

The Synthesizer Orchestra : A proposal for the structure of a live electronic ensemble

By Paul Sheeky

Introduction

The use of synthesizers in an orchestral context is nothing new. In fact most of the earliest completely electronic instruments were used in this way: the Theremin in works by Shostakovich¹ and Martinů², the Ondes Martenot was favoured by Messiaen, and Paul Hindemith wrote some pieces especially for the Trautonium. But these all used the electronic instruments as an addition to the traditional orchestra, and almost always as a solo instrument (with the notable exception of Percy Grainger's Free Music #1 which required the use of 4 Theremins). As synthesizers developed from the late 1950's onwards, electronic music began to find its own unique voice. However, the music was produced in studios by single instruments, with performances often taped for use in a live context due to the awkwardness involved in moving such unwieldy yet oddly fragile machines. Multi-track tape could be used to give the impression of polyphony, but the technological limitations prevented any kind of live electronic ensemble being formed. Avant-garde composers wrote for electronic instruments, but their small scale experiments were hardly a match for the well established pomp and splendour of a full-sized classical orchestra.

Thus it was that the earliest large scale classical electronic works were originated in studios through the use of multi-tracked monophonic instruments, especially the Moog synthesizer as used by Wendy Carlos on her seminal Switched On Bach (1968). Although the first works of this sort were electronic reproductions of music written for traditional instruments, the fact remained that with the limited technology, such music could not be played live. Add to this the fact that there was no established musical tradition associated with particular collections of electronic instruments, as there was for traditional instruments in the form of standard configurations such as chamber orchestra, string quartet, symphony orchestra etc. This all boded ill for the creation of a truly live electronic tradition. Even so, in 1970, Gershon Kingsley formed the First Moog Quartet with the express aim of performing electronic music live (although conventional instruments were often also included) and achieved a small measure of success for a short period of time. In general however, live electronic music has suffered from the fact that the synthesizer developed in parallel first with analogue tape, then with computer based sequencing and digital audio, which make playing live more of a choice than a necessity. Plus from a classical music perspective, the instruments have become associated more with cheesy pop music than with serious works of art. It is with this in

¹ In his soundtrack to the 1931 film Odná (Directed by Leonid Trauberg and Grigori Kozintsev).

² Fantasia from 1944.

mind that I set out the purpose of this essay, and that is to propose the formation of an orchestra formed entirely of electronic instruments i.e. a synthesizer orchestra. I intend to lay out and justify the structure this orchestra should take and to explain why I think such an enterprise is worthwhile. Finally I shall discuss the potential repertoire of such an orchestra.

Why is a Synthesizer Orchestra desirable?

I believe that live music is intrinsically valuable both as a cultural form and as individual artistic expression. Although huge amounts of electronic music is played 'live' every year, it is rarely fully live and is digitally sequenced with only some elements played live or parameters tweaked during the performance. The complexity and aural precision required by most modern electronic music makes a one hundred percent live performance of it very difficult. It would require numerous people with often expensive and complicated equipment. Thus most artists sacrifice the subtle individual nuance a human being brings to playing an instrument for the convenience of being able to control the music themselves. This can lead to the live performance itself rarely differing from performance to performance, or even from the recorded work. Some largely electronic artists, such as Faithless, combat this by adding conventional instruments to their live act, where these were barely noticeable in the studio-produced work, making the performance itself a remix of the album version of the track. This is good as far as it goes, but it can't work on purely electronic music. Prior to the advent of digital sequencers, performed electronic music was necessarily closer to a fully live experience, but the size and expense of the synthesizers used made it impractical for anyone but the originating artists to play the music live. Even then tape machines could be used as substitutes for individual performers, reducing the possibility of the players individual interaction with the other musicians and the music as it's played. This interaction is at the heart of live music and it makes each performance unique. This is one of the key things a synthesizer orchestra could bring.

