"A PLETHORA OF POLYS" – A LIVE ALGORITHMIC MICROTONAL IMPROVISATIONAL COMPOSITION FOR IPAD

Warren Burt
Box Hill Institute
Institute of Higher Education – Department of Music

ABSTRACT

"A Plethora of Polys" is a polytimbral, polyrhythmic, poly-microtonal algorithmic live performance composition for a collection of iPad apps which uses various capabilities of the software in unique and unusual ways. Using the interconnectivity of AudioBus and CoreMIDI, microtonally enabled apps on the iPad can control each other's tuning in both expected and unexpected ways.

1. INTRODUCTION

"A Plethora of Polys" is a polytimbral, polyrhythmic, poly-microtonal algorithmic live performance composition which uses the interconnectivity of CoreMIDI, microtonally enabled iPad to control each other's tuning in both expected and unexpected ways. By combining the tuning possibilities of several programs, as well as getting desired microtonal scale, we can also get unpredicted microtonal resources based on mistakes in one program controlling another.

The principal apps used in the piece are Thumbjam, by Sonosaurus LLC (Sonosaurus 2014), Gestrument by Jesper Nordin and Jonatan Liljedahl (Nordin 2015), Jasuto Modular by Chris and Amanda Wolfe (Wolfe and Wolfe 2013), BirdStepper by Travis Henspeter and Beau Jeffrey (Henspeter and Jeffrey 2014), and Audiobus, by the Audiobus Team (Audiobus 2015). Additionally tuning files for the program were made on Wilsonic, by Marcus Hobbs (Hobbs 2015), and ScaleGen, by Jesper Nordin and Jonatan Liljedahl (Nordin 2015). Given the interconnectivity being developed in the iOS environment, clumsy though it is (with the use of iTunes still being necessary to transfer some data between programs), one can now begin thinking of a collection of apps as a modular environment, a set of composing potentials similar to the patching-thought of older analogue synthesizers.

2. THE TUNINGS

Wilsonic is an app which allows one to explore a portion of the tuning universe opened up by Ervin Wilson (Wilson 1969). There are a number of tuning formations developed by Wilson which assemble scale complexes by multiplying various harmonics against each other, in different combinations. The Hexany, for example, makes six-note scales by taking all the possible two-element products of a set of four harmonics. Various extensions of this idea then generate larger sets of pitches. Some of these are the Stellated Hexany, the Tetradic Diamond, and the Hexany Diamond. For this piece, I used the Hexany Diamond, which consists of all the ratios possible between 4 elements, plus the six possible ratios of all the 2 element products of the 4 elements. This sounds complicated, but immediately becomes clear when you see the diagram. The scales made with this formation have 19 tones, some spaced very closely together, functioning more as beating variants on each other rather than as single tones. Using this pattern, I made five scales, each of which uses successive combinations of consecutive odd numbered harmonics as their basis. That is, 5 7 9 11; 7 9 11 13; 9 11 13 15; 11 13 15 17; and 13 15 17 19; are the base set of harmonics for each successive scale. These scales are used by the program Thumbjam, and can be freely accessed at any time.

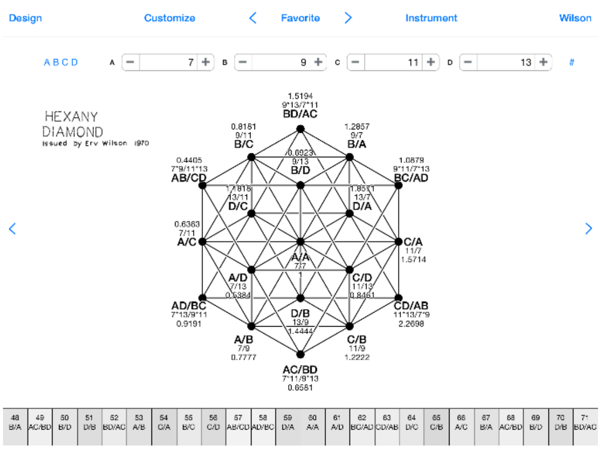

Figure 1 – Wilsonian Hexany Diamond in the Wilsonic app

Here is a listing of the pitches in the 5 7 9 11 Heaxany Diamond scale.

