EECS 651 Source Coding Theory
Winter 2003

Syllabus

1. Introduction
   JPEG image coding
   Overview of the course

2. Fixed-rate lossy source coding
   Vector quantization (VQ) as the lossy source coding paradigm
   partition, codebook, rate, distortion (MSE), opta functions
   Examples (structured and unstructured)
   Bennett's high-resolution analysis of distortion
   Zador's high-resolution analysis of the opta function
   Summary of Shannon's rate-distortion analysis of the opta function
   Comparison of high-resolution and Shannon analyses

3. Lossless source coding
   Block and conditional variable-length coding
   Entropy theory

4. Variable-rate lossy coding
   Vector quantization as the paradigm
   partition, codebook, binary codebook, distortion, rate, opta functions
   Examples (structured and unstructured)
   High-resolution analysis of rate
   Zador's high-resolution analysis of the opta function
   Comparison with fixed-rate and Shannon analyses.

5. Specific lossy source codes (fixed and variable-rate)
   Performance vs. Complexity (arithmetic operations & storage)
   Scalar quantizers -- uniform and nonuniform
   Transform coding -- KLT, DCT, and wavelet based
   Predictive coding -- DPCM, Δ-mod
   Fast quantization of unstructured VQ.
   Structured VQ: tree-structured, multistage, polar, pyramid, lattice, hierarchical table lookup, ...

6. Source coding of speech, audio, images and video
   CELP speech coding
   MP3-like perceptual audio coders
   JPEG-2000 wavelet-based image coding
   MPEG-like video coding
   (these topics may be interspersed earlier in the class)

7. Source coding for noisy channels (time permitting)
   Noisy channel quantizers
   Resynchronizing lossless codes

8. Specific lossless codes (coverge as time permits)
   Run-length coding
   Rice-Golomb
   Lempel-Ziv
   Arithmetic
   Burrows-Wheeler
   JPEG lossless, JBIG, ...

9. Project presentations