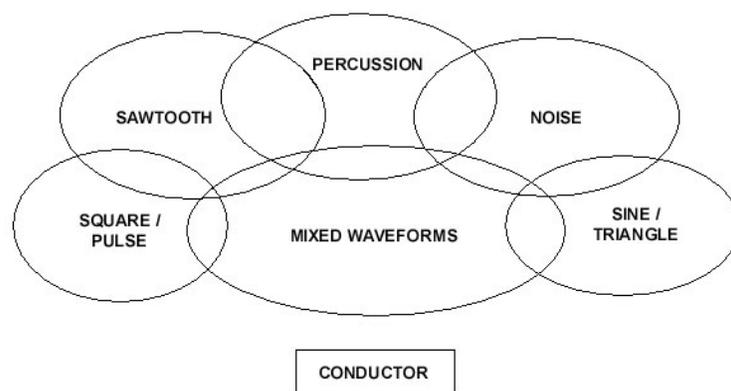
The second major reason a synthesizer orchestra (in a structure as described below) is desirable, is that it would allow electronic works to be easily reproduced by any ensemble without the need of specific equipment, bringing electronic music in line with classical and opening out the possibilities for the performance of works worldwide at any time, and not just when a particular artist tours. For this reason, the orchestra needs to be designed in such a way as to allow for the maximum compatibility between different ensembles, which could potentially contain very different synthesizers. The structure described below is an attempt to do this. A standardised orchestral structure also has some unique benefits for composers. Currently, electronic music composition is inextricably bound up with electronic music production. Standardised electronic ensembles would negate the need for complex and time-consuming production and

mastering procedures and could give the composer more time to concentrate on the music itself (although a certain amount of this time may end up being used for the purposes of communicating the sounds to be used in a work (see appendix 1), and the parameters that change during it (see appendix 2)).

One final reason for the formation of a live electronic ensemble suggests itself. There are large numbers of people that own and love synthesizers; far more than could ever conceivably make a living out of their use. The synthesizer orchestra could harness this untapped resource of synth experts and bring them together for the common purpose of making one hundred percent live electronic music accessible to all.

The structure of a Synthesizer Orchestra

In designing a synthesizer orchestra, it is first useful to briefly analyse the structure of a traditional orchestra. The most immediately noticeable thing about a conventional orchestra is the fact that it is divided into various sound groups determined by the physical nature, and the timbral qualities, of the instruments involved i.e. string, woodwind, brass and percussion sections. This poses a problem for the synthesizer with its vast array of possible sounds. However this problem is easily solved by the introduction of a simple rule (or rather convention), whereby the sound groups are determined by the basic waveforms used in analogue synthesis i.e. sine / triangle, square / pulse, sawtooth and noise. One problem that arises from such a grouping is that many of the more interesting sounds produced by synthesizers are a combination of these waveforms. This could be solved by having a mixed waveform area in the centre alongside distinct sound groupings for specific passages so that the physical arrangement of the orchestra could look something like this.



Another issue raised by such an arrangement is that of the positioning of digital sample-based synthesizers and other electronic instruments such as samplers, which could play any variety of sounds. In reality this problem is not so much a question of positioning as a question of whether such instruments should be in the orchestra at all. The general conception of the orchestra is to create a standardised aural palette that any electronic musician has access to and any composer can have in mind when writing the music. The most important thing therefore is that any synthesizer orchestra can play the composed works in a reasonably accurate way. The vast array of sounds possible through sample-based synthesis and sampling makes this incredibly difficult for the orchestra without the exact same synthesizer or the same samples. It may well be the case that these can be made available to the orchestra by the composer, but this can't be assumed, meaning that the orchestra would have to spend a lot of time trying to recreate the sounds. On top of this, the kinds of sounds likely to be produced by such instruments are copies of "real world" sounds and conventional instruments, but as the object of the synthesizer orchestra is to make live music, it would be preferable to append the orchestra with conventional musicians rather than use sampled versions of them. This is not to say that samples should never be used by the orchestra (classical music has plenty of examples of taped accompaniments such as Respighi's use of birdsong in *The Pines Of Rome* (1924)), but that they should not be used as standard, in the same way that choral sections are not used as standard in a conventional orchestra.

As the basic timbral character and physical arrangement of the proposed orchestra are established, I shall now return to the analysis of a conventional orchestra and see how this aids in the design of an electronic one. The vast majority of instruments in a conventional orchestra are monophonic. This includes all string, woodwind and brass instruments. Chords are played by combinations of performers playing different notes. Percussion and percussion-based instruments are polyphonic. These include keyboard instruments like the harpsichord and piano. However, synthesizers can be both monophonic and polyphonic. This leads us onto the complex question of what kinds of synthesizers should be used in the orchestra. Considering the monophonic / polyphonic question first, I think this can be left very much up to the practical circumstances of a particular orchestra. Polyphonic synths provide greater sound generating power in a smaller space. However monophonic synths would create a richer live sound by introducing more of a human touch to individual elements, but at the cost of a great deal more space (and transport costs and set-up times etc.). Now let us consider the relative merits of digital and analogue synthesizers. One disadvantage of digital sample-based synthesizers in this context has been discussed above, but this by no means rules them out as most would still have the basic waveforms required for them to play a part in the orchestra. Rather it is some older digital synths lack of expressive real-time controls which might lead to them not being used. And it is for the opposite reason that analogue and analogue-modelling synths would perhaps be favoured. Add to this the general acceptance that analogue synths have a richer and more organic