0: 1/1 0.000000 unison, perfect prime
1: 11/10 165.004228 4/5-tone, Ptolemy's second
2: 10/9 182.403712 minor whole tone
3: 63/55 235.104252
4: 90/77 270.079867
5: 11/9 347.407941 undecimal neutral third
6: 14/11 417.507964 undecimal diminished fourth or major third

7: 9/7 435.084095 septimal major third, BP third
8: 7/5 582.512193 septimal or Huygens' tritone, BP fourth
9: 140/99 599.911676 quasi-equal tritone
10: 99/70 600.088324 2nd quasi-equal tritone
11: 10/7 617.487807 Euler's tritone
12: 14/9 764.915905 septimal minor sixth
13: 11/7 782.492036 undecimal augmented fifth
14: 18/11 852.592059 undecimal neutral sixth
15: 77/45 929.920133
16: 110/63 964.895748
17: 9/5 1017.596288 just minor seventh, BP seventh
18: 20/11 1034.995772 large minor seventh
19: 2/1 1200.000000 octave

ScaleGen is an app by Jesper Nordin and Jonatan Liljedahl, which was designed as an adjunct to their Gestrument, an algorithmic composition and performance environment. Many different kind of scales can be generated by ScaleGen, and these can be exported to Gestrument, or as Scala files, or as text files. As well, one can use ScaleGen as a performance environment to hear what these scales sound like. I decided to concentrate on sub-harmonic scales in Gestrument. The classic subharmonic scale starts with a very high frequency and then divides that frequency by successive integers, ie 2, 3, 4, 5, etc. This produces a scale which is the inverse of the harmonic series, starting with a descending octave, then successive fifth, fourth, major third, minor third, neutral third etc. descending rapidly to groups of successive microtones, each slightly smaller than the previous ones. Gestrument allows you to use any division factor to make a "subharmonic" scale. (And any multiplication factor to make a "harmonic" scale as well.) For my purposes, I decided to make six subharmonic scales based on division factors of .23, .29, .31, .37, .41 and .43, which are also successive primes. These produce scales which have a smaller interval at the top, and then get into closely spaced microtonal intervals much more quickly. They all sound similar, but each one has a slightly different harmonic character and a different starting interval. Here is a listing of the starting intervals of the scales.

Division factor	Starting Interval in Cents
.43	619
.41	595
.37	545
.31	467
.29	441
.23	358

In this graphic you can see the nature of one subharmonic scale with the larger intervals starting off at a high pitch, and the intervals getting successively smaller as you go down in pitch.

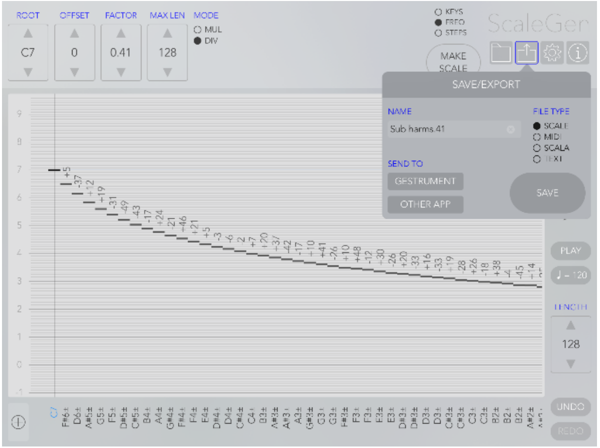

Figure 2. Subharmonic scale in ScaleGen app.

3. TUNING INTERACTIONS BETWEEN APPS

Both Thumbjam and Gestrument allow for microtonal scales to be used. They also both use the same algorithm for making microtonality, which is the "MIDI note number + MIDI pitch bend" routine. That is for each note in a microtonal scale, a table is made which has the MIDI note number and the MIDI pitch bend number needed to detune the note to the desired pitch level. This requires that each voice be monophonic, on a separate MIDI channel, but both allow for multi-MIDI-channel operation. For tuning accuracy, it also requires that the pitch bend range of the target synthesizer be set to +/- 2 semitones on each channel. This means that if Gestrument is used as a normally tuned MIDI generator, it can control a synthesizer that is set microtonally, and that synthesizer will then play in the desired scale. It also means that if Gestrument is set to perform microtonally, it can send "MIDI note number + MIDI pitch bend" sets to any desired target synth which is capable of "round-robin" channel assignment and has a settable pitch bend range. So, for example, if Thumbjam is set to normal tuning with a pitch bend range of +/-2 semitones, (with a starting MIDI channel of 1 and a MIDI channel limit of 16), it can play in whatever microtonal scale Gestrument is set to. And, as stated before, it also means that if Gestrument is set to play normal chromatic tuning, but Thumbjam is set to play a microtonal scale, Gestrument can control Thumbjam playing in its target scale.

