Title: Motion Vector Coding
Source: Yasuo Katayama (GCT)

1   Introduction

A Variable Length Code for Differential Motion Vector was presented by T. Savatier at the Rome meeting, which was modified from my contribution (MPEG92/555) at the London meeting (Table 1). These codes are the variations of "Wyle code". This contribution provides a discussion of these two VLC's.

Both VLC's have the following features:

(1) Independence from f_code and full_pel, which simplifies decoder.

(2) Having niether maximum nor minimum of DMV, which makes encoding easier.

(3) Having no wrap-round of DMV

(4) Removing inefficiency of short vectors when using large f_code

The length of the Rome version VLC is longer by 1 bit than MPEG 92/555 for its values in nearly equal sections as $((2^{n-1} - 1)$–$(2^n - 2)$ and 2^{n-1}–$(2^n - 1))$.

The MPEG 92/555 should be inverted 0 to 1, 1 to 0 because VLC for MV is to concatenated. The position of "s" can be changed to before "x"s from after "x"s .

Table 1. MPEG92/555 and Rome version

n	|DMV|	MPEG92/555	|DMV|	Rome version
			0	0
1	0	1	1	10s
2	1-2	01xs	2-3	110sx
3	3-6	001xxs	4-7	1110sxx
4	7-14	0001xxxs	8-15	11110sxxx
5	15-30	00001xxxxs	16-31	111110sxxxx
6	31-62	000001xxxxxs	32-63	1111110sxxxxx
7	63-126	0000001xxxxxxs	64-127	11111110sxxxxxx
	.....	....	.....	....
n	$(2^{n-1} - 1)$–$(2^n - 2)$	2n bit	2^{n-1}–$(2^n - 1)$	2n+1 bit
	.....	....	.....	....
x: 0 or 1, s:sign of DMV (s=1: minus)				

2   Result

SNR results of these new VLC's are shown in Table 2. The Rome version and MPEG 92/555 have slightly better result than MPEG-1 for the sequences which have slow motion (M&C, FG, Bus).

The Rome VLC is worse than MPEG-1 by about -0.10dB to -0.12dB for the sequences which have fast motion (Ftball, Bicycle, Carousel, Confetti).

On the other hand, the MPEG92/555 has nearly equal efficiency to MPEG-1 for the same sequences with fast motion (-0.02dB).

Although the Rome version has an advantage in that it is equal to dct_dc_size, coding efficiency for longer vectors is important, because they will be more frequent in HDTV coding.

Table 2. The SNR result of DMV coding (4Mbps)
(Motion vectors are in ±15.5/frame if not specified.)

Y, Cb, Cr		Y, Cb, Cr	
Mobile&Calender		Flower Garden	
TM2	28.51 34.19 34.24	TM2	29.72 32.86 34.59
92/555	28.53 34.20 34.25(+0.02dB)	92/555	29.74 32.88 34.61(+0.02dB)
Rome	28.53 34.20 34.26(+0.02dB)	Rome	29.75 32.88 34.61(+0.03dB)
Ftball		Bicycle (±31.5/frame)	
TM2	32.94 36.69 38.73	TM2	27.80 33.85 34.57
92/555	32.92 36.68 38.72(-0.02dB)	92/555	27.78 33.84 34.55(-0.02dB)
Rome	32.84 36.61 38.67(-0.10dB)	Rome	27.69 33.79 34.49(-0.11dB)
Bus		Carousel	
TM2	31.52 38.33 40.55	TM2	28.57 33.27 33.72
92/555	31.55 38.34 40.57(+0.03dB)	92/555	28.56 33.26 33.71(-0.01dB)
Rome	31.55 38.34 40.57(+0.03dB)	Rome	28.48 33.22 33.66(-0.09dB)
Carousel(±31.5,±15.5)/frame		Confetti	
TM2	29.72 34.12 34.77	TM2	29.39 33.11 34.16
92/555	29.69 34.11 34.75(-0.03dB)	92/555	29.38 33.10 34.15(-0.01dB)
Rome	29.60 34.06 34.70(-0.12dB)	Rome	29.28 33.01 34.08(-0.11dB)

Average code-lengths of one component of DMV are shown in Table 3. The Rome version is longer by about 0.4 – 0.5 bit/component of DMV for Football and Bicycle. The MPEG 92/555 is slightly (0.1 bit/component) longer than MPEG-1.

Table 3. Average code-length of a component of DMV(4Mbps)

	TM2	92/555	Rome
Mobile	2.236	2.131	2.080
Flower	3.070	2.928	2.913
Bus	3.587	3.405	3.415
Ftball	5.976	6.030	6.411
Bicycle	6.389	6.503	6.895