LBYEC4A – EK3

Signals, Spectra and Signal Processing Laboratory

Final Project Proposal

Audio Effects Application on MATLAB

Ethan Joseph S. Dee
Mariel Annika S. Ong
Matthew S. Peruel

PROJECT DESCRIPTION (Describe what your project is all about and its intended application. Include your research showing how your intended application can be achieved by your project. Also, provide theoretical concepts that will be utilized.)

Audio effects are used to enhance the audio recording's sound quality and add unique elements to musical productions. Reverb, delay, distortion, chorus, flanger, phaser, equalization, and compression are just a few of the many audio effects that can be applied to an audio file [1].

For this project, only four audio effects will be applied. These include distortion, phaser, flanger, and digital delay. Given a single-medium audio file that is recorded and inputted onto MATLAB, a program will be developed that allows for effects to be applied on the audio file based on the desired output to be produced. By applying these effects, variations can be created that allow for differing creative applications in music.

According to Pfister, the MATLAB scripting language may be used optimally to apply audio effects such as equalization, reverberation, and distortion when given a sound file or an audio signal. The *audioread* command allows a WAV file to be loaded and played and extracted to be used within MATLAB for visualization and potential modification. Through the *audioread* function, the samples and sampling rate can be obtained, allowing for more control in the manipulation of the given audio signal [2].

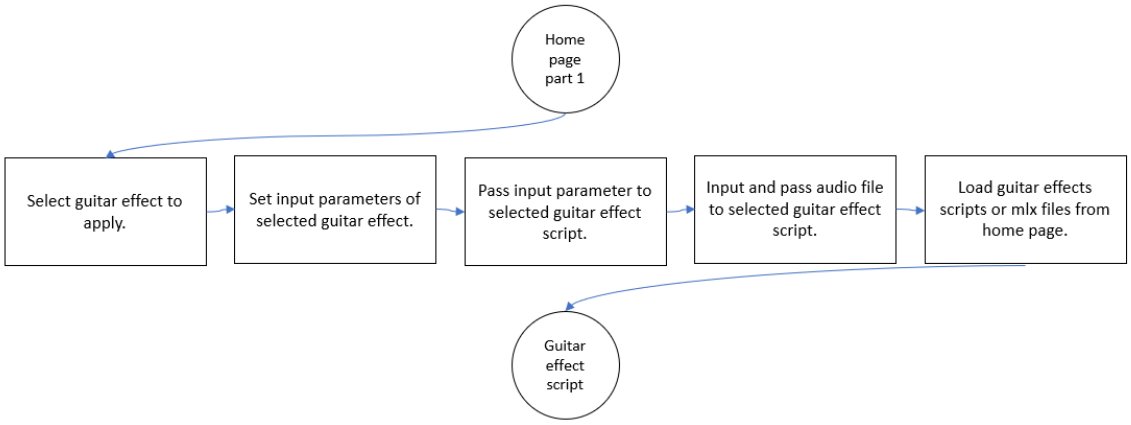
A distorted audio is achieved when the input data is amplified and then clipped. A tone setting is used to make the audio sound “thinner” or “thicker” which is just depends on which frequencies the filter allow to pass. The output of a phaser effect block is a sum of the input signal and the modulated input signal. When the amplifier is driven into saturation, the signal is distorted, particularly for larger output values. In vacuum tube amplifiers, the resultant distortion has a soft edge, which is noted to be enjoyable for rock musicians. One potential soft-limiter is the inverse tangent function *atan,* which allows the changes the signal to lower the rate of change of the signal [2].

