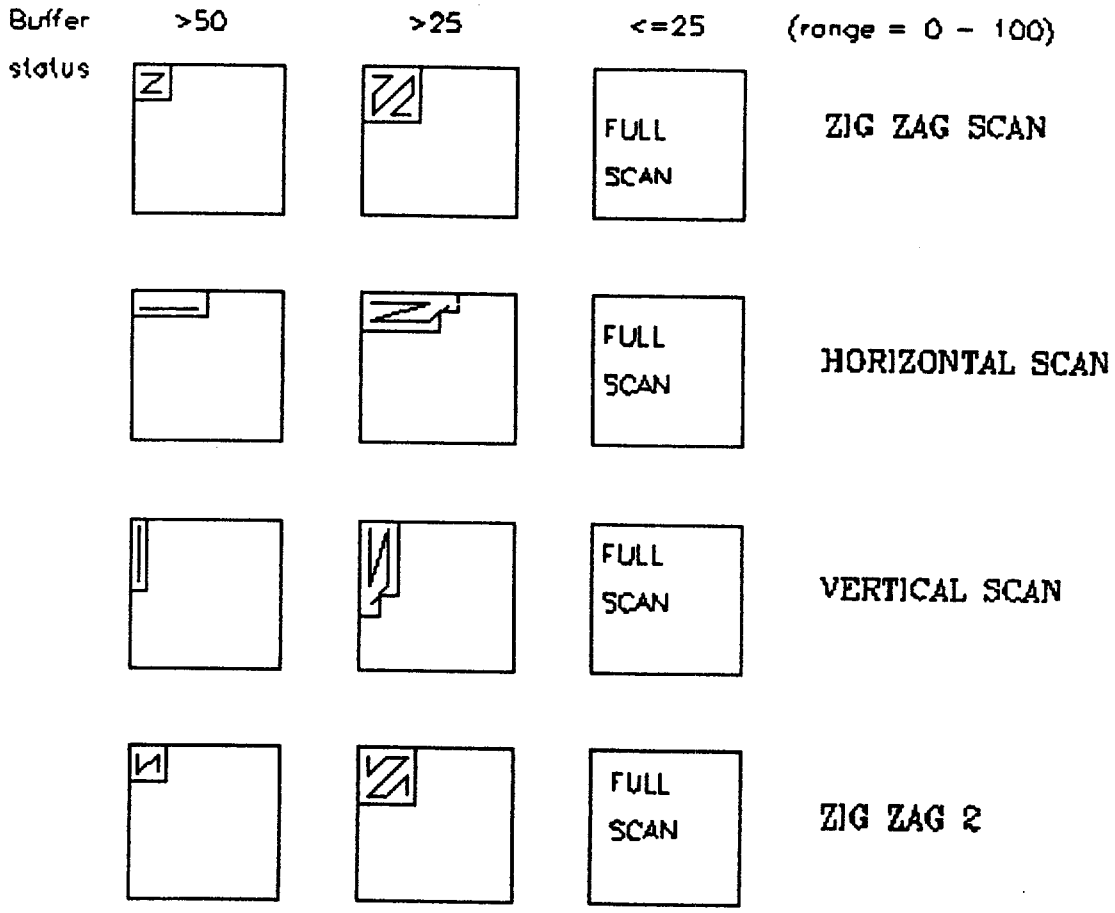

FIGURE 1 SCANNING CLASSES

Non adaptive Scanning : CLAIRE.

Item			FRAME	FRAME	AVERAGE
1)RMS FOR LUMINANCE					3.24
2)SNR FOR LUMINANCE					37.9
3Mean value for step size					13.7
4)Mean value Non-zero coef					746
5)Mean value of Tx'd zeros					2103
6) Block type of Y	Fixed				219
	Intra				0
	Filtered Fixed				74
	Non-filt Fixed MC				10
	Filtered Fixed MC				1
	Non-filt Inter				43
	Filtered Inter				9
	Non-filt Inter MC				23
	Filtered Inter MC				12
	Filtered				
7) Block of type C	Fixed				146
	Intra				0
	Filtered Fixed				23
	Non-filt Inter				19
	Filtered Inter				7
	Filtered				—
8) Number of bits	Attributes	Y			495
		Cr			46
		Cb			59
		TOTAL			
	Class indicies				178
	EOB				233
	Motion vectors				
	Coefficients	Y			3929
		Cr			143
		Cb			356
		TOTAL			
	TOTAL				6348
Buffer status (0-100)					42.7%

Adaptive Scanning : CLAIRE

Item			FRAME	FRAME	AVERAGE
1)RMS FOR LUMINANCE					6.7
2)SNR FOR LUMINANCE					31.966
3Mean value for step size					8.97
4)Mean value Non-zero coef					702
5)Mean value of Tx'd zeros					1769
6) Block type of Y	Fixed				227
	Intra				∅
	Filtered Fixed				43
	Non-filt Fixed MC				7
	Filtered Fixed MC				1
	Non-filt Inter				69
	Filtered Inter				10
	Non-filt Inter MC				25
	Filtered Inter MC				10
	Filtered				
7) Block of type C	Fixed				177
	Intra				∅
	Filtered Fixed				20
	Non-filt Inter				30
	Filtered Inter				8
	Filtered				
8) Number of bits	Attributes	Y			445
		Cr			51
		Cb			59
		TOTAL			
	Class indicies				233
	EOB				312
	Motion vectors				
	Coefficients	Y			3496
		Cr			295
		Cb			594
		TOTAL			-
	TOTAL				6368
B-ffer (0-100)					33.4%