Music and Engineering

Homework 1

Prof. Hoerning

January 29th, 2019

Due: February 5th

You must use the prototype function declarations and example script distributed via email. This will facilitate smooth evaluation of your work. If the code does not execute, the assignment will be given an automatic F.

All plots and source code should be printed and handed in. Every plot must include an appropriate title, x label, y label, and z label when appropriate. Addition text should be added to the plot when requested. Make sure the font size is appropriate and legible. If you don't know how to do this, please ask in class or email me.

Explanatory text is expected. When you are asked to Discuss something, please use the amount of text necessary to answer the question to the best of your ability. Please try to use this to explain the rationale behind your calculations

In addition to a printed paper summary of your results (including plots, source code and essay responses) you must publish to you githum account and email a link to me at *tim@musicandengineering.co* I will clone from github to grade your assignment.

This is not a programming course. However, you will be expected to follow normal guidelines for structured programming (tab levels, copious amounts of explicit comments, etc).

You are expected to do your own work. You may discuss the assignment with other students. Helping and teamwork is encouraged. However, I do not want to see two copies of the exact same source code handed in twice. If two separate copies of the same assignment are handed by two different people, both will fail the assignment.

Homework should be handed in on the due date. If not, your maximum grade will be reduced by 10 percent for each day after the due date.

You will be given a base frequency which represents a pitch (ex A=440). Use this base pitch to create the following.

1. **Tables**

   (a) Create a complete table showing all the frequencies for all of the notes in every key using just intonation (like on slide 15 of the presentation)

      i. You may do it in MATLAB or a spread sheet

ii. Do it as intelligently as possible (Hint: first determine how to find the reference frequency for each key)

(b) Create a complete table showing all the frequencies for all of the notes in every key using equal intonation (like on slide 15 of the presentation). Hint: This should be easy

2. **Scales**

Use the provided sample function outlines to demonstrate the following

(a) Create the just tempered Major and (natural) Minor scales

(b) Create the equal tempered Major and (natural) Minor scales

(c) Use the MATLAB functions to play through a sample of each of the four scales - the script you hand in must do this

3. **Chords**

Use the provided sample function outlines to demonstrate the following

(a) Create the root major chord from the just tempered scale

(b) Create the root major chord from the equal tempered scale

(c) Play a short sample of each chord. (2-3 seconds) - the script you hand it should do this

(d) Create the root minor chord from the just tempered scale

(e) Create the root minor chord from the just tempered scale

(f) Play a short sample of each chord. (2-3 seconds) - the script you hand it should do this

4. **Plots**

(a) Show two plots of each of the four chords. One should be on the scale of a wavelength of the fundamental. The other should be a tens of wavelengths, so that you can see the envelope.

(b) Can you see a difference in the difference plots between the just and equal tempered chords? Over one wavelength? Over tens of wavelengths?

5. **Discussion** - These can be answered in paragraph form or as sentences in response to each question.

(a) Can you hear the difference between the just tempered Major scale and the equal tempered Major scale?

(b) Which one sounds better? - Why (explain)

(c) Can you hear the difference between the just tempered Minor scale and the equal tempered Minor scale?

(d) Which one sounds better? - Why (explain)

(e) Can you hear the difference between the just tempered Major chord and the equal tempered Major chord?

(f) Which one sounds better? - Why (explain)

(g) Can you hear the difference between the just tempered Minor chord and the equal tempered Minor chord?

(h) Which one sounds better? - Why (explain)

Some Ideas for extra credit:

- Create the Harmonic and Melodic minor scales.

- Create all seven chords based on any key

- Use harmonics to synthesize an instrument. i.e. instead of creating the chords out of pure tones, simulate an instrument and create the chords from that.

- Add attack and decay to the notes to eliminate pops at the beginning and end of the sounds

Do Not:

- Try to do the extra credit and use unnecessary loops

- Give one word answers to discussion questions

- use audio samples (either recorded yourself or downloaded)