Abstract

Digital video compression has been research topic for many years. Most of the video compression architectures are aimed at compressing the video with high complex encoders and low complex decoders, which are termed as conventional video coding schemes. Compressing the video with low complexity encoders has become the essential requirement for the portable multimedia devices. For this purpose, distributed video coding (DVC) is considered as a suitable solution. Due to the poor Rate-Distortion (RD) performance compared to the conventional video coding scheme H.264, much importance is given to improve the compression efficiency of DVC since last decade. DVC architecture is composed of several blocks and each block is having a considerable impact on the RD performance. In this thesis, several architectures are designed to improve the compression performance focusing on different blocks.

The first work in this thesis is aimed at improving the quality of side information (SI) through layering approaches for transform domain wyner-ziv (TDWZ) codec. Each Wyner-Ziv (WZ) frame is divided into multiple layers and each layer is encoded independently. At the decoder, each layer is decoded by exploiting the correlation between the layers. After decoding each layer, temporal and spatial correlation is exploited to refine the quality of side information for decoding the next layer. The first contribution in this thesis is to propose three layering approaches for improving the quality of SI. The proposed three layering schemes are (a) block based, (b) block and Discrete Cosine Transform (DCT) band based and (c) band based.

In the second work, we propose encoder and decoder driven skip/WZ coding mode decision schemes. In the encoder driven approach, coding mode decisions are applied at 8x8 block and DCT coefficient level. In the decoder driven approach, mode decision scheme is proposed for SI refinement based WZ codec and applied at 8x8 block and layer level.

In WZ codecs, WZ frame is encoded without considering the amount of correlation noise present between the original WZ frame and the decoder estimated SI. The number of parity bits required to decode the WZ frame is more compared to the case where the

WZ encoding is performed by considering the correlation noise (CN). The third part of the thesis is to propose the CN based WZ encoding scheme.

To improve the quality of reconstructed WZ and key frames, post-processing schemes are proposed in the next part of thesis. The first post-processing scheme is to improve the quality of key frames by using WZ frames. The processed key frames are used to improve the quality of SI for decoding WZ frames. The key frame processing scheme is employed at encoder to improve WZ encoding. The second post-processing schemes is to improve the quality of reconstructed WZ frames by using non-local means filter. In the final post-processing scheme, block motion estimation and optical flow based SI refinement scheme is proposed for improving the quality of decoded WZ frames in higher group of pictures (GOP)

The final contribution of this thesis is related to WZ architectures for feedback channel free and limited feedback channel. In the feedback channel free WZ architecture, 8x8 block level skip/WZ, DCT band and frame level intra/WZ coding mode decision schemes are employed at encoder. Unequal error protection based rate estimation scheme is proposed for improving the quality of SI estimation at decoder. At the decoder, iterative decoding tools are used to reduce the bit-plane errors and adaptive reconstruction is proposed to improve the quality of reconstructed WZ frame. In the limited feedback channel WZ architecture, number of feedback channel requests are limited for each WZ frame. In the feedback channel constrained WZ architecture, rate estimation and techniques to correct the errors present in the SI are proposed. To utilize the feedback channel effectively, the number of parity bits to decode the WZ frame is initially calculated by the encoder. At the decoder, for each feedback channel request, the additional number of parity bits required to successfully decode the bit-planes are calculated and requested from the encoder. After each feedback channel request, the following steps are applied. (1) The proposed error correction techniques are applied to decode the unsuccessfully decoded bit-planes by using updated number of parity bits, (2) SI is refined and (3) The proposed error correction techniques are applied to decode the unsuccessfully decoded bit-planes by using updated parity bits and the refined SI.

Keywords: Side Information, Wyner-Ziv coding, Slepian-Wolf coding, feedback channel, Correlation noise, mode decision, key frames, WZ frames, Intra coding, Channel coding, Reconstruction.