

DESIGN AND IMPLEMENTATION OF A GUITAR TUNER USING MATLAB

by: Dayrit, Guevarra, Rodriguez | LBYEC4A- EK2

ABSTRACT

A guitar tuner is used to measure and display the pith of the strings on a guitar [1]. It helps guitar players in adjusting the tuning of their instruments for the correctness of their notes when played. This project involves the development of a digital guitar tuner using digital signal processing principles, such as filtering, sampling interval, and Fast Fourier Transform (FFT). he guitar tuner was designed and implemented in MATLAB, having five modes available: standard tuning, drop D tuning, double drop D, DADGAD tuning, and open D tuning. The tuner compares the input audio signal to the standard frequencies of the guitar notes, and then converts the signal to the frequency domain using FFT. Then, the signal is filtered and the tuning is indicated by the results of the compared frequency found in the input audio signal. The project achieved its intended application of a digital guitar tuner, demonstrating the practical application of digital signal processing in audio processing.

INTRODUCTION

The ability to tune a guitar is an essential skill for any musician who wants to produce high-quality music [2]. With the advancement of technology, digital guitar tuners have become more accessible, accurate, and efficient. The project uses MATLAB, a widely used software for engineering and scientific applications, to create a digital guitar tuner that can accurately identify the standard frequencies of guitar notes and compare them to the input audio signal for tuning purposes. It explores the audio processing features available in MATLAB in order to create a reliable and efficient guitar tuner capable of handling various tuning modes such as standard tuning and drop D tuning, double drop D, DADGAD, and open D tuning.

The project aims to demonstrate the practical application of digital signal processing in the design and development of an effective guitar tuner. The resulting guitar tuner will be a valuable tool for guitarists of all levels, from beginners to professionals, providing them with an accurate and efficient way to tune their guitars and produce high-quality music.

METHODOLOGY

- 1.Input audio file with file type
- 2.Read the audio signal
- 3.Plot the input audio signal.
- 4.Choose what type of tuning
 - a.Standard = 1
 - b.Drop D = 2
 - c.Double Drop D = 3
 - d.DADGAD = 4
 - e.Open D = 5

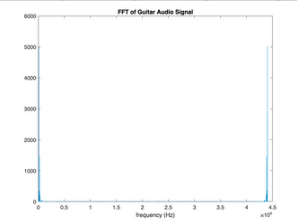
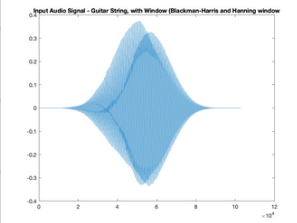
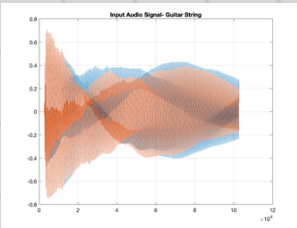
Per tuning mode:

- 1.Read the audio signal
- 2.Play the audio signal
- 3.Determine time vector
- 4.Apply Blackman-Harris and Hanning window
- 5.Plot audio signal with window
- 6.Declare fundamental frequencies
- 7.Declare bounds for frequency filters
- 8.Declare filter coefficients
- 9.Perform FFT
- 10.Check the notes for tuning
- 11.Display if in-tune or out-of-tune

RESULTS

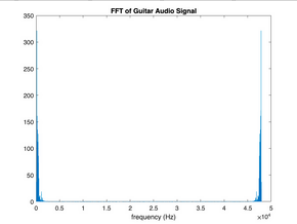
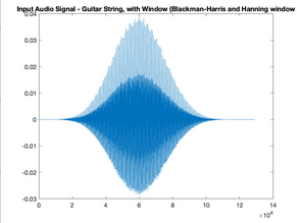
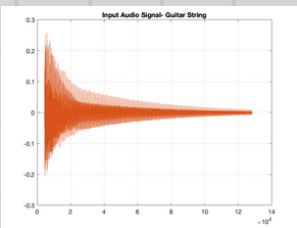
The following section details the results of the tuner with 5 different tuning modes; Standard, Drop D, Double Drop D, DADGAD, and Open D. For each run of the codes, the expected results are: the waveform of the input guitar signal, the waveform as it passed through the windows, the FFT waveform, and the results of the note detected and its tuning instruction. All test runs are deemed successful.

