Distributed Video Coding: Iterative Improvements

Nowadays, emerging applications such as wireless visual sensor networks and wireless video surveillance are requiring lightweight video encoding with high coding efficiency and error-resilience. Distributed Video Coding (DVC) is a new coding paradigm which exploits the source statistics at the decoder side offering such benefits for these applications. Although there have been some advanced improvement techniques, improving the DVC coding efficiency is still challenging.

The thesis addresses this challenge by proposing several iterative algorithms at different working levels, e.g. bitplane, band, and frame levels. In order to show the information theoretic basis, theoretical foundations of DVC are introduced. The first proposed algorithm applies parallel iterative decoding using multiple LDPC decoders to utilize cross bitplane correlation. To improve Side Information (SI) generation and noise modeling and also learn from the previous decoded Wyner-Ziv (WZ) frames, side information and noise learning (SING) is proposed. The SING scheme introduces an optical flow technique to compensate the weaknesses of the block based SI generation and also utilizes clustering of DCT blocks to capture cross band correlation and increase local adaptivity in noise modeling. During decoding, the updated information is used to iteratively reestimate the motion and reconstruction in the proposed motion and reconstruction reestimation (MORE) scheme. The MORE scheme not only reestimates the motion vectors for improving SI and noise modeling but also compensates the residual motion based on the previously decoded WZ frames. Furthermore, the MORE codec enhances the reconstruction by proposing a generalized reconstruction algorithm to optimize reconstructing with multiple competitive SIs. Finally, an adaptive mode decision is investigated to take advantage of skip and intra mode in DVC by deciding the coding modes based on the quality of key frames and rate of WZ frames. Overall, the proposed algorithms significantly improve the coding efficiency of DVC contributing valuable solutions for the emerging applications.

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