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Implementation and Analysis of Video Error Reconcealment: An Overview

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***Abstract* — With rapidly growing interest in video delivery over unreliable channel such as wireless networks, Error concealment in video communication is becoming increasingly more important. Motion Vector Recovery is one important subclass in Error concealment. MVR techniques attempts to retrieve the lost motion information in the compressed video streams based on the available information in the locality of lost data. The main task of error concealment is to replace missing parts of Image and video content by previously decoded parts of the Image, video sequence in order to eliminate or reduce the visual effects of bit stream error.**

***Key Words* — Error concealment, Video communication**

I. INTRODUCTION

Due to the rapid growth of wireless communications, video over wireless networks has gained a lot of attention. At the beginning, wireless communications was conceived for voice communication; however, nowadays it is able to provide a diversity of services, such as data, Image, audio and video transmission thanks to the apparition of third and fourth generation (3G/4G) developments of cellular telephony.

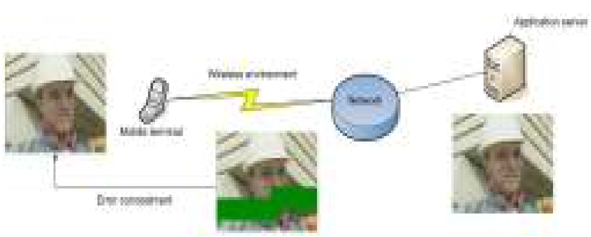

Figure 1: 3G/4G Cellular System

Techniques for error control and error concealment must be employed when video communication on unreliable transmission environments such as wireless network and Internet. Error concealment by post-processing at the decoder is one of the important strategies for combating transmission errors in video communication

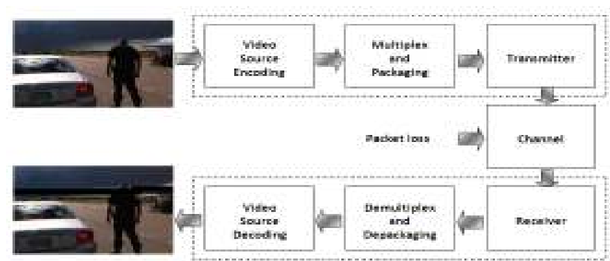

Figure 2 : Block Diagram of the Process

The problem of error control and concealment in video communication is becoming increasingly important because of the growing interest in video delivery over unreliable channels such as wireless networks and the Internet. One inherent problem with any communications system is that information may be altered or lost during transmission due to channel noise which can generate random bit errors or packets losses in a packet network. The effect of such information loss can be devastating for the transport of compressed video because any damage to the compressed bit stream may lead to objectionable visual distortion at the decoder. These distortions are visually annoying and are certainly not acceptable for entertainment applications.

II. LITERATURE REVIEW

Researchers have mostly used Spatial Error Concealment (SEC) and Temporal Error Concealment (TEC) in which SEC is found to give enhanced image quality than TEC and the performance of various error concealment methods calculated by PSNR [1], [5], [7], [12].

The main computational complexity involved is finding the best concealment method for each MB and building the tree. As for the memory requirement at the encoder, the learning sample derived from a frame is about 20 times smaller than the frame itself, so a learning sample derived from a GOP or multiple GOPs may well be reasonable [2].

High-quality restoration of a missing block in an image can be achieved using a few border pixels and with a computation load of about one multiplication per computed pixel. The restoration quality is almost independent of the interpolation coefficient accuracy and a 1-b representation leads to very little degradation. In the 1-b representation process, several interpolation coefficients are actually cancelled. This shows that a given pixel can, in fact, be restored with few most close border pixels and simple combination rules [3].

A content adaptive error concealment algorithm is proposed that reconstructs error blocks by taking advantages of both spatial interpolation EC and block matching EC. In order to select an appropriate EC, an effective content classifier is first presented. And then, to each category, a suitable EC method is introduced. Experimental results show that EBs with different contents is well reconstructed and the subjective visual quality concealed by the proposed algorithm is great improvement over that of concealed only by any one of the three candidate methods. The proposed algorithm exploits only the intra-frame information and is applicable to errors in MPEG, H.26x and JPEG coded images or videos transmitted over error-prone networks [4].

