Subject: Interesting: Subharmonics
Posted by Matts on Wed, 07 May 2003 11:39:01 GMT
View Forum Message <> Reply to Message

Here's a short article on violin I came across about producing subharmonics- notes that are actually up to an octave *lower* than the open string makes. Not sure of the physics behind it- although violins do a lot of amazing things. I'd wonder how to apply this to speakers, but the tone is very bad...

Subharmonics

Subject: Beat frequencies and Hetrodyning
Posted by Wayne Parham on Wed, 07 May 2003 16:27:52 GMT
View Forum Message <> Reply to Message

The subharmonics that are produced are probably caused by hetrodyning which causes two tones to form a second pair of tones, one being a difference between the two and the other being the sum.Here's a link about the Theramin, which also uses this property. Of course, the Theramin is an electronic device and the violin is acoustic, but the underlying process applies to both.

Subject: Re: Thanks, Wayne. I built one of those once...
Posted by Matts on Wed, 07 May 2003 17:51:30 GMT
View Forum Message <> Reply to Message

I made a primitive Theramin out of Popular Electronics or somewhere when I was in high school- didn't know it used heterodyning though. Have only thought of it used to lower radio frequencies to audible one. I couldn't figure out how the subharmonics formed from the strings, but that makes sense.something else about violins- they have a bass bar inside the top plate on the side of the lower pitched strings, to accentuate the lower notes, and the sound post on the other side emphasizes the higher frequencies. Little two-way system in there.

Subject: Re: Beat frequencies and Hetrodyning
Posted by Paul C. on Mon, 12 May 2003 00:22:06 GMT
View Forum Message <> Reply to Message

I have used this principle in my arranging for saxophone quartet, R&B horn sections, theater pit

orchestra, etc, for many years. The difference frequency produced by a combination of notes, properly chosen and placed in a chord, can reinforce the root note of the chord, or fall an octave or more below.The players must have good ears for tuning, so that their intervals ring (as the barbershop guys say), that is, tune to exactly Pythagorean intervals... those that are NOT of the tempered scale of the piano, where each semitone is a 12th root of 2, but instead, whole number ratios (Pythagorean tuning). This is the tuning that sounds correct to the ear.For example, a C major chord is composed of the notes C, E, and G. If we assign a low note C as the frequency of X, then a C an octave higher would be 2X. An octave above that would be 4X. An octave above that would be a C whose frequency is 8X.The other notes would have other whole note ratios. The G between the C (=4X) and C (-8X) would have a frequency of 6X. The note E would have a frequency of 5X. So, these three notes of the C major chord would be C (4X), E (5X), and G (6X). The difference frequency between the C and E would be 5X - 4X = 1X. That 1X is a C two octaves down. This is IF the notes are played in tune such that they "ring". The difference between the G and the E would be 6X - 5X = 1X, again, reinforcing that low C, 1X.The difference between the G and the C would be 6X - 4X = 2X. That would be a C one octave below the C (4X). So, with all these notes beating together, you produce two subharmonics, which are both harmonically related to the root of the chord (C, 4X), one and two octaves below the root. So, when this chord is played well in tune, to whole number ratios (Pythagorean tuning), the chord can obtain great depth to the overall sound.Did I lose anyone?The E

Subject: Re: Beat frequencies and Hetrodyning
Posted by Paul C. on Mon, 12 May 2003 01:20:17 GMT
View Forum Message <> Reply to Message

For those interested, I am a featured columnist at Sax On The Web.www.saxontheweb.netAnd you can find a link to my articles, including a series on arranging / orchestration at:http://www.saxontheweb.net/Coats/Paul Coats

http://www.saxontheweb.net

Subject: Acoustics of musical instruments
Posted by Paul C. on Wed, 14 May 2003 01:15:50 GMT
View Forum Message <> Reply to Message

Yes, that post is under the bridge, and couples the vibrations in the bridge to the backside of the violin. Interestingly, the shape of the violin is not just style, with the cutouts on each side, and the "f" shaped slots on each side. There is a reason for the contour of the violin, and all of the curves. There have also been some interesting measurements of the vibrational characteristics of the wood and varnish of the Stradivarius instruments. They have been able to duplicate the tonal effects.Dr. Arthur Benade did acoustical research into reed instruments, mostly the clarinet. It

was easier to model, with its cylindrical bore. In place of the mouthpiece and reed, he used a driver not unlike a horn driver. There were also many observations that to me, appear to be similar to what we observe with horn speakers.There is a link to saxophone acoustics:http://www.phys.unsw.edu.au/~jw/saxacoustics.htmlAnd if you hunt around on that site, you can find acoustical treatises on other instruments.

http://www.phys.unsw.edu.au/STAFF/ACADEMIC/wolfe.html

Subject: Re: Acoustics of musical instruments
Posted by Wayne Parham on Wed, 14 May 2003 01:24:45 GMT
View Forum Message <> Reply to Message

A while back when we were discussing Benade, I took an evening to look through some of his work. Wow! He has really done some interesting stuff. What started as a casual session of glancing over some papers turned into a whole evening's read.I get sort of tired of the papers written about loudspeakers because they all look pretty much the same. Each tends to put a spin towards the hoped for conclusion, but they all say the same thing - It's a pretty simple field. So it's nice to see things coming at you from a slightly different angle. Familiar enough to be comfortable with the concepts but different enough to be refreshing and enlightening.

Subject: Re: Beat frequencies and Hetrodyning
Posted by Matts on Wed, 14 May 2003 18:18:37 GMT
View Forum Message <> Reply to Message

thanks for posting all this info- is very interesting. I've done this with jazz chords on the guitar, and not really understood how it worked. On a lot of those chords, you play a 3rd, 5th, and a couple upper extensions, like a maj7, 9th, and the ear will hear the root and put it all together. I always thought it was somehow tricking the brain, because the brain likes to seek out a tonal center in a bunch of notes. I've been playing violin for a few years and am constantly amazed at how complex and amazing it is acoustically.

Subject: Re: Beat frequencies and Hetrodyning
Posted by Paul C. on Thu, 15 May 2003 20:41:43 GMT
View Forum Message <> Reply to Message

I talk about this effect, the brain filling in tones not heard,

here:http://www.saxontheweb.net/Coats/OrchSax4.htmlThis is the 4th in the series... start reading at:http://www.saxontheweb.net/Coats/OrchSax1.html

http://www.saxontheweb.net/Coats/OrchSax1.html

Subject: Re: Acoustics of musical instruments
Posted by Paul C. on Thu, 15 May 2003 20:50:40 GMT
View Forum Message <> Reply to Message

Wayne: I would be glad to mail all of those to you as pdf files on CD , so you don't have to hunt thru the websites.What I thought would interest you was the way he applied the math, and the similarity of his analysis to horn speaker technology.For those wondering what this is about... Dr. Arthur Benade was a physicist and clarinetist, who did much acoustical research into wind instruments.But here are some links I have:http://www-ccrma.stanford.edu/marl/http://ccrma-www.stanford.edu/marl/Benade/BenadeHome.htmlhttp://www.phys.unsw.edu.au/~jw/saxacoustics.htmlPaul

---

Subject: Re: Acoustics of musical instruments
Posted by Wayne Parham on Thu, 15 May 2003 23:45:27 GMT
View Forum Message <> Reply to Message

Man, Paul, you're just too cool. I'd love a copy of a CD containing all those articles. Thanks for posting the links here!

Subject: Re: CD of articles
Posted by Paul C. on Tue, 20 May 2003 10:43:29 GMT
View Forum Message <> Reply to Message

Will do.Paul