Of course, that inevitably leads to the question, what happens if Gestrument is set to play in one microtonal scale, and Thumbjam is set to perform in another? The result here is a strange kind of hybrid scale, where the already detuned notes of Thumbjam are then modified, or retuned, by the MIDI pitch bend instructions of Gestrument.

Furthermore, Gestrument can play its own internal sounds (which can be any desired SoundFont .sf2 sound set), so these can be set to play in one scale, while controlling Thumbjam in another scale. This leads to lots of possibilities for strange doubling of pitches and timbres, which I exploit extensively in this piece.

Here are six sound examples: (These will be played live during the paper delivery from the iPad.)

1. Gestrument set to play chromatically; Thumbjam set to play Archytas' Enharmonic Genus, Dorian Mode. The result is a scale in the Enharmonic Genus.
2. Gestrument set to play Archytas' Enharmonic Genus, Dorian Mode; Thumbjam set to play chromatically. The result, again, is a scale in the Enharmonic Genus.
3. Gestrument set to play chromatically; Thumbjam set to play chromatically. The result is a normal chromatic scale.
4. Gestrument set to play Archytas' Enharmonic Genus, Dorian Mode; Thumbjam set to play Archytas' Enharmonic Genus, Dorian Mode. The result is a strange hybrid scale. I could figure out what the pitches are, but for the moment I prefer just to be charmed by it, and use it for its found-object possibilities.
5. Gestrument and Thumbjam set as above, but with Gestrument's internal sounds turned on. A similar timbre is used to Thumbjam – a plucked string. Now we hear Gestrument's string playing normal Enharmonic, but Thumbjam playing in the hybrid scale.
6. Gestrument set to play Chromatically with internal sounds, Thumbjam set to play Enharmonically. Now we have Chromatic scale and Enharmonic mode juxtaposed.

There are other combinations that can be explored here, but you get the idea from these. With five different scales on Thumbjam, and five different scales on Gestrument (plus the chromatic scale on both), you can see that there are lots of combinations of scales to explore in this algorithmic composing/performing environment. And as is probably obvious, my aim here is not to explore any one scale thoroughly, but to have a wide variety of harmonic resources that I can rapidly move between. The historical influence here is more, say, John Cage and Lejaren Hiller's HPSCHD (Cage and Hiller, 1969), with individual tapes in each equal temperament from 5 to 56 tones per octave, rather than say, any work of Harry Partch's, which thoroughly explored the resources of one portion of a just intonation scale-complex.

4. GESTRUMENT AND ITS PERFORMANCE INTERFACE

Gestrument has an interesting performance interface. It consists of a grid. Across the top of the grid are a series of musical durations, which are selectable by the user. Pitch is given by vertical position, duration by horizontal. There are also four sliders which affect the performance. Top left is a "Pulse Density" slider, which determines what percentage of the time a note will be played in the given rhythmic setting. Top right is a "Scale Morph A>B" slider – one can "morph" between two different tunings with this slider. The tunings are determined by Scala files, or ScaleGen files. On the left border, at the top is a "Pitch Fluctuation" slider. If this is set to 0, then a given part (of 8 possible parts) will only keep repeating the note the grid is indicating. At full on, the program will randomly select from a range of random pitches above and below the note the grid is set to. The range of this is set on the secondary page, in which settings and ranges of parameters for each of the 8 parts are given. Finally, on the left border, on the bottom, is a "Rhythm Randomness" slider. At 0, the program just produces notes at the horizontally given duration. At full on, it randomly displaces these durations by a quantization amount set on the secondary page. Combining this slider with the "Pulse Density" slider can produce quite a variety of rhythms. As stated above, there can be up to 8 voices controlled by this interface, and each one can have its own ranges for all of the parameters. This makes a powerful and flexible way of controlling music, once one gets one's head around the kinds of control made possible by this interface. What's more, the vertical pitch duration does not necessarily have to be low-to-high, as is usually the case. In the case of the subharmonic scales, in fact, the traditional pitch range direction is reversed, with a low position on the interface producing high pitches, and a high position on the interface producing low pitches. If a subharmonic scale is set on the left of the scale morph slider, and the chromatic scale is set on the right of the scale morph slider, then positions between these two will produce weird hybrid scales that tend to cluster around the middle of the pitch range. Having resources like this gives me a very rich environment to improvise within.

