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TITLE : Comparison between KLT and DCT

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1. Introduction

This document decribes the results of comparative experiment between discrete cosine transform (DCT) and Karhunen-Loeve transform (KLT) based on RM4.

Since KLT is well-known as the optimal transform from statistical point of view, the comparative results are useful for studying the efficiency of DCT-based coding method for motion-compensated interframe predicted error signals (MC errors).

2. Simulation results

The following two methods have been compared ;

(1) DCT-based coding method :
This method is the same as RM4 method.
(2) KLT-based coding method :
KLT is used as transform instead of DCT except for scene cut mode and intraframe blocks. All blocks of MC error are used as the set of sample data to compute the basis vectors of KLT
The dimension size of KLT is 64, because DCT block size is 8 * 8.

The simulation results are shown in Table 1. It has been shown that the coding performance of the two methods differs on each sequence. This may be explained that the basis vectors are not necessarily optimal for the set of significant blocks, since the insignificant blocks as well as significant blocks are contained in the set of sample data to compute the basis vectors of KLT.

3. Summary

The performance of DCT-based coding method can be considered to be closer to that of KLT within the limited simulation experiments.

Since the coding efficiency of KLT-based coding method considerably depend on how to select the set of sapmle data, it may be necessary to study the characteristic of the MC errors in transform-based coding.

Table 2. Simulaion results

Item			CJ		SP-TR		MA	
			DCT	KLT	DCT	KLT	DCT	KLT
1)R.M.S for luminance			3.11	3.01	3.35	3.47	2.48	2.50
2)SNR for luminance			38.28	38.55	37.63	37.33	40.23	40.16
3)Mean value of the step size			11.61	11.39	13.77	14.36	11.16	10.97
4)Mean value of the number of non-zero coefficients			3.21	3.29	4.20	4.08	2.58	2.63
5)Mean value of the number of zeros before the last non-zero coefficients			8.60	8.73	6.81	6.68	6.86	5.56
6) Block type of Y	Fixed		937	925	773	648	986	957
	Intra		2	2	43	44	1	1
	Filtered Fixed		76	110	65	197	81	122
	Non-filt Fixed MC		18	15	27	28	57	56
	Filtered Fixed MC		15	14	63	71	58	62
	Non-filt Inter		344	304	138	130	156	128
	Filtered Inter		78	100	53	54	71	84
	Non-filt Inter MC		63	60	169	160	85	81
	Filtered Inter MC		52	54	253	251	88	93
	Filtered		220	278	433	573	298	360
7) Block type of C	Fixed		571	522	568	413	331	274
	Intra		0	0	10	10	1	1
	Filtered Fixed		38	106	57	217	82	136
	Non-filt Inter		151	103	77	54	164	128
	Filtered Inter		33	63	80	99	216	253
	Filtered		71	167	138	315	297	389
8) Number of Bits	Attributes	Y	3000	3090	3565	4081	2997	3147
		Cr	465	612	525	848	716	796
		Cb	468	602	562	855	1001	1140
		Total	3932	4303	4652	5783	4693	5084
	Classification indexes		1078	1038	1313	1278	804	774
	EOB words		1447	1370	1647	1605	1564	1537
	Motion Vectors		1182	1142	4093	4088	2302	2338
	Coefficients	Y	10883	10738	16306	15428	6369	6316
		Cr	567	526	837	769	1457	1376
		Cb	400	366	870	786	2678	2461
		Total	11850	11631	18014	16982	10504	10153
	Total		19489	19484	29718	29786	19887	19886