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Abstract

In this thesis, several practical and theoretical contributions are made to the field of robust video transmission in general and feedback-based error control in particular. Theoretical results are verified by experimental results obtained with an H.263 compatible video codec, and this important ITU-T standard is used as an example throughout the work. Three major contributions are made:

1) The concept of distortion-distortion functions (DDFs) is introduced as a formal tool for the evaluation of video quality in the presence of errors. DDFs illustrate the trade-off between both distortion types that contribute to the overall distortion at the decoder: The distortion caused by signal compression at the encoder and the additional distortion caused by transmission errors. Instead of building a combined distortion measure, both distortion types are available to evaluate the resulting system performance. The use of DDFs and their theoretical analysis also allows a better understanding of the interactions and trade-offs between system components involved in video transmission.

2) A low-complexity Error Tracking algorithm is described that allows to reconstruct spatio-temporal error propagation based on feedback information from the decoder. The result of this algorithm is an estimate of the error distribution in the current frame of the video decoder, which can then be used in the coding control of the encoder to terminate interframe error propagation. Hence, this algorithm forms the basis for the practical implementation of feedback-based error control. It has been adopted as Appendix 1 of the ITU-T Recommendation H.263 for low bit rate video coding.

3) An analysis of interframe error propagation in hybrid video coding is presented that describes the additional mean squared error (MSE) that is introduced at the video decoder after transmission errors. The derived model includes the effects of INTRA coding and spatial loop filtering and corresponds to simulation results very accurately. It can also be used to explain the performance gain of feedback-based error control – both in terms of DDFs and overall MSE.