

# Math 399 Programming Project II - Spring 2018

## Chirp Signal Response Processing

Please submit all project parts on the Moodle page for MAT399. You should include all necessary files to recompile, and a working executable, all in a zipped folder (one file for upload). Time-stamp determines the submit time, due by midnight on the due-date.

Due: Tuesday, March 6

Programs should compile under g++, so no Windows specific code is allowed. Please test code on a Mac in the Sound Lab to make sure that it compiles and runs and produces correct output.

Write a command line utility that accepts as inputs: a mono wav file that contains a sine sweep (or chirp signal) and a stereo file that contains the chirp response. The two files should be the same length, but if they are not then the length of both should be interpreted in your program as the length of the mono chirp signal file. Both files should be at the sample rate 44100 and bit depth 16.

The output file impulse.wav should have those properties and should also be a mono wav file, 16 bit, with sample rate 44100 Hz.

The output should be computed using the formula

$$h = \mathcal{F}^{-1} \left( \frac{\mathcal{F}(y)}{\mathcal{F}(x)} \right),$$

where  $x$  is the chirp signal,  $y$  is the chirp response signal, and  $h$  is the impulse response signal.

The operator  $\mathcal{F}$  is the Fourier Transform, or DFT, and  $\mathcal{F}^{-1}$  is its inverse.

Extra credit: Use your own implementation of FFT instead of DFT. If the chirp has length equal to a power of 2, use that as your  $N$  value, otherwise compute the largest power of 2 which is less than the length in samples of the chirp, and use that for  $N$ .

Apply this program to your sequence of eight chirp signals, with chirp response files, in both of the cases: i) using the dummy head, and ii) using the diffuse field recording with the binaural mics. Turn in all the wave files, labeled appropriately.

Note: You will need to process the left and right channels of each of your stereo binaural signals separately in code, but the output should be written as a stereo file.