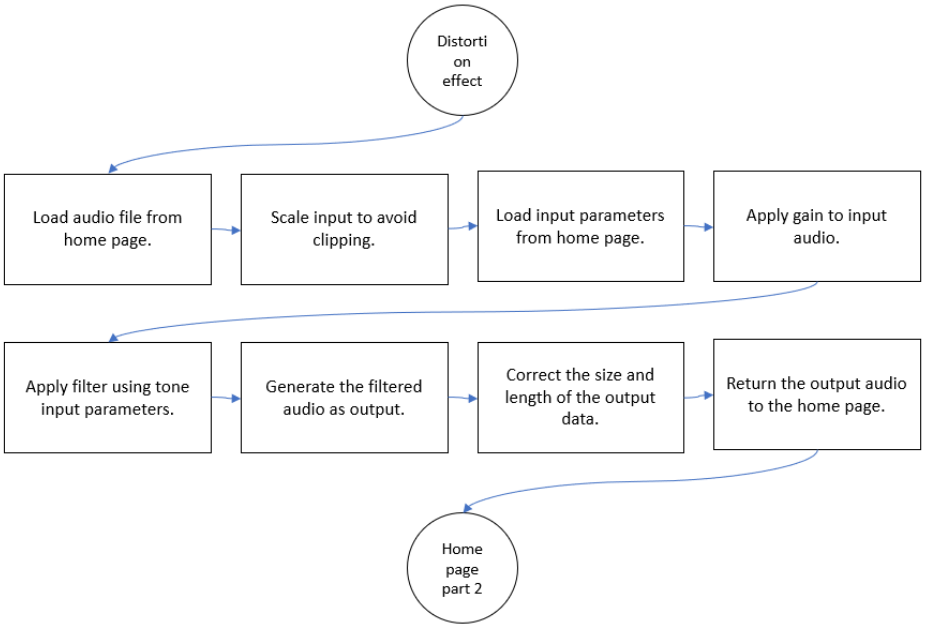
Theoretical concepts such as frequency response, spectrum analyzer, and total harmonic distortion computation. For frequency response, this measures the output of system given an input signal which is the audio file. The frequency response of an audio effect informs the user how the application affects the balance of frequencies in a signal. The magnitude is measured in dB while the phase is in radians [3]. It is easy to see how an audio effect is altering the frequency content of the signal by utilizing a spectrum analyzer on an audio signal that has the effect applied. When modifying and fine-tuning audio effects to get the desired

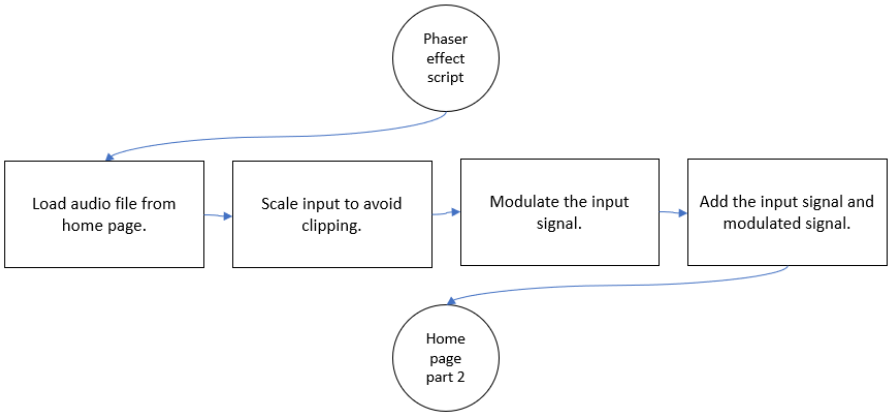
sound, a spectrum analyzer might be helpful [4]. The user can decide how to modify the effect settings to achieve the desired tonal balance and character by considering the frequency content of the signal. THD measurement can be helpful for assessing an audio effect's quality and for contrasting several effects. Less harmonic distortion introduced into the signal by the effect is indicated by a lower THD value, which produces a more accurate and transparent sound [5].

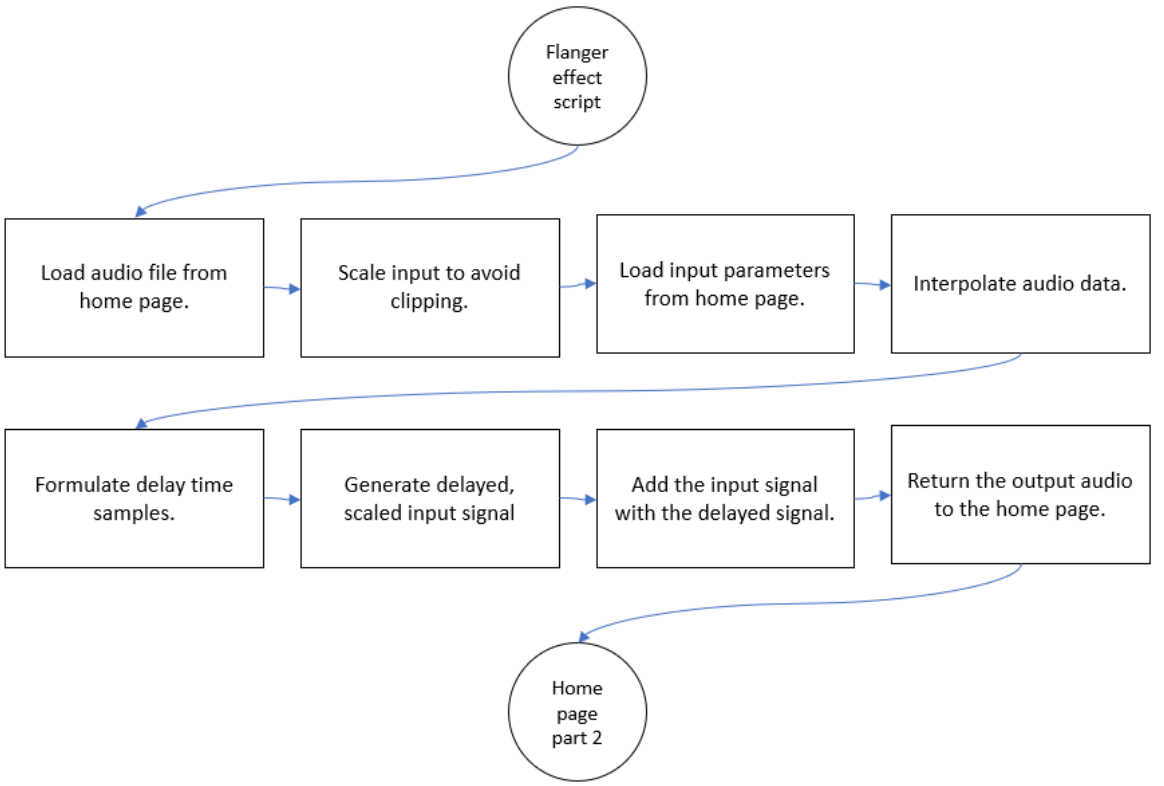
METHODOLOGY (How are you going to do it? Included an overall system flowchart of how your project should work as well as initial draft of schematic diagram. Include description of digital signal processing concepts that will be used to develop the project.)

