

Error Resilient video coding using RD optimized mode selection and rate control

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1 Motivation

In a video communication environment, unless a guaranteed quality of service (QoS) is available between the source and the destination, packets may be lost or corrupted due to traffic congestion. This is precisely the case with the current day wireless networks and Internet where error-free delivery of data packets can be guaranteed only by re-transmission of the lost/damaged packets. Such re-transmissions have the disadvantage of significant delay and spurious increased bandwidth. Also, the spatio-temporal prediction encoding and Variable Length Coding (VLC) of the source causes error propagation. Thus, error resilience [5] is an important component of the video communication system.

2 Review of existing techniques for Error resilience

Error control can be carried out at different levels from the encoder (application layer), the transport layer to the decoder (application layer). Techniques for error control at the transport layer such as FEC, error resilient packetization and delay constrained re-transmission [6] are applicable. These methods can be applied with some degree of success to correct transmission errors, however they do not guarantee complete removal of errors and the decoder may still receive erroneous bitstream. By considering error-resilient encoding techniques, these effects can be mitigated by generating a robust bitstream at the encoder that does not adversely affect the operation of the decoder under transmission losses [7]. Compared to coders optimized for coding efficiency, ER encoders are less efficient in terms of the coding efficiency in the absence of transmission errors. The extra bits are essentially redundancy bits that are introduced to enhance the video quality under losses. The redundancy can be introduced in a number of ways [6], to mitigate the effects of error propagation, facilitate decoder error concealment and minimize the effects of losses by providing a base-level quality and graceful degradation of the video quality.

3 Proposed Approach

One way to generate a robust encoded bitstream is to stop the error propagation by inserting "intra-coded" (I) macroblocks(MB) or frames to terminate the effects of error propagation by insertion of independently coded units [1]. The use of high data rate I-frames however is not favorable for real-time delay constrained networks and results in reduced coding efficiency. Hence, a less expensive option of using intra-coded MBs only in the affected high motion regions is more prudent alternative[8], [2]. The disadvantages of the schemes suggested in the literature mentioned is the fact that they are essentially greedy algorithms that look into the best decision for the MB, depending on just the distortion it carries from

the past and the resulting distortion due to its loss in the current. There has been little effort to make the decision of both mode and rate jointly for a group of MB by considering a horizon into the future. There should be advantages of jointly optimizing the macroblock mode and the quantization parameter(QP) for a group of MBs(rate control) [4] based on the loss conditions in the channel. In this project, an effort will be made to jointly optimize the rate and mode for not just a MB but to consider the joint effect of a group of MBs and its dependences in the past (parents) and future (children) in an elegant non-iterative approach. The optimization will be done in the R-D sense to minimize a Lagrangian cost for a set of modes (which affect the distortion and rate) and choice of QP (which affects the rate). Some smart pruning strategies [4] will be used to reduce the computation of unnecessary suboptimal operating points. The realization of all of the above goals is also subject to constraints of time and difficulty of implementation.

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