CONTRIBUTION

We propose the EB-TDTP method to fully account for the TDTP interference with sub-pixel interpolation filter, and spatial correlations outside the reference block boundary.

BACKGROUND: TDTP

Traditional inter prediction copies pixels one-by-one, which is suboptimal because it ignores spatial correlation.

Transform Domain Temporal Prediction (TDTP): DCT (largely) achieves spatial decorrelation, enabling optimal one-to-one prediction in DCT domain.

Pixel Domain

\[ \rho \approx 1 \]

DCT Domain

At low frequency, \( \rho \approx 1 \)

Temporal correlation \( \rho \) in pixel domain is dominated by the low frequencies (\( \rho \approx 1 \)), inspiring the traditional pixel copying prediction.

TDTP: Accounts for variation in temporal correlation across frequency, which is hidden in pixel domain.

The optimal TDTP predictor for each transform domain coefficient is given by,

\[ \hat{x}_n = \rho \hat{x}_n \]

\[ E(\hat{x}_n - x_n) \]

\[ E(\hat{x}_n^2 - 1) \]

At high frequency, \( \rho < 1 \)

EB-TDTP

TDTP did not completely dis-entangle spatial and temporal correlation, and ignored the correlation outside the block.

The optimal prediction coefficient is the temporal correlation coefficient, assuming \( \hat{x}_n \approx x_n \).

The optimal prediction coefficient is the temporal correlation coefficient, given by, \( \hat{x}_n = \rho \hat{x}_n \).

\[ x_n = \frac{E(x_n \hat{x}_n+1)}{E(\hat{x}_n+1)} \]

CHALLENGE

TDTP: scales the DCT coefficients by \( \rho \), where at low frequencies \( \rho \approx 1 \), and at high frequencies \( \rho < 1 \).

Interferes with the low-pass sub-pixel interpolation filters, which has similar frequency response.

EXTENDED BLOCKS TDTP

First get the extended reference block with all the neighbor information, de-correlate the spatial correlation using DCT, design the prediction coefficients for each DCT coefficient, then follow the standard sub-pixel interpolation procedure to get the final prediction.

The prediction coefficients \( P_B \) is designed to optimize the final prediction error, which can be converted to a linear optimization problem.

Asymptotic Closed-Loop (ACL) Design

Introducing a new predictor results in different statistics, which will propagate and grow over frames through the closed loop video coding operation.

This deviation in statistics between design and operation makes an effective off-line training impossible.

EXPERIMENTAL RESULTS

The proposed approach was implemented in HM 14.0. Both prediction size and transform size are restricted to 8x8, and the motion search is at half-pixel precision.

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