New shape error concealment schemes for MPEG-4 video transmission are proposed. In the proposed spatial domain algorithm BCF, there are only three points needed to be found for curve fitting. The feature, which just needs three control points, is very appropriate to exploit Bezier curve theory. Although many other curve-interpolation theories, e.g., Hermite interpolation, cardinal spline, B-spline, etc., could draw the approximated curve to imitate the error shape, most of them need more than three control points or higher computation complexity to achieve the similar performance as our proposed algorithm. For WSM, nearer pixels to the boundary of error block provide larger weights. Spatial and temporal error concealment algorithms get higher objective and subjective performances [5].

Yen Chen, Xiaoyan Sun, Feng W u, Zhengkai Liu and Shipeng Li proposed a spatio-temporal error concealment algorithm based on priority-ranked region-matching is proposed. Rather than recovering the MBs in “lost” area one by one, the proposed scheme is able to conceal the “lost” MBs from different directions according to the priorities of the edge pixels [6].

This combination order is based on experimental observation and achieves better result than other possible combination orders. Every time we combine two EC algorithms, the weighting coefficients are set to 0.5 for the results of both algorithms. Although it is possible to use other weights, the equal weights are found during the experiments to produce the best results in most cases. The proposed JSTEC is better than the existing algorithms both in PSNR and in subjective quality for a wide range of block error rates and quantization parameter settings [7].

SVC has been recently approved as an international standard. Apart from better coding efficiency, it provides improved adaptation capability to heterogeneous network compared to earlier SVC standards. Error resilient coding and error concealment are highly desired for the robustness and flexibility of SVC-based applications. In this paper, we reviewed error resilient coding and error concealment algorithms in H.264/AVC and SVC. LA-RDO algorithm for SVC was presented in detail. Moreover, five error concealment methods for SVC were proposed and analyzed. Simulation results showed that LARDO for SVC, the proposed error concealment methods, and their combination improve the average picture quality under erroneous channel conditions when compared to the design applying no error-resilient tools at the encoder and only picture copy error-concealment method at the decoder [8].

It introduces a precise motion vector refinement algorithm to improve the motion vector precision derived by a motion copy error concealment method. In our proposal, the motion vector differences between any successive frame pair are calculated first. Afterwards, the recursive motion vector difference refinement area selection algorithm is performed iteratively to discover an area which will be used to obtain the final refined motion vector differences. Finally, the motion vector difference with maximum occurrence will be extracted from the refinement area and added to the motion vector derived by motion copy method to obtain the motion vector for concealing the current lost frame. Simulation results show that our proposed whole frame loss error concealment algorithm can achieve significant PSNR improvement when compared to previous works [9].

Two basic and one hybrid MDC method have been proposed by Chia-Wei Hsiao and Wen-Jiin Tsai. The MDC process in the hybrid encoder is divided into two stages: the first stage splits the residual data into spatial domain, and the second stage splits the ac coefficients into the frequency domain. In the decoder, two types of estimation of lost description, which explore the spatial correlation between residual pixels and the frequency correlation between adjacent blocks, were proposed to improve the reconstruction quality when there are descriptor losses. The performance evaluation of the proposed MDC methods in both descriptor loss and packet-loss environments has been provided. It concludes that the proposed hybrid method is adaptive to heterogeneous networks with different number-of-descriptor requirements and also adaptive to dynamic environments with packet loss during transmission [10].

Mengyao Ma, Oscar C. Au have proposed an EDEC algorithm to recover the lost regions in a video frame. It consists of three main steps. First, the strong edges in the corrupted frame are estimated based on the edges in the neighboring frames and the received area of current frame. Second, the lost regions along these estimated edges are recovered using both spatial and temporal neighboring pixels. Finally, the remaining parts of the lost regions are estimated. The proposed EDEC algorithm can reconstruct the corrupted frame with both a better visual quality and a higher decoder PSNR [11].

The proposed method shows that a joint spatial and temporal estimation which takes advantages of data correlation in these two domains for better estimation of lost descriptions.

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It included fixed and adaptive approaches for estimation method selection. The fixed approach adopted the estimation methods based on the situations of description loss, while the adaptive approach adopted the estimation methods according to spatial and GTs of the lost pixels and thus, was adaptive to different kinds of video sequences. The proposed approaches were designed in the context of the hybrid MDC which segmented the video in both temporal and spatial domains. With the proposed estimation methods, the Hybrid MDC was adaptive to various video sequences and PLRs [12].

III. Implication

The proposal assumes that no erroneous or incomplete slices are decoded. After all received slices of a picture are decoded; skipped slices are concealed according to the proposed algorithms. In practice, record is kept in a Macro block (MB) based status map of the frame. The status of a Macro block in the status map is "Correctly received" whenever the slice that the Macro block is included in was available for decoding, "Lost" otherwise. After the frame is decoded if the status map contains "Lost" Macro blocks, concealment is started.

