Laboratory Exercise 2: Reverberation

Due Date: May 18, 2006

Problem 1. [20 Points]

A balloon pop and a repeated chirp response recorded in Memorial Church are posted to the web site along with the chirp and all of the other responses and balloon pops we measured. Note that the repeated chirp is two instances of a chirp which is 2^{20} samples long. Find the impulse response of the church as `ir = real(ifft(fft(r)./fft(c)));`, where `c` is one instance of the chirp and `r` is the response during the second instance of the chirp.

- Why does the method for recovering the impulse response only use the response during playback of the second instance of the chirp? What assumptions about the $T60$ are being made in computing the impulse response in this way? *Hint(Note that the* `fft` *function used in this way (without zero padding(does circular convolution(*

- Plot the first portion of the impulse response estimate and balloon pop response.

- Estimate impulse response measurement SNRs (peak impulse response square amplitude to average noise floor energy) for the ballon pop and the chirp technique.

Problem 2. [20 Points]

Estimate the following parameters for the measured impulse response:

- initial equalization

- late-field decay rate as a function of frequency

- echo density profile

- approximate wet/dry mix

For the balloon pop, estimate the late-field decay rate as a function of frequency.

Problem 3. [40 Points]

3(a). [20 Points] Synthesize an impulse response late field which sounds like the measured impulse response. Install SIR or another free convolutional reverberator, and listen to the measured and synthesized impulse responses applied to different tracks. How close were you able to get?

3(b). **[20 Points]** When we recorded the responses in the church, the pews were unoccupied. Occupied pews have Sabine absorptions about 0.25 greater than unoccupied ones. Process the measured impulse response so that it approximates one we would have measured had the pews been occupied.