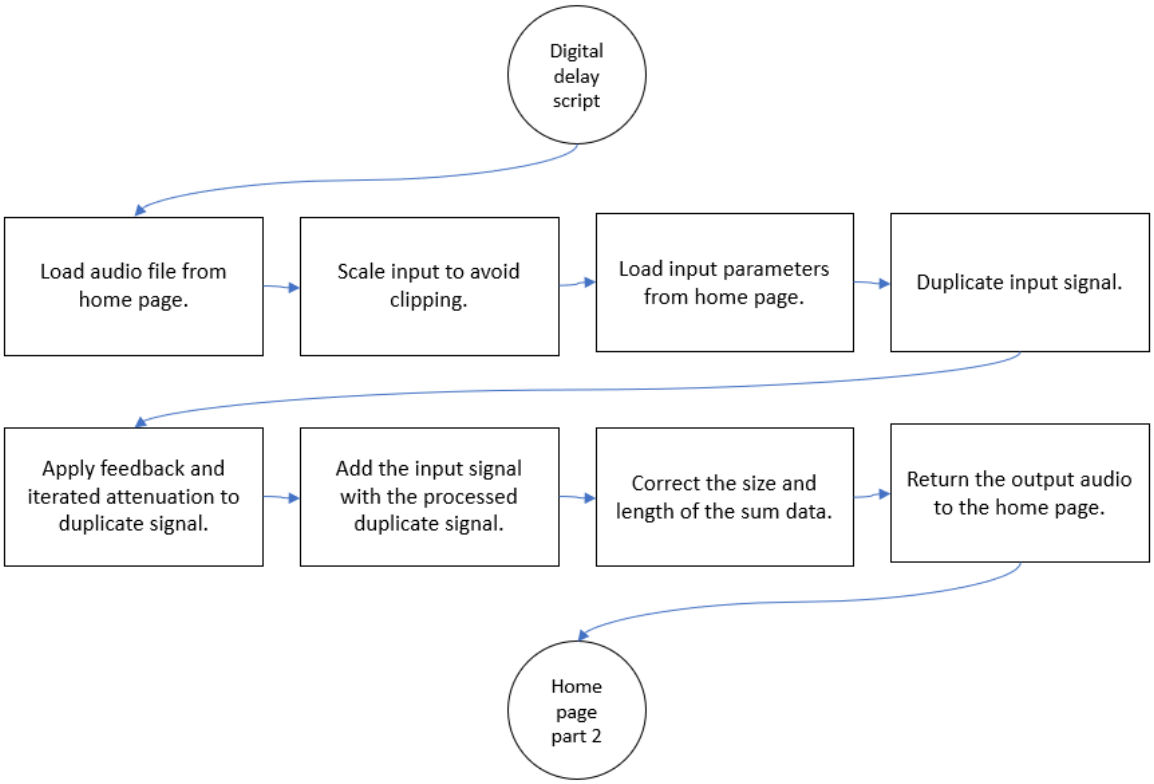
The following flowcharts how to input audio and parameters are processed. These processes also outline the major processes to be written as MATLAB live scripts. The project will contain five live scripts: home page, distortion effect process, phaser effect process, flanger effect process, and digital delay process. The digital signal processing concepts involve signal scaling, signal clipping, time shifting, and modulation.