STANDARD TUNING test



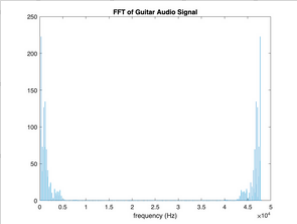
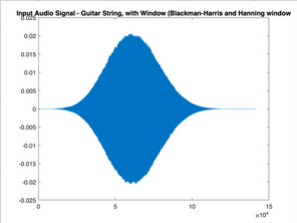
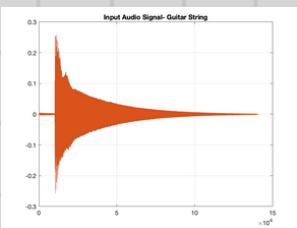
Note: E2
E2 is in tune!

DROP D TUNING test



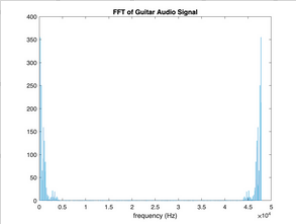
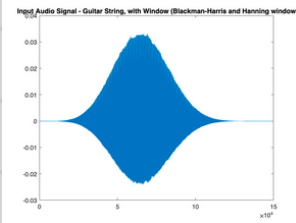
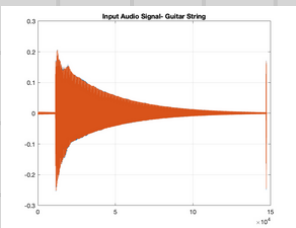
Note: D2
D2 is in tune!

DOUBLE DROP D TUNING test



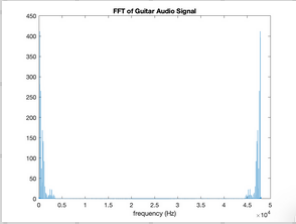
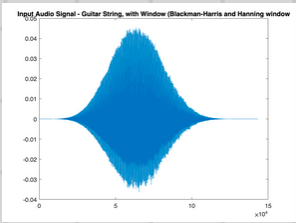
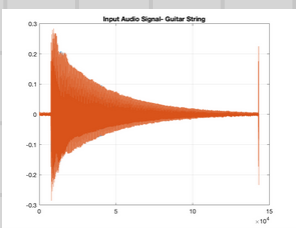
Note: D4
D4 is in tune!

DADGAD TUNING test



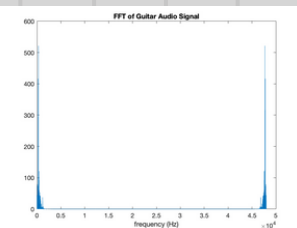
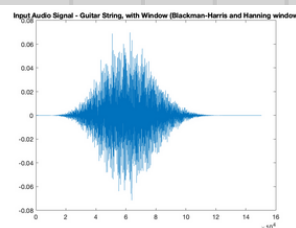
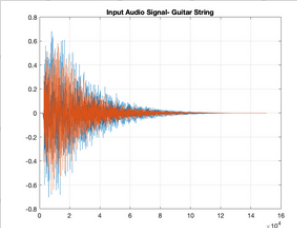
Note: A3
A3 is in tune!

OPEN D TUNING test



Note: GB3
GB3 is in tune!

OUT OF TUNE test:



Note: A3
Comment: Tune up!
Frequency difference:
3.4865

CONCLUSION

With the guitar tuner having 5 modes at once, it is flexible for a digital guitar tuner. Using the Blackman-Harris and Hanning window as well as performing FFT made the audio signal intelligible for tuning. Even though the digital guitar tuner is only limited to deal with only one harmonic, it leaves a room for improvement if further experimented on. With this, the general objective of the design project - which is to design a digital guitar tuner with 5 different modes, was satisfied through the use of MATLAB.

REFERENCES

- [1]"Tune Your Guitar," strettonpayne.com. <https://strettonpayne.com/how-to-tune-your-guitar/#~:text=What%20is%20a%20digital%20tuner> (accessed Apr. 10, 2023).
- [2]"How to Use a digital tuner to tune your guitar," WonderHowTo. <https://acoustic-guitar.wonderhowto.com/how-to/use-digital-tuner-tune-your-guitar-303500/> (accessed Apr. 10, 2023).
- [3]"Digital Guitar Tuner," www.mathworks.com. <https://www.mathworks.com/matlabcentral/fileexchange/14759-digital-guitar-tuner> (accessed Apr. 10, 2023).