sound (an important consideration for a quality live experience), and we can safely assume that an orchestra composed of analogue synths would simply sound better. An additional attraction is the fact that vintage analogue synths often drift out of tune and would require tuning at the start of a performance, much like a conventional orchestra, which would add to the sense of occasion. Again, this is not to say that digital synths should always be excluded, just that they would not form the backbone of the orchestra. Above I discussed the difficulty of reproducing specific sounds created from samples, and it could be argued that the same difficulty exists for analogue synths as each has its own unique sound. In response to this I would say that if the sound groupings mentioned above are respected, or at least taken into account, by the composer, then the sound produced by the orchestra would be close enough to what was intended. In fact the difference could be a great strength. Each orchestra would have its own distinct sound, making the live experience all the more special. Remember, no two violins sound the same either.

Another important consideration is the way in which the synthesizers would be amplified. The instruments in a conventional orchestra do not have this concern as their sound comes directly from themselves (with microphones picking up and amplifying the sound if necessary), but a synthesizer needs amplification and a speaker to be heard, and there is no real need for this to be in close proximity to the instrument itself. Three distinct amplification options present themselves, each with their own advantages and disadvantages. The first and simplest is that all instruments are routed to a mixer which then feeds out to a standard PA system, in much the same way most conventional bands are amplified (albeit with microphones rather than a direct feed). This has advantages for the portability of an orchestra as only the synths themselves need to be carried with no additional amplification equipment needed as this would be already installed at the venue. However, the number of available channels on the mixer could be restrictive, plus a sound engineer is likely to be needed. But perhaps most importantly, the sound would not appear to be coming directly from the orchestra. This is not a problem with the second option, which is that each performer has his own amplification (either a powered monitor or guitar amp), which is placed directly in front of their synthesizer. From an audience perspective this would be much closer to the way a conventional orchestra would be heard, but could end up being too loud for certain performers (depending on where they were positioned). This method also has the advantage that the monitors could be chosen to match and enhance the individual characteristics of the synthesizer concerned. The third method is a compromise between the other two. In it each sound group in the orchestra would have its own small mixer and amplifier set up with the output speakers strategically placed to match the location of the actual instruments as much as possible, without damaging the hearing of the performers. However, in this as in much else of concern here, a great deal depends on the size of the ensemble. For instance the second method is an obvious choice for a synth quartet, but a small ensemble playing small venues would perhaps choose the

first, and a full orchestra may determine that the third option is best. One thing however is vital for all three methods and that is that each performer must have some kind of monitoring so they can hear their own instrument clearly. Single-sided headphones are the obvious choice here so their own playing can be heard but also that of the performers around them, creating the potential for more of a live vibe unique to each concert.

Having the analogue synthesizer as the key instrument in the orchestra presents a unique problem to the performer, namely that he may not have enough hands. Some of the most interesting effects of synthesis are created by changing one or more of the synthesizers parameters during play. This may prove difficult to achieve if at least one hand is engaged in playing the keyboard. Thus, floating 'knob twiddlers' may be required to achieve the composers wishes during particular passages. On top of this it should not be assumed that only a keyboard should be used as a control device. Breath controllers, laser harps and touch sensitive control pads are all suitable for use in a synthesizer orchestra. One thing that is very important however is that as much as is humanly possible should be played live. Any sequencing (which should ideally come from either a synth workstation or a separate hardware sequencer and not a computer) should be restricted to those passages that are unplayable by human beings, and even then these should be triggered by people and not programmed. This does raise the question of strict tempo matching as the orchestra itself would not be working from a metronome but from the pace dictated by the conductor. It would thus become one of the sequencer operator's key tasks to match the sequences to the current tempo of the orchestra through a constant process of tempo tapping and tweaking. Any tempo variations that occur as a result of this only add to the uniqueness of the live experience.

