CprE 492

Date: 01/15/18 – 01/26/18

Team: 39

Title: Sound Effect Devices for Musicians

Advisers: Dr.Chen & Dr.Geiger

Team:
Tom Kimler – Team Lead
Virginia Boy – Power Lead
Ben Reichert – Test Lead
Dan Kroese – Embedded Lead
Garrett Mayer – Software Lead

Weekly Summary:

We have collected data using an improved data recording methods, designed to provide high fidelity, repeatable test results. Researched filter algorithms and began development of filters in MATLAB. Installed "fftw" and wrote small usage demo. Created template c program to allow easy porting from MATLAB to c. Created sandbox MATLAB script for automated data analysis and quick emulator design.

Past Two Weeks Accomplishments:

Test Bench Re-Vamp – Ben

Justification: the most critical aspect of our project is that we adequately modeling both the linear and non-linear distortions characteristic of the tube amplifier. Since the previous semester, we have updated our stance on our data collection methods. For the time being, data is no longer to be collected from an instrument output rather, input signals (in the guitar frequency range) are to be generated in a precise and controlled fashion via a signal generator. In this configuration, the fidelity of our data can be accurately assessed, and experiment conclusions become far less abstract in nature.

- Collected time-domain amplifier output samples at a variety of inputs
    - Single input signal (at various tonic frequencies), as well as multiple simultaneous input signals (mostly root + major 5^{th} + minor 3^{rd} triads)
        - Idea for future: input frequency sweep – gain insights on frequency dependence of amplifier transfer function
        - Idea for future: Input signal amplitude sweep – insights into output dependence on input SNR, etc.
        - Ideas for future: test with input phase incoherence – characterize output (this brings us closer to the simulating the

types of signals that would be generated by the magnetic pickups of the instrument)

- Began to analyze and characterize output data, findings to be submitted to filter design team to inform algorithms

- Investigated Test Bench noise isolation methods for higher degrees of data fidelity
    - Potential use of ferrites and faraday cages to improve SNR and data integrity

Matlab Script – Garrett

- Developed script for automation of data analysis for ease of use for filter designers

C Template – Garrett

- Created template program for future use when versions of emulators are created

FFTW Download Script – Garrett

- Created script to download fftw and install it on the computer automatically

Coding Practices – Garrett

- Created best coding standards and practices for team to use in MATLAB and c

Git Tutorial – Garrett

- Created basic tutorial on how to use Git correctly

FFTW Research – Dan

- Read up on Fastest Fourier Transform in the West (FFTW) in order to understand in order to know how we could later implement fft on microcontrollers in c code
- Did preliminary research on best practice of getting fftw software onto different computers, found likely best to move all .tar code to gitlab repository that way it can be accessed from every computer and used.
- Began figure out how to navigate gitlab repository and trying to learn how to add a source file that is the fftw downloadable file to it

Filter Research – Virginia

- Completed preliminary research on various filter theories and techniques
- Investigated the mathematics behind advanced filter design and implementation

Project Direction Research – Tom

- Recognized a need for change in design/exploration space parameters and metrics based on research findings and discussions.

Amplifier Research – Tom

- Researched amplifier design and characterization parameters. The major insight gained from this research was the usefulness/need for transfer characteristics associated with amplifiers. This research also helped differentiate definitions of non-linearity and distortions

Filter Research and Implementation – Tom

- Researched discrete-domain (digital) filtering techniques. Specifically, a category of filters called "Wave Digital Filtering" were researched due to their ability to replicate non-linear systems
- Created a MATLAB script that generates transfer characteristics from either user-defined matrices in MATLAB or measured data-sets

Pending Issues:

Test Bench - Ben

- Test bench noise isolation methods need further investigation. Solutions here will provide high degrees of data fidelity.
    - Potential use of ferrites and faraday cages to improve SNR and data integrity

Individual Contributions:

Team Member	Contribution	Weekly Hours	Total Hours
Ben Reichert	Gathered Data, Revamped Testbench	8	8
Tom Kimler	Project direction, research amplifiers, research and implementation of filter techniques	12	12
Garrett Mayer	C & Matlab standards, Git tutorial, c template project, MATLAB script, created script for fttw download	11	11
Dan Kroese	FFTW download research, Git research	7	7
Virginia Boy	Researched filter techniques and starting implementing in Matlab	5	5

Comments:

No specific comments, beginning development of emulator in the next weeks.

Plan for Next Two Weeks:

Data Collection/ Test Bench Improvements – Ben

- Input frequency sweep – gain insights on frequency dependence of amplifier transfer function
- Input signal amplitude sweep – insights into output dependence on input SNR, etc.
- Test with input phase incoherence – characterize output (this brings us closer to the simulating the types of signals that would be generated by the magnetic pickups of the instrument)

Data Analysis & Filter Design– Tom, Virginia

- Analysis new data and develop first design first emulator

C Implementation and Development – Garrett, Dan

- Begin functions needed for emulator design in c
- Includes reading mp3 files, fft, and filter techniques

Summary with Advisors:

Have not met yet.