Fast Partial Distortion Elimination Algorithm for Lossless and Lossy Motion Estimation Using Hadamard Transform and Probability Model

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We intuitively derive DC and AC constraints to model local block complexities using ordered Hadamard transform from pixel based gradient method. For lossless motion estimation (ME), using (1), we obtain the optimized search order in the matching error calculation by descending order of local constraints using sum of these two constraints.

$$LBC(k) = AC_{Sum}(k) + |DC_{MB} - DC_{LB}(k)|$$ (1)

After the calculation of all local block complexities, the partial SAD is calculated in the order of greatest local block complexities for each local block. This enables ME more quickly in the SAD calculation of a candidate position.

And for lossy ME, using two probability models which are approximated by the CDF of constraints and previous minimum SAD, we also propose the accurate total matching error prediction algorithm in the middle of calculation without all matching error calculations by (2).

$$Predictive\ SAD(k) = \frac{Partial\ SAD(k)}{CDF_{LB}(k) + w \cdot CDF_{pmSAD}(k)} - SAD_{LB}(k)$$ (2)

Compared with full search algorithm (FSA) and Kim’s algorithm [3], various experiments were tested on the MPEG-4 Optimization Model [1] with Recommend conditions [2]. The value of $w$ in (2) was set equal to 0.95 by various experiments. Compared with the conventional FSA, proposed algorithm reduces the ME complexity up to 92.4% for lossy ME and 89.4% for lossless ME with bit-rate decrease (-0.04%) and negligible PSNR loss (-0.001dB) on average.

References

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