In addition to the synthesizer sections of each sound group, two further sections could be added as required. These are a rhythm / percussion section and an effects section. Much modern electronic music contains numerous complex and very specific rhythmic elements that may be difficult to reproduce. So in accordance with the general principle of this orchestra (i.e. that the sounds should be simple enough to produce to make them easily shareable and playable live without the need for complex sequencing), the percussive palette could be restricted to those sounds commonly found on any drum machine: Bass Drum, Snare, Hi-hat, Crash, Ride / Cymbal, Clap, Cowbell and Toms. The same principle should be applied to the effects section. Many of the most interesting and complicated electronic sounds are actually the result of effects applied to various kinds of audio, sometimes rendering the source sound unrecognisable. Unfortunately, these effects are often very specific and would require the purchase of particular effects units or plug-in's. Thus, for the sake of universality, the effects allowed may need to be restricted to those available on the majority of effects units: Reverb, Delay, Chorus, Phaser, Flanger and Pitch Shifter. Additionally, real time changes to effects parameters are a commonly used creative tool, so effects units with easily accessible real time controls may need to be favoured.

So the synthesizer orchestra is beginning to take shape. Ideally it would consist of analogue (or analogue-modelling) monosynths, each played by an individual, with knob twiddlers, sequencer operators, rhythm players and an effects section added as required. It would play in specific sound groups through amplifiers as close to the originating synth as possible, but it is highly adaptable to individual circumstances, and can be appended and moulded as required. But one important question remains: What would it play?

Repertoire

As stated above, there have been many instances of classical music being adapted for synthesizers in electronic music history. These continue to prove relatively popular with William Orbit in particular bringing works in this vein to a modern audience. However, I do not feel that the electronic reinterpretation of traditional classical works should form the backbone of the synthesizer orchestra's oeuvre. These works were written specifically for the instruments with which they are traditionally played, and as such may not entirely suit the sometimes radically different sounds a synthesizer is capable of producing. Adaptations from classical works to electronic ones can take this into account and be wonderfully subtle and aurally bold, but in terms of a live experience, I think the audience for classical music would for the most part prefer the original works in the original style, and would regard the electronic versions as a mere novelty that they would soon lose interest in. The synthesizer orchestra must play to its strengths and provide something that the audience can get nowhere else. Nor would I propose that the orchestra should make adaptations of existing electronic works its main focus. Numerous works by hundreds of artists as diverse as Jean-Michel Jarre, Aphex Twin, Vangelis, Daft Punk, Brian Eno, Autechre and Kraftwerk could be played by the orchestra in a modified form. But these could still suffer from comparison to the original work. The fact that the sounds in the source work were electronically generated may mean the orchestra could provide a more accurate reproduction, but this does not change the fact that the works were written using specific instruments, without the synthesizer orchestra in mind. However, the playing of established works could be a good way to draw an audience to the live electronic ensemble, but their effectiveness will depend a great deal on the quality of the adaptation.

It is with the above in mind, that I thus propose that the synthesizer orchestra's main focus should be the playing of original works specifically written for the structure described above. This would provide an original and unique experience for the audience, as well as creating a platform for new composers. Original works will be hard to come by at first, but once the principle of universality in electronic music composition becomes more established, the repertoire will grow and fully live electronic music could become commonplace. To help promote the idea of a full-size synthesizer orchestra, other

smaller ensembles, such as quartets, could be written for. As I myself have written for this design of synthesizer orchestra, I can testify to the difficulty the restrictions above impose, especially to electronic composers whose aural palette has very few boundaries. But the challenge is an interesting and welcome one and the prospect of hearing your music played one hundred percent live lies at it's end.

Conclusion

Above I present my idea for a synthesizer orchestra, but it should in no way be inferred that the structure of such an ensemble is fixed and unchangeable. All ideas develop over time and change is part of the process of bringing them to life. I merely discuss what I think are some of the key areas that would need to be addressed if an electronic orchestra were to be formed, and present some reasons such a thing may be desirable. I also suggest some principles (aural universality, as much played live as physically possible) on which it should be based. It is highly unlikely that a full orchestra of this type would be formed straight away, but through the gradual formation of smaller groups the idea could gain momentum and one day become a reality. It is thus that I encourage secret synthesizer virtuosos to reach out to their fellow electro heads and form themselves into electronic trios, quartets and quintets. Original music written for such ensembles should be practised and performed. It is through this process of trial and error that the concept of a fully live electronic ensemble will be honed and the formation of a full-sized synthesizer orchestra will become more than just an idea.

