Rate-Distortion Optimized Video Streaming for SNR Scalable H.264

Sangho Yoon and Mark Mao
{holyoon,markmao}@stanford.edu

1 Background

The new H.264 standard promises higher quality video transmission for both high and low bandwidth networks. In order to improve the performance in case of varying link quality, a scalable version of this standard has been recently proposed. The SNR scalable H.264 partitions the compressed video data into layers so that different qualities of video can be transmitted according to the availability of network bandwidth. This scalability makes it ideal for video streaming over wireless network or internet where available bandwidth fluctuates over time.

Chou et al. proposed a rate-distortion optimized streaming algorithm using Markov decision process [1]. As the number of data unit grows, finding optimal policy for sending the entire data units becomes intractable[4]. They reduced the complexity in scheduling to roughly proportional to L(=the number of data units to transmit) by using iterative descent algorithm. Their algorithm provides a bound on rate-distortion, but it is still complex. Miao et al. [3] proposed a low complexity heuristic algorithm, but they assumed that the number of layers to be delivered per frame is pre-determined.

2 Proposal

In our project, we propose a scheduling algorithm for video streaming that is suitable for SNR scalable H.264.

- We try to formulate the optimal scheduling of packetized video stream [2][1] as a rate-distortion optimization problem. To transmit video

frames reliably over non-stationary network, we want to adaptively update our scheduler.

- We want to design an algorithm to prune the source data units, both to reduce the complexity of scheduler and to efficiently adapt to the network condition. Rather than putting rate constraints at the encoder, our algorithm performs rate-control by pruning higher (less important) layer packets to meet the rate constraints, taking advantage of the SNR scalablity.

- We need to define distortion reduction per data unit, which is dependent on frame, layer and the interdependency of data units, and use Lagrangian formulation to achieve rate-distortion optimized pruning.

- We also want to devise a low complexity heuristic algorithm in scheduling and compare it to the rate-distortion bound produced by Chou's algorithm.

- We use the wireless LAN model as our network model, which can be provided by Mark Kalman. We use simple sender driven scenario.

References

[1] P. A. Chou and Z. Miao, "Rate-distortion optimized streaming of packetized media," Microsoft Research, Tech. Rep. MSR-TR-2001-35, Feburary 2001, (also submitted to IEEE Transactions on Multimedia).

[2] M. Kalman, and B. Girod, "Rate-Distortion Optimized Streaming of Video With Multiple Independent Encodings," Proc. IEEE International Conference on Image Processing, ICIP-2004, Singapore, October, 2004.

[3] Z. Miao and A. Ortega,"Optimal Scheduling for the Streaming of Scalable Media ", Proc. of Asilomar Conf. on Signals, Systems and Computers, Pacific Grove, CA, Oct. 2000

[4] M. Podolsky, S. McCanne, and M. Vetterili, "Soft ARQ for layered streaming media," Tech. Rep. UCB/CSD-98-1024, University of California, Computer ScienceDivision, Berkeley, CA, Nov. 1998.