

Guitar Pick Thickness and Sound Quality of an Acoustic Guitar

Natchaya Makjumroen¹, Peerapat Prugsamas², Seksan Yoadsanit²

1. International School Bangkok, 39/7 Samakee Rd, Pakkret, Nonthaburi, Thailand 11120

2. Kamnoetvidya Science Academy, 999 Moo 1 Payupnai, Wangchan, Rayong 21210

Email: m.fainatchaya@gmail.com

Abstract

The relationship between the thickness of a guitar pick and the sound quality produced by an acoustic guitar was investigated. An open E on the first string of a guitar was plucked with picks of five different thicknesses. The relative amplitudes of the first four harmonics were measured for each of the picks tested. Thicker picks produce greater amplitudes in the upper harmonics, creating a fuller sound.

Keywords: guitar, pick thickness, harmonics, sound quality

I. INTRODUCTION

The plucking of a guitar string creates sound waves, as the vibrations of the guitar string cause the air surrounding it to vibrate. When plucking a guitar, not only is the first harmonic produced, but also several upper harmonics. These harmonics occur because the string will vibrate with different frequencies simultaneously. As multiple waves are produced, the sound a plucked guitar string makes can be expressed as the sum of all waves for each harmonic, as seen in figure 1.

Standard guitar picks range from 0.5 to 1.14mm in thickness, where the thinner picks are said to produce a lighter sound, for delicate playing, and thicker picks produce a clean, dynamic sound, preferably for lead playing.¹ According to Uberchord

thicker picks produce a fuller, richer sound, while thinner picks have a thinner lighter sounding tone, as perceived by the human ear.²

The sound quality, or richness of a sound, is determined by the harmonics a person hears. If there is a higher relative amplitude in the upper harmonics, a richer, fuller sound is heard. The sound is said to be less rich if there is a single harmonic. Different instruments have different harmonic structures, and hence different sound qualities, as shown in the Fast Fourier Transforms (FFT) of the recorded sounds of a trumpet (figure 2) and a guitar (figure 5).

This study investigates how the thickness of the pick affects the sound quality, as measured by the relative amplitude of each harmonic frequency, of the sound.

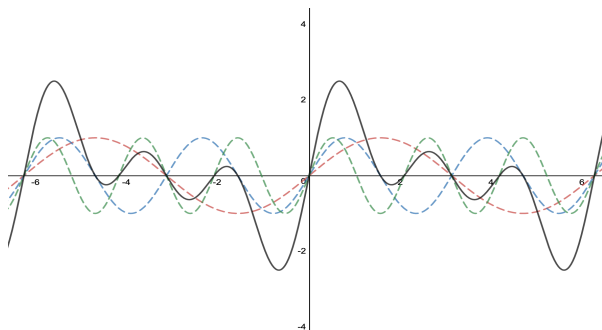


Figure 1. The sound of a plucked guitar string can be expressed as the sum of the amplitudes of each harmonic frequency (red, blue, green), represented by the black wave.

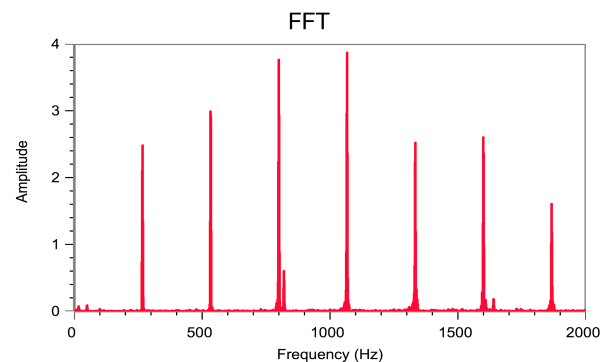


Figure 2. An FFT graph of the relative amplitudes of the harmonics of a trumpet playing middle C.

II. METHODS

A Vernier Microphone, connected to Logger Pro, was clamped on a stand and placed 4 cm away from the middle of the guitar string. Guitar picks with a thickness of 0.50, 0.73, 0.88, 1.00 and 1.14 mm, shown in figure 3, were used to strum an open E on the first string of the guitar, as shown in figure 4.

The data was collected at 100,000 samples/second for 0.5 seconds in Logger Pro. The force applied to pluck the string did not affect the frequency or the relative amplitude of each harmonic, so was not controlled.

The first string of the guitar was plucked with a pick of known thickness and the relative amplitude for each harmonic was determined, using an FFT analysis graph in Logger Pro, as shown in figure 5. This was repeated five times for each pick thickness, plucking at the same point on the string for all trials. The amplitude of each harmonic was normalized relative to the fundamental for analysis.



Figure 3. Top view of the picks of thicknesses from 0.50, 0.73, 0.88, 1.0 and 1.15mm. Picks are from Paul Reed Smith Guitars Delrin Touring Picks.

