Recently, communication has grown very rapidly, and image and video compression for noisy channels is becoming more important. Especially, the video has become a very important component of multimedia applications such as video over wireless or ATM channel, video on demand (VOD), video conferencing, and videophone using internet. To transmit the video data over noisy channels, we need to consider not only compression efficiency but also the effects of noise. However, much research has been done only on the compression of video data.

We showed in [1] that the Spatio-Temporal Tree Preserving 3-D SPIHT (STTP-SPIHT) algorithm is highly error resilient against channel bit errors. The algorithm is based on the very effective and computationally simple 3-D SPIHT algorithm [2, 3]. The idea of the STTP-SPIHT is that the more clean bits, the higher quality of video because of the embedded nature of SPIHT algorithm. To get more clean bits, we divided the wavelet coefficients into spatio-temporal (s-t) blocks, and concatenated with the RCPC coder with a block interleaving scheme. As a result, the algorithm gets many more clean bits than that of the normal 3-D SPIHT algorithm. The useful property of this algorithm is that any decoding failure affects only a certain region, and doesn’t propagate into any other.
However, there are 2 problems with the STTP-SPIHT algorithm. The first problem is the rate allocation among the sub spatio-temporal (s-t) tree blocks, because some s-t blocks correspond to the background which contains no motion or just little motion, and the others to high motion area. In this case, the rate should be allocated differently according to the characteristics of s-t blocks. The other problem is that very early decoding failure affects a certain region, and that region is decoded with a very low resolution compared with the other area. If the affected region contains very important motion, then the video quality would be worse.

In this paper, we use a different method for partitioning the wavelet coefficients into s-t block to solve those problems. Instead of getting adjacent coefficients, we get coefficients in some fixed intervals in the lowest subband, and this interval is decided by the number of s-t blocks $P$. Then we track the spatio-temporal related trees of the coefficients, and merge them together. As a result, the s-t blocks of the STTP-SPIHT correspond to certain regions, but the s-t blocks of our new method correspond to the whole region with lower resolution. We call this algorithm Error Resilient and error Concealment STTP-SPIHT (ERC-SPIHT) algorithm.

This algorithm gives the desired results. In a noiseless condition, the average PSNRs of the decoded video are 0.02 ~ 0.3 dB higher than those of the STTP-SPIHT for most of $P$s. This result comes from the fact that the rates to each substreams are uniformly allocated for both of the STTP-SPIHT and ERC-SPIHT algorithms. In the case of ERC-SPIHT, this allocations make more sense because all the substreams represent a similar shape of motion. In a noisy channel condition of the ERC-SPIHT, the very early decoding failure affects the whole region because the decoded coefficients would be spread out to the whole area along with the sequence, and the coefficients are concealed by the other surrounding coefficients which are decoded at a higher rate. When the decoding failure occurs in the same position, the quality of ERC-SPIHT is much better in visually and numerically (PSNR) because ERC-SPIHT algorithm itself has the function of error concealment. Therefore, the ERC-SPIHT no longer suffers from small areas which are decoded with a very low resolution.

7. KEY WORDS: error resilient, SPIHT, embedded video, error concealment.


8. BRIEF BIOGRAPHIES

Sungdae Cho received the B.S. in computer science from Soongsil University, Seoul, Korea, in 1996 and the M.S. degree in electrical, computer and systems engineering from Rensselaer Polytechnic Institute, Troy, NY, in 2000, and pursuing the Ph.D degree at the Rensselaer Polytechnic Institute,
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