Figure 3. Gestrument performing interface

5. THE COMPLETE PATCH AND PERFORMANCE STRATEGIES

The iPad environment has grown in complexity and sophistication over the past couple of years, to the point now where I can construct pretty complex patches in various programs and then link those programs together. The Jasuto modular synthesis environment, by Chris and Amanda Wolfe, is an iOS or Android modular patching synthesis environment with a unique interface (One of the delights of the touch screen environment, whether iOS or Android, is the variety of physical interfaces that are being developed.) In Jasuto, modules, symbolized by differently coloured balls, are interconnected by patch cords. But the distance between the modules acts as an amplitude control for the strength of the connection. And the balls can be automated to move about the screen. So in this way, one can get a wide variety of changing LFO-style modulations happening within a particular patch. For this piece, I only wanted to use Jasuto to construct a particular kind of delay patch, so I didn't use the "motion" capability of the program. In this patch, the input sound travels immediately (through an allpass filter) to both channels of the output. The sound is also delayed 10 seconds and appears in the left channel, and also is delayed 20 seconds to appear in the right channel. A simple use of the program, but just what I wanted for this piece.

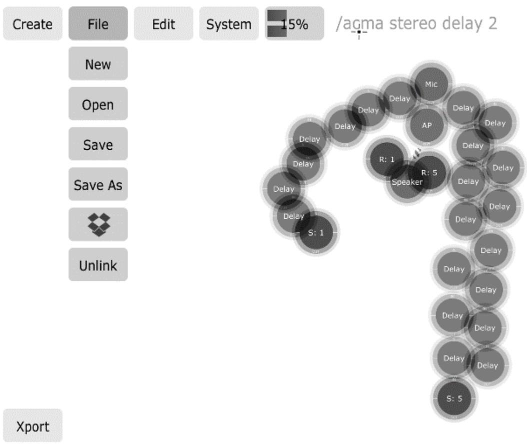

Figure 4. Jasuto GUI for this piece.

In this patch, the final effect unit is BirdStepper, an interesting set of 8 effects with an interesting control device. In this piece, I'm only using the "Spectral" effect in BirdStepper, but I'm controlling the 3 available parameters (time, feedback and gain) with hand drawn graphs which are stepped through very slowly. The "Spectral" effect produces a kind of "harmonic echo" on the input, which I found quite pretty and surprising in its sound.

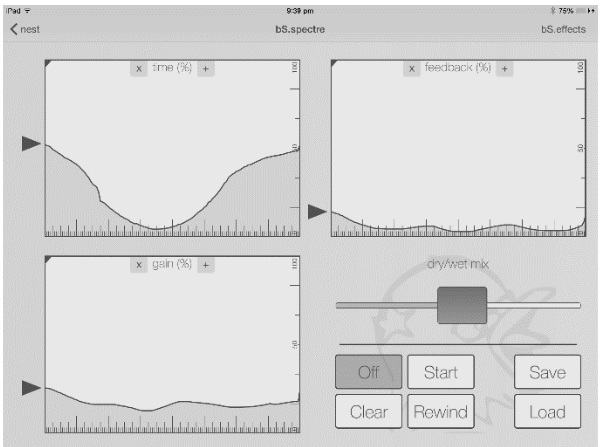

Figure 5. BirdStepper Interface

So with these four programs connected in Audiobus, I have a performance environment that is pretty powerful, and that I can improvise within. Here are some of the performing strategies that I can choose to use in an improvisatory performance using this setup.

