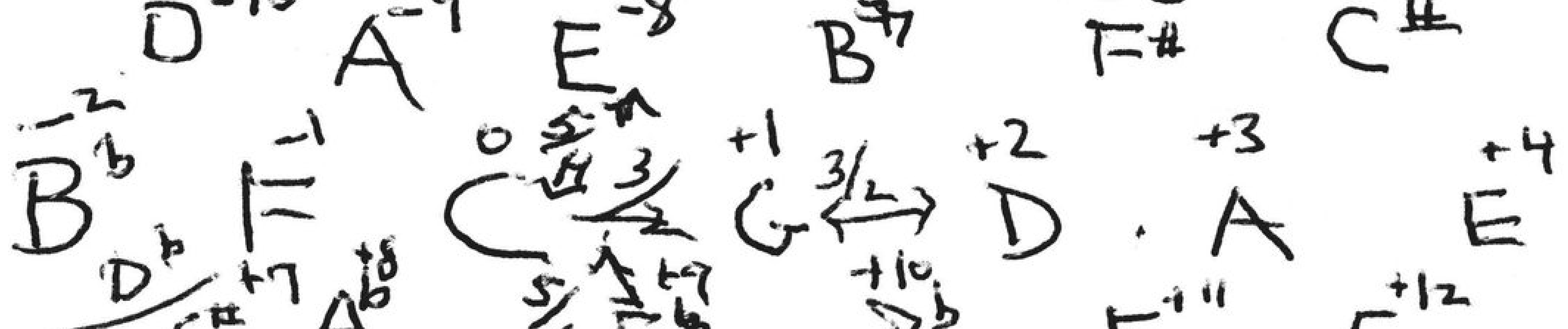
Best wishes for a merry Christmas and an interesting and rewarding 2011 Dave

Sat, Dec. 18th, 2010

Dear Colleagues in "beyond 12",

Enclosed, are 2 copies of Ivor Darreg's "Prelude for organ in D major" – a beautiful manuscript. One is without annotations and the other is annotated with some of the harmonic and melodic intervals marked with the just frequency ratio to be used for them. Ivor made some of the annotations (neat and clear) and I also jotted some notes or directions on the score.



In addition to indicating frequency ratios between some notes, in cases where there are more than one version of a note I use the scheme sketched at left, where the intervals between notes along a horizontal line go up by fifths, the intervals between notes lying on a diagonal line going from "southwest to northeast" go up by 5/4 major thirds, and the intervals between notes on a diagonal line from "north west to southeast" increase by 6/5 minor thirds. The E reached by stepping down from C by eight fifths is slightly higher in pitch than the E reached by stepping "northeast" from C by a major third (5/4), but the difference is slight (about 2 cents – a schisma) and conflicts involving a schisma aren't expected to arise very often. When ratios of 7 occur, the intervals are generally marked indicating where and what they are.

There are a few hexadecimal numbers to be found which indicated elements in a pitch table or else a jump table pointing to a particular continuation point in my QUADVOX program which sounded the music being played.

In addition to Ivor's Prelude in D major, I'm enclosing (please return to me when you've finished reading them and are done with them) (A) Plots showing some of the mathematical acoustic properties of a recorded piano note which I analyzed using additive sound analysis software which I developed at FSU with a big boost from the engineers at the University of Illinois, who developed the "platypus" or "PPS", an ultra fast (for its time) music supercomputer with its own machine language and equipped with very high quality A/D and D/A converters — and (B) Plots revealing some of the mathematical acoustic characteristics of musical sounds produced by the human voice. In this case two sung notes which a music student volunteered to record at a demonstration on sound which I was giving for her class at FSU. The notes were at pitch e4 - about 330 Hz - and sung with vowel sounds "ee" and "ah". Analyses of the audio spectra of these notes with different vowel sounds clearly revealed the marked diffences between them.

Acoustic analysis of recorded and digitized notes sounded on a number of different musical instruments revealed a fascinating plenitude of complex and unique patterns possessed by sounds produced on one or another of the different instruments

I hope to "get out to" many music lovers a feel for how there is a world of harmonies beyond the strictures of 12 notes-per-octave-equal temperament that is so much richer and more variegated than what 12-EQT has to offer and what many of us grew up to believe was all music had for us as regards harmony.

But somehow so many of us "just can't believe" that yes, hearing music in tunings other than 12 equal temperament really feels different than hearing "the same" music in 12-EQT. It's really something more than "the placebo effect"

Deeply rooted beliefs held to be true — obvious, self-evident — sometimes linger and linger even in the face of irrefutable evidence that they are seriously and irredeemably in error.

