
LAB 3: THINGS THAT ‘BEEP’

ECE180: Introduction to Signal Processing

OVERVIEW

The Fletcher-Munson Equal Loudness Curves (<http://hyperphysics.phy-astr.gsu.edu/hbase/sound/eqloud.html>) indicate that human hearing is most sensitive in the 3 to 4 kHz band. Examine the hypothesis that things that go “beep” (microwave ovens, smartphones, touch pads, smoke detectors, audible indicators, and the like) are intentionally designed to take advantage of this particular frequency band.

NOTE: This lab is very open-ended. As such, there is not a formal worksheet as in other labs.

LAB ACTIVITIES

1. Figure out how to record sound on your mobile device and export the file to your PC for analysis in MATLAB. State the name of the app (or apps) that you used and describe the step-by-step procedure that you developed.
NOTE: You will likely end up with stereo recordings, and the function call `[x, fs]=audioread('audiofile.wav')` will return an Nx2 array. Use one channel or the other with `x(:,1)` referring to the left channel and `x(:,2)` referring to the right channel.
2. Take as many “field measurements” as possible (at least 8 different sounds), keeping track of what you are recording, your location, and other conditions that seem important.
3. Measure the frequency of the sound using two methods: time-domain (look at the waveform plot and zoom in until you can measure the period) and frequency-domain (use the spectrogram technique). Document your measurement as a pair of screenshots (time-domain and spectrogram) for each sound.
4. Tabulate the measured frequencies, and from these measurements draw a conclusion as to whether or not the designers of “beep” sounds intentionally use the Fletcher-Munson curves.
5. Discuss the degree to which the beep is purely sinusoidal or contains significant harmonics. Relate what the beep *sounds* like to what it *looks* like in the time-domain plot (the waveform shape) and in the spectrogram plot (number and intensity of spectral lines).

DELIVERABLES

1. Report with supporting evidence (screenshots) your four best results and MATLAB script in a document submitted to Gradescope.
2. .zip file containing your recorded audio clips to the lab 3 Moodle drop box.