

Introduction

Investigating the data collected in this sound lab proved to be very interesting. The most common interesting information I found in the power spectrums related to the specific frequencies present in the power spectrum that did not indicate the root note. This is prominently displayed in the data for the different sources for the A note. All sources had frequencies that produce an A tone, as would be expected. Additionally, every source showed a frequency that produces an E tone. Two of the sources even showed the C# frequency. What is notable about these notes are their harmonic properties. In a harmonic series, the overtones are multiples of the fundamental frequency. Table 1 shows this arithmetic progression distinctly. For example, for guitA1, the peaks occur at 110 (fundamental), 220 (2*fundamental, or first harmonic), 330 (3*fundamental, or third harmonic), 440, 550, and 660. This is a clear example of a harmonic series. The notes that correspond to these frequencies are A,A,E,A,C#,E. In fact, this is the exact pattern of the harmonic series (root, root, perfect fifth, root, perfect fourth, perfect fifth). Coincidentally, these notes are all part of the A major chord (ie, root, major third, perfect fifth). It is interesting that the power spectrum is able to recognize these overtones that the human ear notices subconsciously.

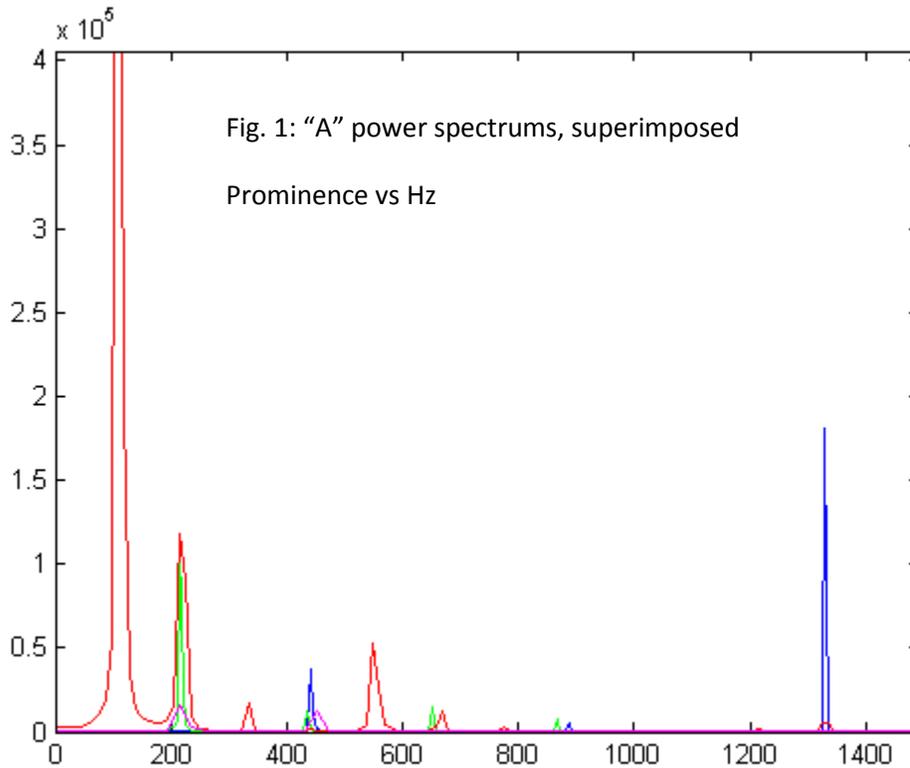


Table 1: "A" Peak Frequencies

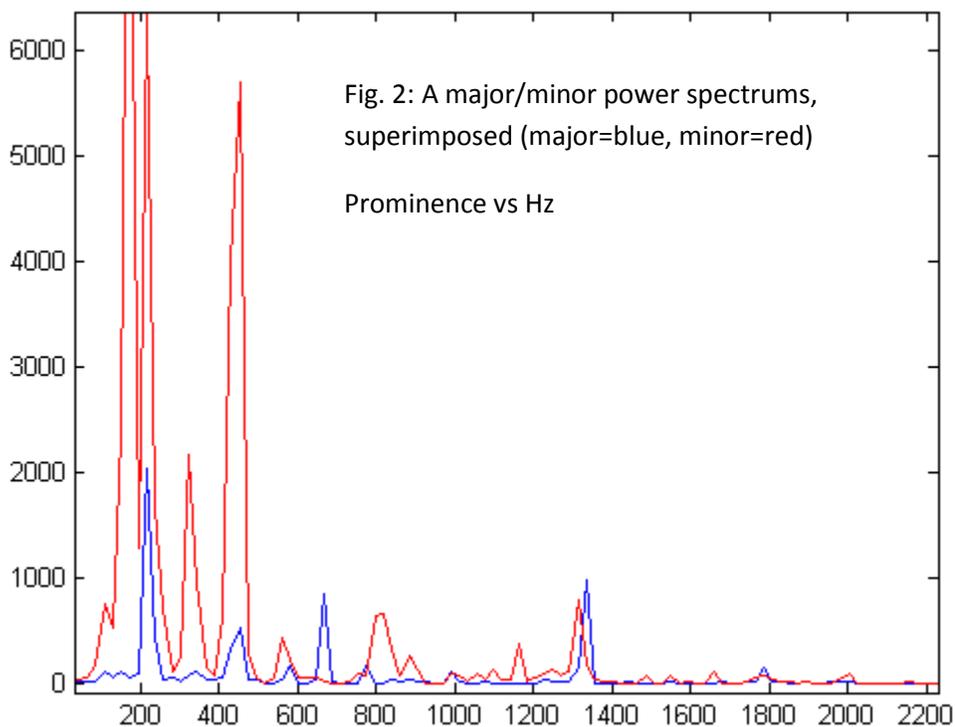
Frequency [Hz]	110	220	330	440	550	660	880	1320	1760	2220	Notes
pipeA				X			X	X	X		A,A,E,A
humA		X		X		X	X				A,A,E,A
guitA1	X	X	X	X	X	X					A,A,E,A,C#,E
guitA2		X		X		X					A,A,E
guitA3				X			X	X	X	X	A,A,E,A,C#

Pitch Analysis