I've felt that to really bring out non-12, the music and demonstrations which we use to bring it to people need to be really good.

I believe that by making good and sensitive use of the results of probing analyses of a decent number of acoustic instrument sounds, their various idiosyncracies. We can have a good shot at getting many people excited about non-12

Right now I'll point out a few very basic features the plots reveal about (A) the F3 piano note and (B) the two sung e4 notes having the different vowel sounds "ee" and "ah".

If the musicality — instrument tone qualities, flow of notes — shape of the notes — attacks, sustains (can't be rigidly constant for very long), decays, connections between notes, tempo & spacing between notes — appropriate for the music, quality of vibrato — then the pleasingness of the musical examples themselves — and of the whole presentation — avoidance of both monotony and abrupt changes &c &c &c

A The six piano plots all chart the time course of various physical acoustic parameters of the sound produced by the striking of the center string of the three unison strings for the f3. All the plots cover a time period between .081 and 2.6 seconds after the exact time the string was struck

Plot #1 charts the trajectory over time of the overall amplitude of f3 note. The vertical (Y) axis is graduated in units of decibels below an arbitrary zero dB level. It can be seen that sound decayed rapidly over the first half second and then the rate of decay of the note sound slowed until after about 7/10 of a second into the note, its amplitude diminished much more slowly with the rate of decay becoming relatively constant. Plot #2 traces the course of the overal frequency of the note over the 0.081 — 2.6 sec. time stretch plotted. Over about 0.3 sec. this frequency rises by about 4 cents (the Y axis is graduated in units of cents above a somewhat arbitrarily set "nominal" frequency and the early rise in note frequency is from about 3.5 cents above nominal to about 7.5 cents or so above nominal. After Peaking, the note frequeny decreases at a slower rate over the next 2 sec, falling by about 3.5 cents from its peak. The changes in overall frequency are made to appear quite large by the finely graduated scale of "cent deviation from nominal" lying on the plot's Y-axis. The note's sound is affected by its frequency changes over time but I'd guess somewhat "unobtrusively". Plots #3 and #4 depict the time courses of the amplitudes of partials 1 through 10 over the from 0.081 to 2.60 sec. analyzed stretch of time following the initial striking of the string at time 0. Partials 1-5 are depicted in plot #3 and partials 6-10 are depicted in plot #4. The analysis at this point shows up intriguing irregularities in the behavior of these partials. Finally, the last plots for this piano note - #s 5 and #6 - depict the phenomenon for which the piano's sound character is particularly noteworthy - that of "stretched partials".

Plots #5 and #6 trace the time courses of the frequency deviations from strictly harmonic of the partials. The frequencies of these partials, instead of being exactly equal to the product of the partial number and the note's fundamental frequency over its course, hold steadily to values of the order of a cent or two on up to substantial fractions of a semitone higher (sharpward) than this. The upward deviations rapidly become greater as the partial number increases. Plots #5 and #6 clearly depict this effect for the piano note from whose analysis these plots were made. Thus, for example, while the deviation upward from strictly harmonic of the fifth partial doesn't exceed 6 cents at any time over the course of this note, the tenth partial deviates upward in frequency from strictly harmonic by close to 20 cents, an offset inteval over three times as great.

The sung e4 "ee" and e4 "ah" were analyzed mathematically, taking as basis for the calculations a "fundamental frequency" an octave below the intended and heard e4 pitch. In fact, analysis revealed that a fundamental sine wave component of the note's sound and faint partials at 3/2, 5/2, 7/2 ...times the approximately 330 Hz e4 value did form components of the sung note, although they were almost completely masked by the set of sine wave components with the 330Hz e4 frequency and integer multiples of that value.

The first page of the set of analysis plots has plots of the overall frequency trajectory of the e4 "ee" based on the subharmonic e3 frequency and underneath the trajectory of the note's root mean square amplitude over most of its course, the analyses being over the time stretch from 0.10 sec after the note's start to a point in time 0.90 sec. after its beginning and close to its end. The next four (pp2-5) pages contain plots of the amplitude trajectories of the first sixteen partials (this time not on the subfundamental e3 but rather on the intended e4). Finally pp 6 & 7 plot the audio spectra for vowels "ee" and "ah". These audio spectra are markedly different, as are the sounds to which they correspond.