Video Coding for a Time Varying Tandem Channel with Feedback

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A robust scheme for the efficient transmission of packet video over a tandem wireless Internet channel is extended to a time varying scenario with a feedback channel. This channel is assumed to have bit errors (due to noise and fading on the wireless portion of the channel) and packet erasures (due to congestion on the wired portion).

The source encoder switches optimally between intra-coding and inter-coding with fixed-length packets, using the rate-distortion (RD) algorithm based on the overall distortion estimation at pixel level precision [1,2]. An adaptive FEC, which consists of a rate-compatible punctured convolutional (RCPC) inner code for error correction and a cyclic redundancy check (CRC) outer code for error detection, adjusts the coding rate according to the channel conditions [1]. The major resource shared between the source and channel encoder is the given target transmission rate. We assume that the channel is time varying, and that a backward link is available. Through this feedback channel, the receiver can signal back its estimate of the current channel conditions, or the specification of lost packets via acknowledgement (ACK) and negative-acknowledgement (NACK), or both.

Assume frame n is currently encoded, and there is a feedback delay d. One kind of feedback information is the current channel conditions. A refined estimation strategy suggests that the encoder uses the updated channel conditions to recompute the distortion estimate from frame $(n-d)$ up to and including frame $(n-1)$ recursively. The refined estimates are incorporated into the RD optimization for current mode selection.

Another kind of feedback information is to specify lost packets via ACK or NACK. Now the transmitter can exactly calculate the decoder reconstruction up to frame $(n-d)$, by employing error concealment whenever packets were lost. Then the reconstructed frame is used to initialize the recursion formulas to estimate the distortion from frame $(n-d+1)$ up to frame n, where the packet loss history is still unknown.

For the tandem varying channel, sending back *both* the channel conditions and the ACK/NACK information can result in further improvement of the performance, by decreasing the mismatch loss from tracking the channel variation, and employing the exact error concealment from the ACK/NACK information together.

Simulation results showed that the refined estimation could dramatically improve the performance for the varying channel conditions, and that combined feedback of both channel conditions and ACK/NACK information could further improve system performance compared with the feedback of just one type of information.

References

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[2] R. Zhang, S. L. Regunathan, and K. Rose, "Video coding with optimal inter/intra-mode switching for packet loss resilience," *IEEE Journal on Selected Areas in Communications*, vol. 18, no. 6, pp. 966-976, June 2000.

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