This data shows that a note can be determined from the frequency power spectrum, as it will always return a harmonic series beginning with the root note. This data also shows that we can determine the initial octave of the note being played, if not the exact instrument it is played on. For example, pipeA and guitA3 sound in the fourth octave, as the fundamental frequencies are 440 Hz (A4), while the fundamental frequency for humA and guitA2 are 220 Hz (A3), and the fundamental frequency for guitA1 is 110 Hz (A2). Thus, were all the notes played on a guitar, one would be able to determine which fret was used to play the note, given that they knew which fret produced the A in each individual octave.

Major/Minor Analysis

The analysis of the A major vs A minor chord is inconclusive at best. The A major spectrum, in blue, shows the expected results, giving the frequencies related to the A, C#, and E played in the A major chord. The minor chord, however, retains a peak at 830 Hz. This is interesting because 830 Hz is G#, and G# is the perfect fifth of C#. However, the note played in the minor chord is C, so one would expect a frequency of 780Hz, for a G, as the perfect fifth of the C. This is a peculiar occurrence. As for determining whether a chord is being played versus a single note, this seems to be possible, as the fundamentals are present for A3, C#3 and E3 that are not present in the single guitar note without the A2 fundamental (as in guitA1). Additionally, the higher octave notes, such as E6 and A6, are only present in guitA3, which does not contain the lower fundamentals. Therefore, it is possible to recognize a chord due to the wide range of frequencies that are not present in the single note recordings.



A Major [Hz]	220	440	550	660	1320	1760				A,A,C#,E,E,A
A minor [Hz]	110	160	220	330	440	550	790-830	880	1320	A,E,A,E,A,C,G-G#,A,E