Nicholas Hender, *Anomalous Divergences in the Course of Fate*: What the program does and how it works

The basic structure of the program:

Additive synthesis. 16 voices, each with 16 partials. Originally, there were many more voices with many more partials, but restrictions became necessary as the program grew (due either to a lack of computational power or coding efficiency). Each voice can be tweaked with general analogue synthesis parameters such as an amplitude envelope, a lowpass filter envelope, bandpass filtration, and LFO to pitch and LFO to amp modulation, but the main point is that the frequencies and amplitudes of each voice's partials can be modified relative to its fundamental while sounding. (One deficiency of my work La Trobe Uni in the 90s was that any changes made to a sounding voice's partials had no effect until the next iteration of the voice, so an exact and direct relationship between tuning and timbre could not be maintained while either or both were transitioning.)

Each voice can be "told" when to play by either its own pattern based sequencer, a range of crude stochastic (or raw random) based generators, a reasonably complex algorithmic phrase generator (my preferred method), or by clicking buttons on an on-screen "keyboard". MIDI input has not yet been implemented. To add rhythmic interest, each voice can have one of four different tempi, and each tempo can be modulated by a complex LFO, to the point of destroying any concept of beat.

The entire output can be captured to disc, and goes through some very subtle chorus and reverb in an attempt to make it sound spacialised and somewhat believable as an acoustic musical instrument.

The purpose of the program as an experiment in tuning:

Inspiration is drawn from Slaymaker's stretched scales, Sethares' tuning for inharmonic timbres and Carlos' harmonic tuning, in that there can be a direct and exact relationship, or an actual equivalence, between the partial frequencies in a timbre and the pitch frequencies of a scale. In both Sethares' and Carlos' scales, regardless of their dealings with harmonic or inharmonic timbres, pitches have frequencies equal to timbral partial frequencies. This results in a congruence of frequencies when voices of different pitch sound simultaneously, perceived generally (although often subjectively) as consonance, due to a minimum of interference between frequencies that are close, but not equal (perceived as beating or "roughness").

In a conventional harmonic timbre, the frequency of each partial = partial number * fundamental frequency. In the program, the frequency of each partial in a timbre = partial number ^ shrench * fundamental frequency. "Shrench", a made-up word combining "shrink" and "stretch", is a variable in the range from 0.5 to 2. The timbres generated by the program can therefore be harmonic (when shrench = 1), resembling harmonic, but stretched or shrunk when shrench = slightly less or greater than 1, or quite inharmonic when shrench = values significantly higher or lower than 1, but not close to ratios of whole numbers; values approximating irrational numbers sound the least harmonic. Very generally, a rather shrunk timbre sounds similar to a sort of membrane (or drum-like), while a rather stretched timbre sounds similar to a sort of metal bar (or glockenspiel-like).

In the program the pitch frequency of each voice (or note of the "scale") is calculated in exactly the same way as the partial frequencies, but with consideration of a bass (or "tonic") pitch as a fundamental frequency; so when shrench = 1, the pitch frequencies are simply the harmonic series. Otherwise, the scale is only a stretched or shrunk version of the harmonic series. There is generally a voice for each pitch, although a single pitch can be assigned to multiple voices if required.

As with my work at La Trobe Uni, the tuning is active, in that it can be varied as the music sounds, along with the harmonicity of the timbre. This enables precise and hopefully expressive control over what I think are very important aspects of music.

What I think makes the program most interesting is that the timbre shrench and the tuning shrench are two different shrenches. They can be equal and controlled simultaneously, for the sake of perfect consonance, but they can also be controlled independently of each other; a stretched timbre can be played with shrunk tuning, or vice versa. This is in consideration of three ideas:

1. If two pitches are far enough apart, there will be few, if any, very audible frequencies overlapping between them, and hence little chance of dissonance; also, if the instruments have short decay times, notes don't exist for long enough to cause noticeable dissonance, so why be melodically or harmonically restricted by a tuning that fits only for the sake of mathematics?

2. For a shrunk timbre, or an harmonic timbre with greater than 8 partials, it can be argued that the frequencies in a single voice are close enough to interfere with each other and cause dissonance within a single voice. For an harmonic timbre these upper partials are usually too quiet to have a significant effect on consonance or dissonance (although not always) and are necessary to achieve a natural and pleasantly coloured sound more complex than a basic electronic organ (not meaning to say that basic electronic organs can't be extremely useful). However, with a particularly shrunk timbre, a tuning that fits for the sake of consonance is only reasonable for reducing dissonance to a minimum with simultaneously sounding voices; a particularly stretched tuning for such a timbre actually provides a better solution (in terms of consonance).

3. A lot of what gives tonal music it's motion through time and therefore its ability to engage an audience is dissonance. Consonance can be merely a trivial novelty if not preceded or followed by some level of comparative dissonance. Dissonance is important in making music meaningful, so I've included the capacity for it to be at least as apparent as consonance because I want my music to be more than only a demonstration of unusual tones and pitches.

I feel that tonal music can become tedious if restricted to a single chord or key, so the program includes the capacity to transpose. This is done by changing the bass frequency used to calculate the pitch frequencies. To make the bass frequencies available for selection relevant to the tuning, they are the pitches of the upper shrenched octave, transposed down by 3 or 4 shrenched octaves.

Nicholas Hender