Ming Hsieh Department of Electrical Engineering

Enhanced Scalable MDC For Wireless Video Transmission

Lei Feng

Advisor: C. –C. Jay Kuo

Electrical Engineering/Signal Processing Group

USC Viterbi School of Engineering

Abstract

Enhanced Scalable Multiple Description Coding system is proposed to provide spatial scalability and error resilience for wireless video transmission over two-antenna MIMO system in case of heterogeneous different resolutions and channel failures. The proposed method is to spatially subsample input video as four levels that are assigned into primary and redundant modules which are further grouped into descriptions. With introduced context based adaptive prediction mode the results show under channel failures BD-PSNR can be up to more than 10dB compared with H.264/AVC Flexible Macroblock Ordering.

Proposed method description

ESMDC system is shown in Fig. 1. Input video sequence is spatially subsampled into four parts: P1, P2, P3 and P4. For description1 P1 and P2 are primary module whereas P3 and P4 are redundant module. P1 is coded as base level and P2 is coded as subsidiary level2 dependent on P1. P3 and P4 are coded as subsidiary level3 and level4 which are dependent on both of P1 and P2. Description2 is opposite where P3 and P4 become primary module and P1 and P2 become redundant module.

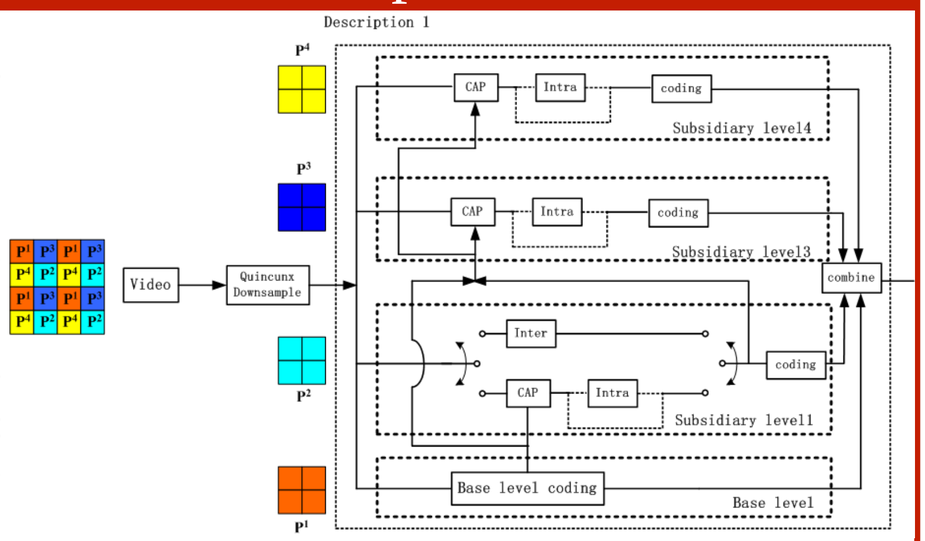


Fig. 1 ESMDC system scheme for description1

Error resilience and spatial scalability

If both of the descriptions received, the primary modules from both descriptions are kept and redundant modules are discarded. Otherwise, if only one description received, both the primary and redundant modules of the description will be used. This mechanism is very useful for MIMO system with spatial multiplexing where possible channel failure may occur.

Spatial scalability can be realized by discarding all subsidiary levels in each description to obtain the low resolution video, or to keep the subsidiary levels to reconstruct the full resolution.

Context based Adaptive prediction (CAP)

Predict P2 from reconstructed part

If (Variance of 4x4 neighbors >=Threshold)

MAD along 0, 45, 90, 135 degree in 4x4 block

If (ratio MAD for 45 or 135 degree< Threshold)

1-D spline interpolation along the direction — **Sharp edge**

Else if (ratio MAD for 0 or 90 degree< Threshold)

2-D bi-cubic interpolation

Else — **Rough area**

2-D weighted bilinear interpolation (weight from MMSE)

Else

2-D bi-cubic interpolation — **Smooth area**

Simplified CAP

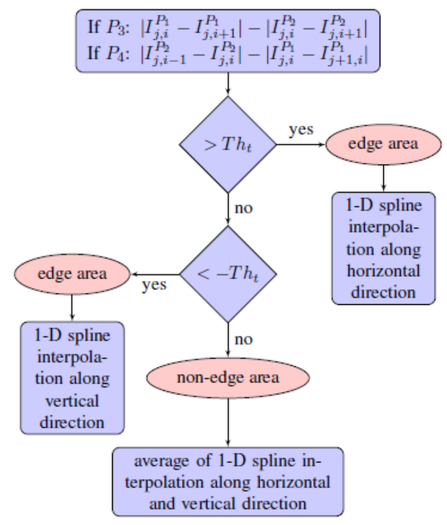


Fig. 2 Simplified CAP flow for P3 and P4 prediction

Experimental results

ESMDC is implemented in JSVM 9.19.14 and H.264/AVC FMO is Implemented in JM 11.0. The BD-PSNR under channel failure 5%, 10%, 30% and 50% is shown in Table. 1.

	soccer	crew	city	harbor
5%	2.998	0.534	-0.988	0.690
10%	5.322	2.336	0.925	2.852
30%	8.855	5.517	4.048	6.374
50%	10.24	6.899	5.313	7.838

Table. 1 BD-PSNR for comparison with H.264/AVC FMO

H.264/AVC FMO can only rely on error concealment at receiver when only one description received which is not efficient for moving objects causing significant quality degrading as shown in Fig. 3 and Fig. 4.

