

VIDEO ERROR-CORRECTION METHOD IN THE BITSTREAM DOMAIN

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Partner institution:

ÉTS

BACKGROUND

Wired packet networks, such as the Internet, are afflicted by packet loss. Wireless channels, on the other hand, are typically affected by bit errors. These transmission errors are one of the many challenges of video communication. Since error handling is outside the scope of video compression standards, a decoder's behavior when confronted with errors is unspecified. Thus, approaches for error control can be roughly grouped into four categories:

1. Forward error correction (FEC)
2. Retransmissions
3. Error concealment
4. Error-resilient video coding

TECHNOLOGY

Our algorithm attempts to correct corrupted video slice packets at the bitstream level (fix bits of the bitstream) using low computational complexity to further combat transmission errors. This is achieved on the decoder side as a pre-processing step to standard decoding. The system estimates (using a maximum likelihood approach) the most probable syntactically valid video slice content (video packet) based on a received corrupted video slice. The method can be applied at the slice-level or at the syntax element level. It can use an average bit error rate equally to each received bit or the soft output information (probability that a 1 is really a 1) obtained from the channel decoder (log-likelihood ratio).

COMPETITIVE ADVANTAGES

- Improved visual quality.
 - o PSNR gains near 2 dB in comparison with the error concealment algorithm in the reference software.
 - o PSNR gains near 0.8 dB in comparison with state-of-the-art error concealment.
- Wide applicability.
 - o Works with and without soft-output information.
 - o Applicable to most standards.
- Reduces error propagation.
- Small computational overhead compared to traditional decoding.
- Since it can work in a complementary fashion to error resilience, less error resilience is required to obtain the same quality as traditional methods. This means that the bits not spent on error resilience can be used to increase the video quality.

APPLICATIONS

- Mobile video applications
- Real-time applications (videoconferencing, webcast, etc.)
- Wireless links

TECHNOLOGY DEVELOPMENTAL STAGE

We built a fully functional prototype written in C/C++ of a baseline H.264 decoder implementing our error correction method. The decoder was designed and implemented from scratch and runs on Windows and Mac OS (Linux-based) systems. We demonstrated that applying the method to the decoding of H.264 baseline profile video, at the syntax element level and using only 4 header syntax elements, gives improved visual quality compared to state-of-the-art error concealment methods.

PATENT STATUS

Pending in US and Canada.
Method and system for video error correction
WO2013170381 A1

The work was also displayed in various publications:

1. Golaghazadeh, Firouzeh, Stéphane Coulombe, Fabrice Labeau, and François Caron. 2014. "Performance Evaluation of Maximum Likelihood Decoding Combined with Error Resilient Video Coding." in 2014 IEEE Symposium on Industrial Electronics & Applications (ISIEA).
2. Caron, François, and Stéphane Coulombe. 2014. "Video Error Correction Using Soft-Output and Hard-Output Maximum Likelihood Decoding Applied to H.264 Baseline Profile." IEEE Transactions on Circuits and Systems for Video Technology PP(99):1–14.
3. Caron, François, and Stéphane Coulombe. 2013. "A Maximum Likelihood Approach to Correcting Transmission Errors for Joint Source-Channel Decoding of H.264 Coded Video." Pp. 1870–74 in 20th IEEE International Conference on Image Processing (ICIP).
4. Caron, François, and Stéphane Coulombe. 2012. "A Maximum Likelihood Approach to Video Error Correction Applied to H.264 Decoding." Pp. 1–6 in 6th International Conference on Next Generation Mobile Applications, Services and Technologies (NGMAST).
5. Caron, François. 2013. "A MAXIMUM LIKELIHOOD APPROACH TO VIDEO ERROR CORRECTION APPLIED TO H.264 DECODING." PhD. Thesis. École de technologie supérieure. <http://espace.etsmtl.ca/1219/>

BUSINESS OPPORTUNITY

Co-development and licensing.

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