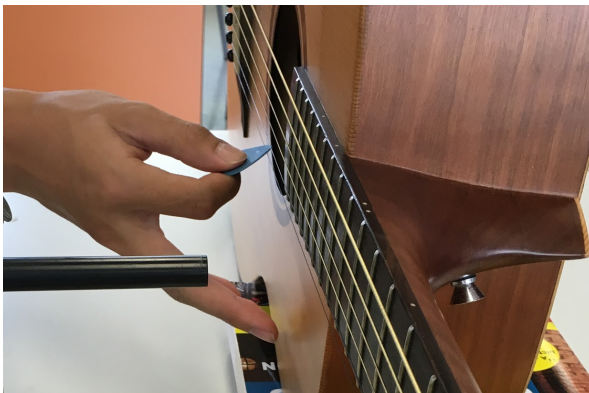


Figure 4. A pick plucked on an open E of the first string of a guitar.

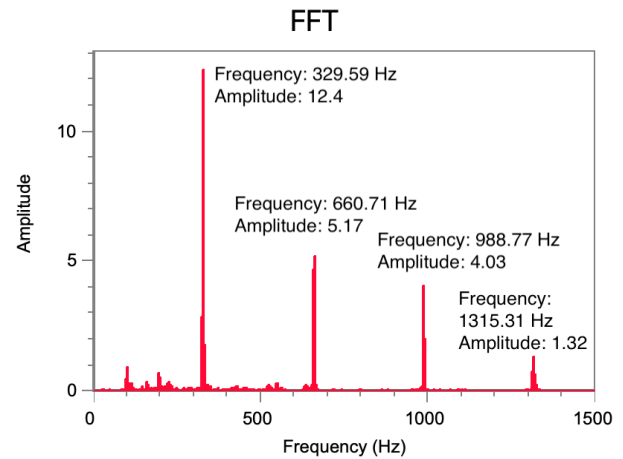


Figure 5. FFT graph displaying the amplitude vs. the frequency for Trial 1 of the 0.50 mm thick pick.

III. RESULTS AND DISCUSSION

The average frequencies of the first four harmonics are shown in Table 1. The upper harmonic frequencies are whole number multiples of the fundamental, within uncertainties, as expected. The harmonic frequencies were measured to be the same for all pick thicknesses. Any perceived difference in the quality of the sound from the different pick thicknesses is therefore not due to differences in harmonic frequencies.

From figure 6 it can be seen that increasing the thickness of a guitar pick increases the relative amplitude of the upper harmonics. For the thinnest pick tested, the amplitude of the upper harmonics are all much less than the amplitude of the fundamental. As pick thickness increased, the relative amplitude of the upper harmonics increased also. For the thickest pick, the amplitude of the fourth harmonic

Harmonic	Frequency ($\pm 3\text{Hz}$)
1st	330
2nd	661
3rd	989
4th	1319

Table 1. The frequency of each harmonic averaged for all pick thicknesses.

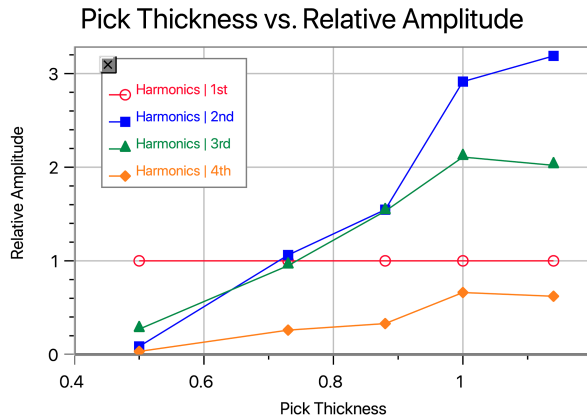


Figure 6. The relationship between the thickness of the picks vs. relative amplitude.

increased to over half the amplitude of the fundamental, while the amplitudes of the second and third harmonics increased to three and two times greater than the fundamental, respectively.

As the thickness of a guitar pick increases, there is a general increase in the relative amplitude of the upper harmonics with respect to the fundamental. Greater amplitude upper harmonics is perceived as fuller, richer sound, supporting the claims of musicians.²

It is interesting that it was the second harmonic which showed the greatest increase in amplitude, with the third and fourth being much less affected by pick thickness. Reasons for this could be investigated in future work. The effects of picking location and string type on harmonic content could also be investigated.

IV. CONCLUSION

It has been shown that the thickness of a guitar pick does not affect the frequency of the harmonics produced by the guitar string when plucked. However, the thickness of the pick affects the sound quality as a thicker pick will have greater amplitude upper harmonics, generating a fuller sound.

REFERENCES

1. Edwards, J. (2017, June 6). Guitar Pick Thickness, Size & Shape: How to pick the perfect pick. Retrieved from <https://www.stringjoy.com/guitar-pick-thickness-size-shape/>
2. Frost, L. (2016, January 25). Different Guitar Picks Different Sounds - Pick What You Like. Retrieved from <https://www.uberchord.com/blog/guitar-picks/>