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Title: Results on Spatial Scalability
Core Expt. TM5: G.6.6.
Source: T. Naveen, Tektronix Inc.
Purpose: Information

I. Introduction

This document presents our simulation results on comparison of dual-loop mode spatial scalability with spatio-temporal weighted prediction, and spatial scalability with spatial only or temporal only prediction (binary selection). This is the MPEG2 Core Expt. G.6.6 in Test Model 5.

II. Simulation Details

A. Common to both methods

Resolution scales: 1/4 and 1
Bit rates: 1.5, 2.5 Mbps for 1/4 and 1 scales respectively in one case, and 2.5, 3.5 Mbps for 1/4 and 1 scales respectively in another
Two layer pyramidal coding schemes, with 2 motion compensation loops
Rate Control: Macroblock rate control, including step 3; TM5 linear mquant
M = 3, N = 15, 4:2:0, 150 frames
Frame structure, frame/field motion vectors, frame/field adaptive DCT
All layers at full temporal resolution: Lower layer video is SIF-Interlaced; Upper layer is CCIR-601/525
±16 radius motion estimation for upper, as well as lower layers.
Interlace to interlace up-sampling, as well as down-sampling were performed through an intermediate progressive stage. Vertical/Temporal upsampling filters given in Table G.2, TM5 were used to obtain this intermediate stage.
Inter quantization was used in spatially predicted blocks in I pictures. Two new entries in the VLC Table B.2c3 for B-Pictures, TM 5, were used:

- 0000 0010 0: compatible, no motion, non-intra, macroblock pattern, no mb-quant
- 0000 0010 1: compatible, no motion, non-intra, macroblock pattern, mb-quant

Table 1: PSNR performances of two versions of spatial scalability and simulcasting

Sequence	Scaling Type	4 Mbps		6 Mbps	
		Lower	Upper	Lower	Upper
Bus	Simulcast	30.60	29.25	33.38	31.09
	Spatial with weighted prediction		30.37		32.47
	Spatial with binary selection		30.47		32.56
Cheer Leaders	Simulcast	26.66	26.85	29.41	28.41
	Spatial with weighted prediction		29.84		32.64
	Spatial with binary selection		30.05		32.89
Flower Garden	Simulcast	30.04	27.18	32.94	29.06
	Spatial with weighted prediction		27.77		29.65
	Spatial with binary selection		27.81		29.69
Mobile & Calendar	Simulcast	29.07	26.16	31.78	27.74
	Spatial with weighted prediction		26.26		27.95
	Spatial with binary selection		26.30		27.98

B. Specific to Weighted prediction method

Prediction weight codes given in Table G.1, TM5 are used.

A variance bias of 128.0 given to the pure-spatial prediction mode (prediction_wt_code = 10, or pure-compatible type) during macroblock typing.

C. Specific to Binary Selection method

Prediction weight codes are not transmitted. Determination of the mode of prediction (temporal or spatial) can be made from the macroblock type.

During macroblock typing, a variance bias of 128.0 given to the spatial-only prediction mode compared to temporal-only prediction mode.

III. Simulation Results

A variety of biases towards selection of all-spatial (pure-compatible) prediction (code 10 in weighted prediction experiment) were simulated. Based on these simulations, a bias of 128.0 was selected. Simulation results for (a) simulcast, (b) spatial scalability with spatio-temporal weighted prediction, and (c) spatial scalability with a binary selection of spatial/temporal predictions are compared in Table 1.

IV. Conclusions

Based on Table 1, we can conclude that:

1. There is a SNR gain from using either of the spatial scalabilities, when compared to a simulcasting situation.
2. Spatial scalability with binary selection performed better than spatial scalability with weighted prediction.

The spatio-temporal weigted prediction for spatial scalability adds complexity to the encoder as well as the decoder, without providing any performance gain over a simple binary selection method.