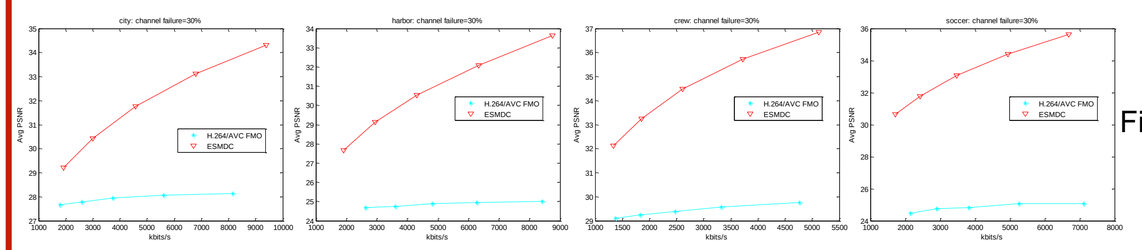
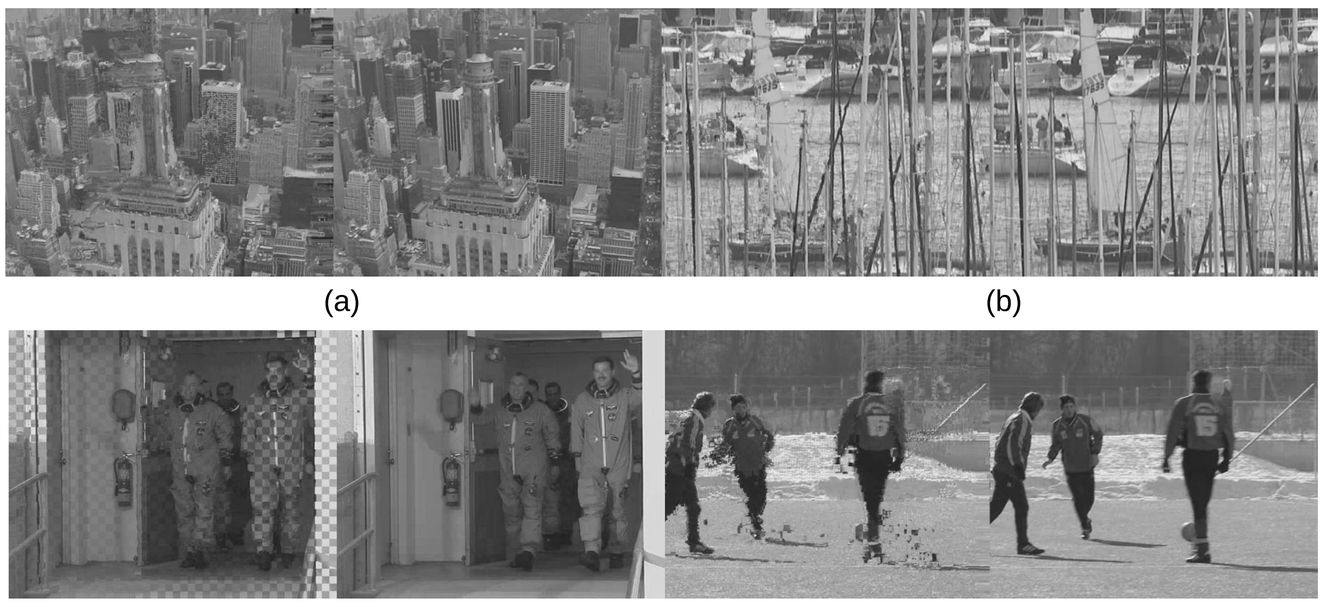


Fig. 3 Average PSNR versus bit rate under channel failure 30% (from left to right: ‘city’, ‘harbor’, ‘crew’, ‘soccer’)



(a) (b)

(c) (d)

Fig. 4 (a) ‘city’ (left: H.264/AVC FMO, right: ESMDC); (b) ‘harbor’ (left: H.264/AVC FMO, right: ESMDC) (c) ‘crew’ (left: H.264/AVC FMO, right: ESMDC); (d) ‘soccer’ (left: H.264/AVC FMO, right: ESMDC)

Conclusion and Future work

We proposed the ESMDC system which is suitable for robust video transmission over MIMO. The experiment shows ESMDC can overall outperforms H.264/AVC FMO under different channel failure conditions. In addition to error resilience, ESMDC could provide spatial scalability by discarding subsidiary levels in each description. Since ESMDC is implemented in JSVM, the header information of NALUs provides priority information for further unequal error protection or bandwidth adaptation for each description. In future work, we are going to research bit allocation for primary and redundant module by adjusting QP according to different channel conditions.

Email: leif@usc.edu

Ming Hsieh Institute
Ming Hsieh Department of Electrical Engineering