Given the slice structure and Macro block based status map of a frame, the concealment algorithms were designed to work Macro block -based. The missing frame area (pixels) covered by Macro blocks marked as "Lost" in the status map are concealed MB-by-MB (16x16 Y pixels, 8x8 U, V pixels). After a Macro block has been concealed, it is marked in the status map as "Concealed". In Concealment Process, “lost” macro block are concealed is important are also the “Concealed” and “correctly received” macro block are treated as reliable neighbor. In such cases a wrong concealment can result in propagation of this concealment mistake to several neighbor concealed Macro blocks. The processing order chosen is to take the Macro block columns at the edge of the frame first and then move inwards column-by-column so to avoid a concealment mistake made in the usually "difficult" (discontinuous motion areas, large coded prediction error) center part of the frame propagate to the "easy" (continuous motion area, similar motion over several frames) side parts of the frame.

Error! Reference source not found.3. Shows a snapshot of the status map during the concealment phase where already concealed Macro blocks have the status of "Concealed", and the currently processed (concealed) Macro block is marked as "Current MB".

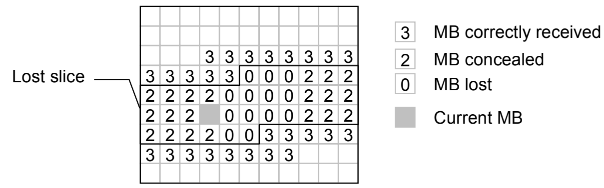

Figure 3: MB status map at the decoder

We considered the eight different EC methods listed in Table- I [2]. The first column lists the name by which we reference the method, the second column lists the types of frames for which it is used, and the last column summarizes how it works. Note that we consider only MBs which have both top and bottom vertical neighbors in a frame, i.e., do not reside in the first or last slice of a frame. The spatial interpolation method works by linearly interpolating within a vertical column from the two nearest pixels in the adjacent top and bottom MBs. For us, an MB consists of 6 blocks of 8 8 pixels, four from the luminance plane and one from each chrominance plane. In frequency interpolation, the lowest nine DCT coefficients (for each of the six blocks composing the missing MB) are estimated by a weighted average of the corresponding lowest nine DCT coefficients of the blocks above and below. Both spatial and frequency interpolation can be used for any type of frame. However, this frequency interpolation requires the presence of the neighbor’s DCT coefficients, thus both top and bottom MBs must be intracoded, which normally happens less than 5% of the time for P frames and 0.5% for B frames. So frequency concealment is not used for P and B frames.

There are five different methods which depend on the presence of other motion vectors in the frame, and so are not immediately applicable to I frames. Two of these are new, and are denoted “panning” and “top/botMV.”

Panning: When a camera pans, many MBs in a scene have similar MVs corresponding to the true panning motion. Individual MBs might have different MVs for a variety of reasons (e.g., noise, object motion). If the global panning MV can be

Method Name	Frame Type	How it works
spatial	I,P,B	interpolate linearly from boundary pixels in top/bottom MBs
frequency	I	weighted average of first 9 DCT coefficients of top/bottom MBs
panning	I,P,B	use the camera panning motion vector
top/botMV	P,B	use top MV for top 8×16 sub-MB, use bottom MV for bottom 8×16 sub-MB
averageMV	P,B	use the average motion vectors of top and bottom MBs
useonlyMV	P,B	top or bottom MB is Intra-coded ⇒ use the only MV available
spat+onlyMV	P,B	use only available MV for nearest half, spatial interpolation for rest
copyPrvb	I	copy co-sited MB from previous P frame if it's Intra-coded or has MV=0

Table.I Available method for Error Concealment

estimated, it might constitute a better estimate for EC purposes than the MVs of the neighboring blocks. We estimate the panning MV by putting all nonzero MVs for the current frame into a histogram with 47 47 bins, which represents MVs ranging from half pixels in both dimensions.

