CCITT SGXV
Working party XV/1
Specialist group on coding
for visual telephony

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SUBJECT : PREDICTIVE MOTION ESTIMATION

SOURCE : SWEDEN

Introduction.

A problem with block-matching motion estimation is that the amount of bits needed to transmit for the motion fields often becomes to large for n x 64 kbit/s (n= 1,2) purposes, especially when an accurate estimation is applied using small blocks and sub pel displacements.
The smallest residual is obtained by using a full search matching algorithm which causes a problem in this respect; Low correlation in the vectorfield due to many good but non-true matches makes transmission of the vectorfields difficult without a substantial decrease in performance.

Method

A considerable increase in the correlation of the motion vectorfield can be obtained by using prediction from previous vectors.
The vectorfield is then a better representative of the true motion and can thus be used for interpolation/extrapolation purposes at the decoder.
At the same time the increased correlation in the vectorfield makes it possible to use DPCM or transform coding for the motion fields resulting in a substantial decrease in the amount of information to transmit to the decoder.
Prediction of the motion vectors can also be used to decrease the number of needed operations for the estimation.
Good results has been obtained by using this together with a logarithmic search algorithm.

Results

Results from a comparison between three schemes is shown below.
All schemes uses 4 by 4 estimation blocksize with a subpel accuracy of 1/4 pel.
The compensation has been made on original pictures, 10 Hz framerate.

The three schemes are :

1) Ordinary full search.
Max displacement +/- 8 pels/lines.

2) Logarithmic search.
Start displacement +/- 4 pels/lines
No prediction used.

3) Same as 2) but using prediction.

Conclusion

The simulation result show a considerable decrease in the amount of transmitted motion field information by using this type of estimation technique, together with compression methods.

A competitive standard on n x 64 kbit/s will have to be flexible for future algorithm development, for instance to allow the possibility to transmit motionfield information in a more efficient way.

Sequence	ANE frame difference	Motion estimation method	Mega operations for est.	ANE comp. frame difference	Coding method	ANE coded compensated difference	Bitrate for motion fields kbit/s
Miss America frames 82- 91	33.56	Fullsearch 1/4 frac.	242	38.79	DPCM	38.79	188
					Transform finer	37.90	155
					Transform coarser	37.11	91
		Log. search no predict. 1/4 frac.	24	38.26	DPCM	38.26	224
					Transform finer	37.58	226
					Transform coarser	36.63	126
		Log. search 1/4 frac.	12	38.21	DPCM	38.21	86
					Transform finer	37.53	7.6
					Transform coarser	37.17	4.8

Sequence	ANE frame difference	Motion estimation method	Mega operations for est.	ANE comp. frame difference	Coding method	ANE coded compensated difference	Bitrate for motion fields
Claire frames 31-40	29.94	Fullsearch 1/4 frac.	147	40.78	DPCM	40.78	135
					Transform finer	37.66	81
					Transform coarser	36.19	47
		Log. search no predict. 1/4 frac.	18	39.37	DPCM	39.37	148
					Transform finer	37.32	100
					Transform coarser	36.10	61
		Log. search 1/4 frac.	14	38.50	DPCM	38.50	104
					Transform finer	37.31	17
					Transform coarser	36.84	10