An Optimal Switched Adaptive Prediction Method for Lossless Video Coding

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In this work, we propose a method of lossless video coding which not only has the decoder simple but the encoder is also simple, unlike other reported methods which has computationally complex encoder. The computation is mainly due to not using motion compensation method, which is computationally complex process. The coefficient of the predictors are obtained based on an averaging process and then the obtained set of switched predictors is used for prediction. The parameters have been obtained after undergoing a statistical process of averaging, so that proper relationship can be established between the predicted pixel and their context.

The change in the intensity values in successive frames is a useful characteristic feature termed as slope which can be used to predict the unknown pixel as it is expected to fall in the same slope rule. Since slope space is large, we tried to optimally classify the slope into bins. After experimenting on the number of bins to be made and their boundary values, we found that the number of bins more than seven do not yield any significant improvement in the performance. In the proposed model we have taken one past frame and the current frame for slope estimation by measuring the variation along x, y and t direction.

$$dh = |W - WW| + |N - NW| + |N - NE| + |X' - W'| + |N' - NW'| + |N' - NE'|$$

$$dv = |W - NW| + |N - NN| + |NE - NNE| + |W' - NW'| + |X' - N'| + |E' - NE'|$$

$$dt = |W - W'| + |NW - NW'| + |N - N'| + |NE - NE'|$$

where N, W, WW, NW, NE, NNE are positions of pixel in current frame while the rest are of previous frame.

Since there are unequal numbers of term in the expression of dx, dy and dt, so we normalize the slope using the following expression:

$$s = \frac{dx}{6} - \frac{dy}{6} - \frac{dt}{4} \tag{1}$$

After the classification, a different predictor is associated with each of the bins. This forms the basic structure of the algorithm. After this classification of slope and association of predictors to each bin, the prediction scheme for the unknown pixels can be obtained as follows:

Firstly, A set of first 'M' frames of the video sequence are taken and the frames are selected one by one out of these 'M' frames for the next step. Secondly, a bin is selected and all the pixels, of the frame, that belong to the selected bin are identified. Then the feed forward type of LS based predictor is obtained for all the pixels belonging to the bin. Similarly, the LS based predictor is obtained for other bins, which results, into a set of switched predictors formed for the chosen frame. The steps are carried out for each frame of the set M. Then we average these M sets of switched predictors to get the optimal set of switched predictor which can be used for the prediction of complete video sequence. This set of switched predictor is passed as the overhead information to the decoder.

The paper presents an adaptive switched predictive coding method for lossless video compression. In this scheme we have calculated the set of switched predictors using just for the first M frames and then have computed the set of switched predictor from the obtained predictors. This set of adaptive switched predictors serves the purpose prediction for entire video sequence. Beauty of the paper is in its low complexity with better performance. The proposed method analyzes every video in the training process and then computes the AR parameters which are sent to the decoder releasing it from the task of computing the parameters once again unlike other methods available in the state-of-art of video compression. Moreover the proposed method shows improved performance for large frame size video sequences.

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