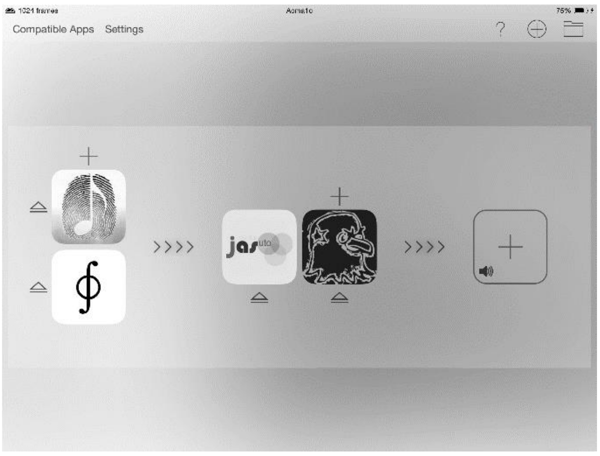

Figure 6. Audiobus with complete patch

I could start with Gestrument's internal sounds turned off, but using the one of the Subharmonic scales to determine pitch. I could route its MIDI signal to Thumbjam, which I might have set to one of the Hexany Diamond scales. This will now produce a weirdly hybrid scale which I don't have complete control over. The output of this goes into the Jasuto delay and the BirdStepper "Spectral" effect, producing delays and harmonic arpeggiations of the gesture I performed with Gestrument. While performing this gesture, I can also change one of the four performance sliders in Gestrument, changing the nature of the gesture produced. I can also turn on and off a number of the voices in Gestrument, producing a texture of changing polyphony. I could then turn off the MIDI output of Gestrument, and turn on the internal sounds, thus producing Gestrument's sounds controlled in a "proper" version of one of the subharmonic scales. Again this will be processed by the delay and "Spectral" effect. Again, I can change the position of the performance sliders, affecting the textures I'm getting. As well, using the controls in Audiobus, I can turn off both Jasuto and BirdStepper, allowing the raw unprocessed sound from the synthesizers to be heard. I can also go into Thumbjam, and change both the patch and the tuning available in that app. As you can see, there are a lot of possibilities for performing here, and for getting different combinations of tunings and timbres, and different families of gestures in the piece.

6. FINAL THOUGHTS

The question might be asked, "Why do I want to compose a piece like this?" One answer might be that I find the combination of spontaneity and complex sounds produced by this patch to be very appealing, and I am delighted in the potentialities of these apps and their combinations. Although the "teen appeal index" of the techniques used in this piece might be low, the ornateness of the sound complexes produced by this patch are quite satisfying to my ears. Or, putting it more simply, these are sounds I want to hear, and if I don't explore them, probably no one else will.

So using the iPad, I've created an algorithmic performing environment of great flexibility. The task now is to spend many hours performing this patch, going back and forth between the apps until I can do so with great ease and flexibility. In the time between when this paper is written (early October) and when the piece is performed at the conference (mid-November), I will have hopefully developed the required flexibility in performing so that a complex and engaging performance which alternates freely between tunings, timbres, varieties of melodic textures, and changing thicknesses of contrapuntal effects can take place.

7. REFERENCES

Audiobus Team 2015. Audiobus, iPad app, https://audiob.us/ (accessed Oct 10, 2015)

Cage, J. and Hiller, L. 1969. HPSCHD, Peters Edition, Henmar Press, New York

Cage, J. and Hiller, L., HPSCHD Available online at URL https://en.wikipedia.org/wiki/HPSCHD

Henspeter, T. and Jeffrey, B. 2014. BirdStepper, iPad app, Available online at URL http://www.birdsoundmusic.com/birdstepper/ (accessed Oct 10, 2015)

Hobbs, M. 2014. Wilsonic, iPad app, Available online at URL https://itunes.apple.com/us/app/wilsonic/id848852071?mt=8 (accessed Oct 10, 2015)

Nordin, J. 2015. Gestrument, iPad app, Available online at URL http://www.gestrument.com/ (accessed Oct 10, 2015)

Nordin, J. 2014. ScaleGen, iPad app, Available online at URL http://www.gestrument.com/scalegen/ (accessed Oct 10, 2015)

Sonosaurus 2014. Thumbjam, iPad app, Available online at URL http://thumbjam.com (accessed Oct 10, 2015)

Wilson, E. 1967. "Some Hexany and Hexany Diamond Lattices (and Blanks)" Available online at URL http://www.anaphoria.com/hex.PDF (accessed 10 Oct 2015)

Wolfe, C. and Wolfe, A. 2013. Jasuto Modular Synth, iPad app, Available online at URL www.jasuto.com (accessed Oct 10, 2015)