

Abstract:

Error resiliency and error concealment are two important tools to combat the effects of data loss during video transmission of multimedia data over lossy channel. This thesis addresses these two issues, taking scene content into consideration.

Error Concealment (EC) techniques attempt to reconstruct the lost area of a frame in a video sequence using spatial and/or temporal correlation. Temporal error concealment (TEC) schemes perform better than spatial error concealment (SEC) schemes in terms of PSNR of the reconstructed frame. However, the performance of TECs deteriorates drastically in presence of scene transitions due to lack of temporal correlation. In the present work, an encoder driven Scene and Illumination Change Index (SICI), a measure of scene change information, is proposed which facilitates error resilience at the encoder and selection of concealment policy between TEC and SEC at the decoder.

A novel SEC scheme, termed as Directional Edge Based Spatial Error Concealment (DEBSEC) is introduced to reduce the blurring. In the proposed DEBSEC scheme, first the edges surrounding the corrupted macroblocks (MB) are detected, then the strongest edge from each direction bin is considered as the candidate edge for the weighted interpolation. A novel TEC technique, assisted by Candide-3 face model, is proposed for the concealment of corrupted region of head-and-shoulder video with reduced visual artefact compared to conventional state-of-the-art video error concealment schemes which reconstruct the lost area through a reconstruction of planar 2-D patches, approximating 3-D movements by translational motion. In the proposed model assisted TEC scheme, the face model is first adapted to facial images and then updated and tracked across frames, even in presence of lost MBs using Kalman filtering. The lost portions of the face are reconstructed through the projection of the 3-D model on the 2-D plane. In unequal error protection schemes, Forward Error Correction (FEC) codes are applied on the video data streams, considering varying importance of video data packets.

In this work, three FEC allocation schemes have been proposed. Two of the proposed schemes are for the streaming video, where FEC packets are allocated to the video data packets, minimizing estimated end-to-end distortions applying significant importance to the packets containing encoded data from the transition frames along with frame position within the Group of Pictures (GOP) and estimated concealment distortion. These strategies are proposed within the Block of Packets (BOP) structure - one is an iterative modified hill climbing approach and the other is a reduced complexity heuristic approach. In the third scheme, buffering of video packets from one GOP is not permitted. There FEC packets are allocated to the video packets from individual frames, satisfying channel bit rate within a moving window of size equal to the number of frames within a GOP.

Keywords: Scene and Illumination Change Index, Error Concealment, DEBSEC, Unequal Loss Protection, Model Based Error Concealment.