The histogram bin with the largest count is assumed to represent the global pan. This was found to give better results compared to just averaging together all nonzero MVs for the frame, since averaging includes objects which may be moving contrary to the global panning direction. This method can be applied to I frames by using the panning parameters estimated from the previous P frame. Top/botMV: In a P or B frame, if both the top and bottom MBs have MVs associated with them, we can estimate the MV for the missing MB by taking the average of the ones above and below (averageMV method). If the MVs above and below are very different in magnitude or direction from each other, it might not make sense to average them. Instead, we might wish to use the MV for the block above for the top half of the missing MB (8 16 submacroblock for luminance and 4 8 subblock for chrominance), and use theMV for the block below for the bottom half. This is called the top/botMV method. This method performs very well, but it has the disadvantage that since we are not providing one single MV for the missing MB, we cannot consider this error concealer as a front-end to a standard MPEG-2 decoder. If exactly one of the top or bottom MBs is intracoded, then we have only one motion vector to go by. We might want to use this one as the MV for the entire missing MB (useonlyMV) or we might want to use it only for the half MB to which it is closer, using spatial interpolation for the other half (spat onlyMV).The last method in Table I was employed only for I frames. If the co-sited MB in the previous P frame was intracoded, or had a motion vector with value zero, then that MB might be useful directly as a replacement for the missing MB. If, however, the co-sited MB had a nonzero motion vector, then likely it is not an accurate reconstruction of the current missing I frame MB. This method is referred to as copyPmb.[2]

IV. Conclusion

In this paper, brief overview of video error reconcealment is discussed. This paper gives idea about removal of error from static as well as dynamic images. It gives idea about implementation and analysis of Video Error reconcealment.

References

1. Myeong-Hoon Jo and Woo-Jin Song, Member, IEEE, “Error Concealment for MPEG-2 Video Decoders With Enhanced Coding Mode Estimation”, IEEE Transactions on Consumer Electronics, Vol. 46, No. 4, November 2000
2. Song Cen and Pamela C. Cosman, Senior Member, IEEE, “Decision Trees for Error Concealment in Video Decoding”, IEEE Transaction on multimedia, Vol. 5, No. 1, March 2003
3. Ziad Al Kachouh and Maurice G. Bellanger, Fellow, IEEE, "Efficient Restoration Technique for Missing Blocks in Images", IEEE Transaction On Circuits and system For video Technology, Vol. 13, No. 12, December 2003
4. Zhang Rongfu, Zhou Yuanhua and Huang Xiaodong, “Content-Adaptive Spatial Error Concealment for Video Communication”, Manuscript received December 17, 2004 IEEE
5. Mei-Juan Chen, Member, IEEE, Chia-Chuan Cho, and Ming-Chieh Chi, Student Member, IEEE, "Spatial and Temporal Error Concealment Algorithms of Shape Information for MPEG-4 Video", IEEE Transactions on circuits and system for Video Technology, Vol. 15, No. 6, June 2005
6. Yen Chen, Xiaoyan Sun, Feng W u, Zhengkai Liu, Shipeng Li,”Spatio-temoral video error concealment using priority ranked region matching” Microsoft research Asia, IEEE 2005.
7. Li Tang, “Combined and Iterative Form of Spatial and Temporal Error Concealment for Video Signals”, IEEE Transaction on Broadcasting, Vol. 52, No. 3, September 2006
8. Yi Guo, Ying Chen, Member, IEEE, Ye-Kui Wang, Member, IEEE, Houqiang Li, Miska M. Hannuksela, Member, IEEE, and Moncef Gabbouj, Senior Member, IEEE, "Error Resilient Coding and Error Concealment in Scalable Video Coding", IEEE Transactions on circuits and system for Video Technology, Vol. 19, No. 6, June 2009
9. Jui-Ting Chien, Gwo-Long Li and Mei-Juan Chen, Member, IEEE, "Effective Error Concealment Algorithm of Whole Frame Loss for H.264 Video Coding Standard by Recursive Motion Vector Refinement",2010 IEEE
10. Chia-Wei Hsiao and Wen-Jiin Tsai, Member, IEEE, "Hybrid Multiple Description Coding Based on H.264", IEEE Transactions on circuits and system for Video Technology, Vol. 20, No. 1, January 2010
11. Mengyao Ma, Oscar C. Au, Senior Member, IEEE, S.-H. Gary Chan, Senior Member, IEEE, and Ming-Ting Sun, Fellow, IEEE, “Edge-Directed Error Concealment", IEEE Transactions on circuits and system for Video Technology, Vol. 20, No. 3, March 2010
12. Wen-Jiin Tsai and Jian-Yu Chen," Joint Temporal and Spatial Error Concealment for Multiple Description Video Coding", Transactions on circuits and system for Video Technology, Vol. 20, NO. 12, December 2010