

## **EE 341: Discrete-Time Linear Systems**

### **Lab 6: Sound/Image Synthesis**

Due Dates: Sound/Image Files must be uploaded by Friday, 9 March 2016, **10:30AM**;  
reports must be uploaded by Saturday, 10 March 2016, **9PM**

In this lab, you will synthesize a sound or an image digitally, from scratch or by modifying and combining existing signals, using at least three of the following EE341 concepts:

- simple signal synthesis (e.g. tones, random noise)
- time (or space) scaling, including reversal
- amplitude operations (e.g. multiplication or addition of signals)
- filtering
- convolution (e.g. for simulating reverberation)
- frequency shifting or other types of modulation

You may concatenate different sounds/images together, but this doesn't count as one of the three EE341 concepts. You can reuse code that you developed in your earlier labs, but you must change it in some way. For example, if you do multiplication, create a function different from the ADSR envelope you used in lab 2. If you do filtering, use a filter that is different from what you implemented in labs 3 and 5.

Do not use sounds or images that may be offensive, e.g., no profanity or pornography.

The class will vote for their favorites in each category, and the winner in each category will get a bonus point. Participating in voting will be worth 2 points as a class assignment, due in class, Friday 3/9.

You may do this lab in groups of 2-3 people, but only the submissions created by individuals will be eligible for winning a bonus point. Winners will be asked to explain to the class how you created your sound or image.

#### **Option A: Music or Sound Effect Synthesis**

Compose a short piece of music or a sound effect. You can use any of the sound files made available on the class web page or search the web for reusable sound files or record a sound yourself. (Do not use recordings of others without their permission.) You can also synthesize sounds using sinusoids or random noise (as in lab 2), square waves, etc. Apply signal processing techniques to one or more component sounds, separately or in combination. The final signal should be 10-20 seconds in length.

Each signal processing technique should have an audible effect. For example, if you synthesize notes as in lab 2 and apply a filter that includes all notes, that would not have an audible effect.

Make sure you pay attention to any differences between the sampling rates of the sound files you use or generate, since the final output will be based on only a single sampling rate.

When you are satisfied with your composition, save it as a .wav file. It is a good idea to check that there were no write problems by listening to that file.

## Option B: Image Synthesis

Create a synthetic image, an image collage or modify a color image. You can use your own images/photos or search the web for reusable images. (Do not use copyrighted images without permission.) You can also synthesize images patterns using the same techniques as for sounds above but with two dimensions, e.g. a square wave in two dimensions should give you a checkerboard, and random noise in two dimensions will give you a speckled pattern. Apply signal processing techniques to one or more component images, separately or in combination. The final image should be a size that will be easily viewed on a laptop screen.

It is fine to work with grayscale images, which you can get using the `rgb2gray` command in Matlab. However, if you want to work with color images, you can do that by separately processing each of the three color planes as its own image (see background discussion of lab 2). Remember that image pixels take values in the  $[0,255]$  range.

You may use code that you developed for lab 2, but you must also use some processing beyond what was explored in that lab.

When you are satisfied with your creation, write it out to a .jpg or .png file using the `imwrite` command. View the file to make sure it is your final version.

## Multimedia:

Occasionally, students are interested in combining image and audio processing. If you would like to do this, please run your idea by the professor in advance. Any multimedia submissions will be judged with the images.

## Turn in to Canvas:

- Your image or sound file (give it a filename that does not include your name but is more unique than “myimage” or “mysong”)
- A brief written description of the techniques and sounds/images used in your creation. For example, if you use filtering, specify the filter design. If you use convolution, describe how you generated (or found) the impulse response. If you use time scaling, specify the scale factor(s).
- Zip file of MATLAB scripts used to generate your sound/image.