Simultaneous / Harmonic Intervals

The combination of two notes creates what we call a “harmony”. Though not sophisticated enough yet to be classified as a chord, with a dyad we still have the building-blocks of colour which combine to form our larger vertical structures.

The important point here is that simultaneous intervals interact with each other in a way that creates a unique and perceptible harmonic “fingerprint”. This is born by the fact that the two frequencies are sharing the same space and their vibrations sum together to make effectively a third new hybrid vibration. Our aural processing does the magical job of deconstructing this hybrid vibration of a simultaneous interval back into its constituent notes.

Since natural timbres are themselves complexes of harmonics, which morph over time, the sensation of harmony becomes an increasingly complex one as we combine more and more notes simultaneously. In order to best expose the essential interaction of the fundamentals of a two-note harmony, I have experimented with pure sine waves, which are timbre-free (containing the fundamental alone). The resulting interactions (or intermodulations) are so strong most listeners can perceive the *difference tones* which result from the combination of two notes.

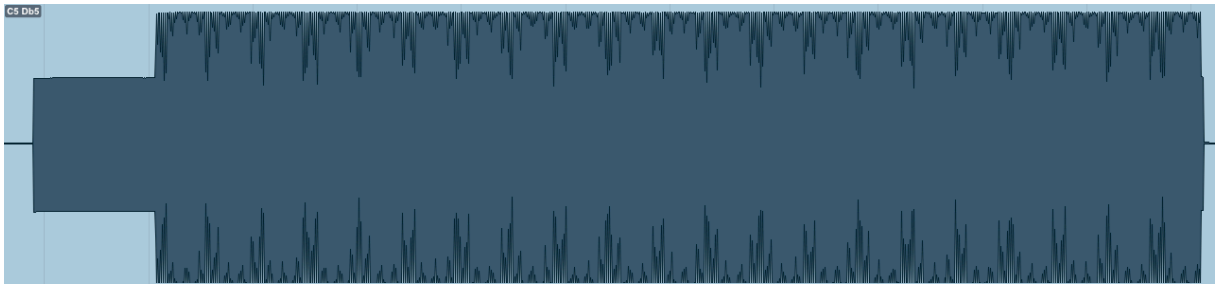
Difference Tones / Tartini Tones / Summation Tones / Combination Tones

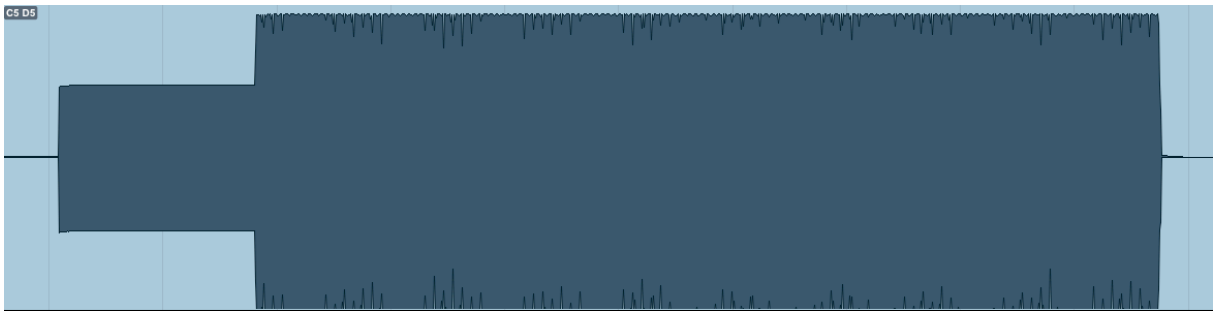
A difference tone is a note that is the result of combining two other notes. Though the phenomenon can be partly psychoacoustic (to do with the inner ear’s perception of sound, beyond the actual physicality of the acoustic event), and outside the scope of this introduction, a simple look at the mathematics is a decent start to understanding what is happening.

C6 (1046.5 Hz)
and
C#6 (1108.73 Hz)
Create
(1108.73-1046.5 = 62.23 Hz), which is a very flat C2 (or sharp B1) – four octaves below.

Follow the table below, listen to my CD extracts, and consider the waveforms of the recordings (extracted from ProTools) also. See if you can hear this mysterious “undertone” melody as the chromatic scale is played!

Bottom Note	Top Note	Difference Tone	Other Diff. Tone
C6 (1046.5 Hz)	C#6 (1108.73 Hz)	C2 flat (62.23 Hz)	
C6 (1046.5 Hz)	D6 (1174.66 Hz)	C3 flat (128.16 Hz)	
C6 (1046.5 Hz)	Eb6 (1244.51 Hz)	G3 sharp (198.01 Hz)	
C6 (1046.5 Hz)	E6 (1318.51 Hz)	Db4 flat (272.01 Hz)	G5
C6 (1046.5 Hz)	F6 (1396.91 Hz)	F4 sharp (350.41 Hz)	
C6 (1046.5 Hz)	F#6 (1479.98 Hz)	A4 flat (433.48 Hz)	Eb5
C6 (1046.5 Hz)	G6 (1567.98 Hz)	C5 flat (521.48 Hz)	
C6 (1046.5 Hz)	Ab6 (1661.22 Hz)	Eb5 flat (614.72 Hz)	
C6 (1046.5 Hz)	A6 (1760 Hz)	F#5 flat (713.5 Hz)	
C6 (1046.5 Hz)	Bb6 (1864.66 Hz)	Ab5 flat (818.16 Hz)	
C6 (1046.5 Hz)	B6 (1975.53 Hz)	Bb5 flat (929.03 Hz)	


C5 Db5

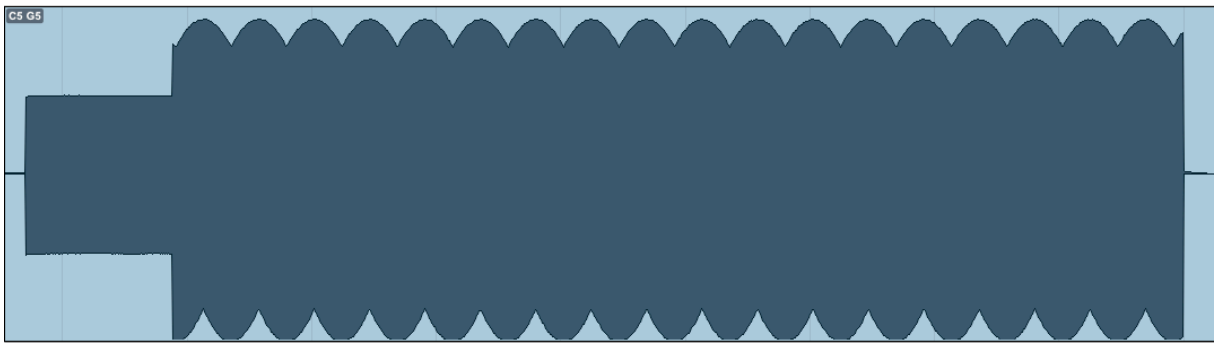

C5 D5


C5 Eb5


C5 E5


C5 F5


C5 F#5


C5 G5


C5 Ab5


C5 A5


C5 Bb5


C5 B5