6. Comparing instruments

The three sound files used below are presented here for your listening pleasure.

Voice singing an A

0:06 / 0:06

Download

Guitar playing an A

0:03 / 0:03

Download

Clarinet playing an A

0:03 / 0:03

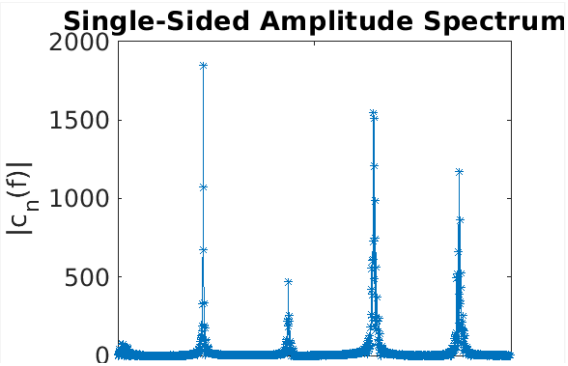
Download

Different instruments, same note (External resource)

```
LenV = length(voice);

signal = voice;
Len = LenV;
Fs = FsVoice;

signal = signal(round(Len*0.3):round(Len*0.5));
L = length(signal);

y = fft(signal);
yMag = abs(y);
N = length(yMag);
f = 0: (Fs/N) : (Fs/2);
yMag = yMag(1:length(f));
figure(2)
plot(f,yMag,'-*');
title('Single-Sided Amplitude Spectrum')
xlabel('f (Hz)')
ylabel('|c_n(f)|')
set(gca,'fontsize',18)
xlim([0,1000])
```

▶ Run Script

Output



What is different in the FFTs?

3/3 points (graded)
Answer the following based on your observations.

The first column is choose the best possible answer. The other two columns are choose all that apply.

Which signal is most similar to a pure sine sound wave?	Which signal(s) has(have) the greatest number of nonzero harmonics?	Which signal is missing harmonics?
○ Clarinet	☐ Clarinet	☑ Clarinet
◉ Guitar	☐ Guitar	☐ Guitar
○ Voice	☑ Voice	☐ Voice
✔	☐ None of the above	☐ None of the above
	✔	✔

Submit You have used 6 of 25 attempts

✔ Correct (3/3 points)

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Topic: Unit 1: Fourier Series / 6. Comparing instruments

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Question regarding the definition of harmonics.

question posted 10 days ago by **gontia0**

Are harmonics here defined to be multiples of $\frac{Fs}{N}$?

This post is visible to everyone.

Add a Response

2 responses

jfrench (Staff)
9 days ago

Not quite! The harmonics are multiples of the base frequency seen in the signal. Not the sampling frequency.

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DirkLievens72
4 days ago

i also don't quite understand the question around harmonics. My graphs show peaks at 220, 440, 660 and 880 Hz for Voice; peaks at 220 and 660 Hz for Clarinet and peaks at 220 and 440 Hz for Guitar...

i therefore thought both Guitar and Clarinet are missing harmonics but the answer suggests it is only the case for Clarinet...

Can you please explain... Thanks

So the clarinet is actually very special in that it is designed to be missing harmonics! The guitar is tough because it is so similar to a pure sinusoid that it is hard to see the higher harmonics. Perhaps this problem is poorly posed, but it is mostly to get you thinking. Maybe I should remove the points...

posted 2 days ago by **jfrench** (Staff)

The guitar has the harmonics but their amplitude is lower. Perhaps it would be useful to go back to amplitude of waves and harmonics. A vibrating string (or column of air) vibrates at a fundamental frequency, but also vibrates at multiples of the fundamental frequency. Double the frequency is an octave higher, and each successive harmonic vibrates at a frequency another multiple of the previous one - so if fundamental frequency is 220, octave higher (x 2/1) is 440; next harmonic is 3/2*440= 660; next is 4/3*660=880 etc. I know this was covered in physics but I learned it in music theory

posted about 24 hours ago by **curiouser_alice**

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