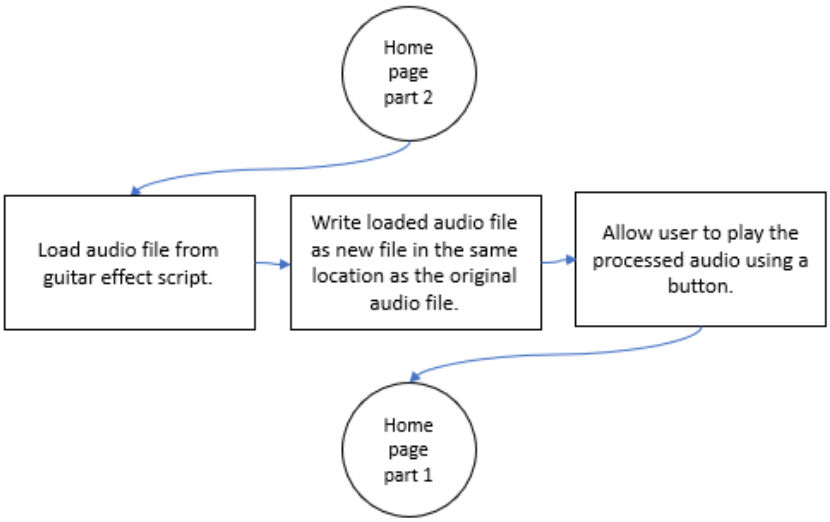



Distorti
on
effect
Load audio file from home page.
Scale input to avoid clipping.
Load input parameters from home page.
Apply gain to input audio.
Apply filter using tone input parameters.
Generate the filtered audio as output.
Correct the size and length of the output data.
Return the output audio to the home page.
Home page part 2


Phaser effect script
Load audio file from home page.
Scale input to avoid clipping.
Modulate the input signal.
Add the input signal and modulated signal.
Home page part 2


Flanger effect script
Load audio file from home page.
Scale input to avoid clipping.
Load input parameters from home page.
Interpolate audio data.
Formulate delay time samples.
Generate delayed, scaled input signal
Add the input signal with the delayed signal.
Return the output audio to the home page.
Home page part 2


Digital delay script
Load audio file from home page.
Scale input to avoid clipping.
Load input parameters from home page.
Duplicate input signal.
Apply feedback and iterated attenuation to duplicate signal.
Add the input signal with the processed duplicate signal.
Correct the size and length of the sum data.
Return the output audio to the home page.
Home page part 2



SCHEDULE OF ACTIVITIES (Provide a timetable or Gantt chart of your deliverables. Indicate also whom and when the specific deliverables will be accomplished.)

Assigned to:	Task:	Week			
		9	10	11	12
All Members	**Project Proposal**				
Ethan Dee	**Initial Compilation of Similar Researches**				
Ethan Dee	Selection of Audio File				
Ethan Dee	Design of Distortion Effect				
Matthew Peruel	Design of Phaser Effect				
Matthew Peruel	Design of Flanger Effect				
Mariel Ong	Design of Digital Delay Effect				
Mariel Ong	Individual Audio Effect Testing				
Mariel Ong	Combination of Audio Effect Testing				
Matthew Peruel	**Recording and Demonstration (Results)**				
All Members	**Initial Draft of Project Paper**				
All Members	**Final Draft of Project Paper**				
Ethan Dee	Project Presentation Slidesdeck				
All Members	**Final Project Presentation**				

REFERENCES (Cite the resources that will be used as well as your research regarding your project.)

[1] T. Wilmering, D. Moffat, A. Milo, and M. B. Sandler, "A History of Audio Effects," *Applied Sciences*, vol. 10, no. 3, p. 791, Jan. 2020, doi: https://doi.org/10.3390/app10030791.

[2] H. Pfister, "From EQ to Reverb & Distortion: DSP Audio Effects in Matlab." Accessed: Mar. 14, 2023. [Online]. Available: http://pfister.ee.duke.edu/courses/ece485/dsp.pdf

[3] "Frequency response (audio) - Glossary - Federal Agencies Digitization Guidelines Initiative," *www.digitizationguidelines.gov*. https://www.digitizationguidelines.gov/term.php?term=frequencyresponseaudio#:~:text=Term%3A%20Frequency%20response%20(audio)&text=Frequency%20response%20is%20the%20measure (accessed Mar. 14, 2023).

[4] "What is a Spectrum Analyzer & What Does it Do? | Tektronix," *www.tek.com*. https://www.tek.com/en/documents/primer/what-spectrum-analyzer-and-why-do-you-need-one#:~:text=A%20spectrum%20%2F%20signal%20analyzer%20measures

[5] M. I. GmbH, "THD in loudspeakers: What's behind it," *www.monacor.com*. https://www.monacor.com/magazine/total-harmonic-distortion#:~:text=It%20is%20a%20measure%20for (accessed Mar. 14, 2023).