Appendix 1 – The Universal Synthesizer Preset

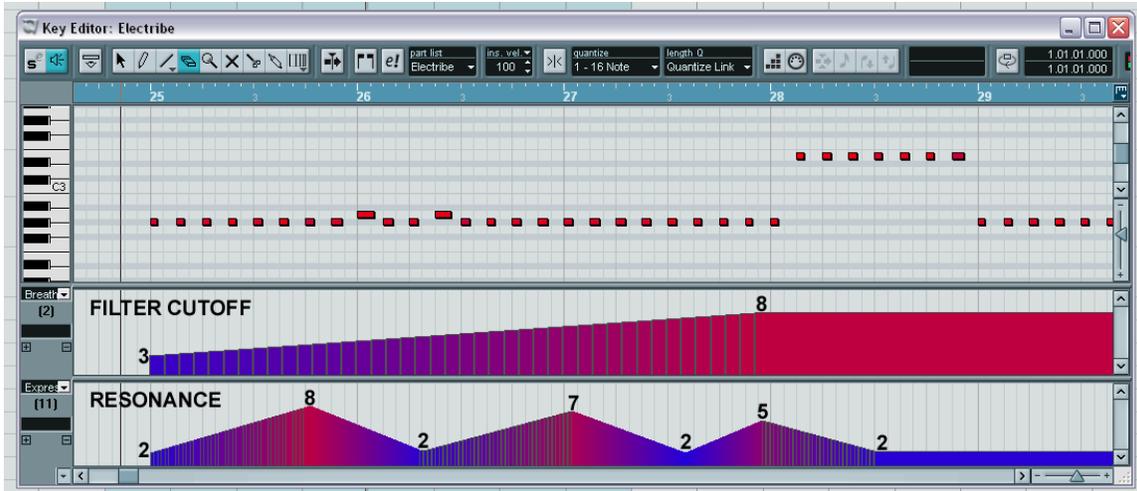
The purpose of the Universal Synthesizer Preset (USP) is to aid ensembles attempting to reproduce a given piece of music by providing a list of the key parameters and corresponding values that are required to create a particular sound. It assumes that the synthesizer being used is either analogue or analogue-modelling, but this does not rule out the possibility that digital synths can use it as a guide to sound creation. It must be stressed that, due to the varied nature of synthesizers, the USP can only provide an approximation and an audio guide track of the complete work should be supplied by the composer. This can be appended by individual sound samples where certain tones are not clearly audible as separate entities in the finished work. As certain parameters require numerical values, and as all synths work on different scales, I'd suggest a standard scale of 0-10 is used. This can then be translated to other synths through conversion to a percentage and adjustment as required. So 8 becomes 80% which roughly translates to 100 in the standard MIDI scale of 0-127. Pinpoint accuracy is neither possible nor important as the initial settings are only to point you in the right direction and will need to be tweaked to match the sound as it appears in the provided

guide track. The below represents a first attempt at a USP table that should provide enough information to a potential ensemble to get them started. More sound creation elements and notes from the composer can of course be added if needed.

	Waveform	Pitch (semitone)	Pitch (fine)	Relationship to next Oscillator	Level	
Oscillator 1						
Oscillator 2						
Oscillator 3						
Noise						
	Parameter affected	Depth / Amount	Attack	Decay	Sustain	Release
Envelope 1						
Envelope 2						
Envelope 3						
Keyfollow						
	Type	Slope	Cutoff	Resonance		
Filter						
	Parameter affected	Shape	Depth / Amount	Speed	Delay	
LFO 1						
LFO 2						
	Type / Room Size	Pre-Delay	Length	Damping	Wet / Dry	
Reverb						
	Type	Delay Time(s)	Feedback	EQ / Filter / Modulation	Wet / Dry	
Delay						

Appendix 2 – Scoring for Synthesizer Ensembles

The only real difference between scoring for electronic ensembles and doing so for classical ones is the increased number of expression instructions available to the composer. Every parameter on a synthesizer becomes available for change either over very short or very long periods of time. To communicate such changes effectively, I would suggest using something similar to the way most audio software displays such events i.e. with a track below the main part of the score that indicates the parameter changed and corresponding values. Screenshots could even be used by the composer to make up the score as in the below example.



Numerical values would need to be added to keep the score in line with the USP concept. MIDI files could also be a suitable choice for a composer distributing their work, but I am unsure about their parameter change storing capabilities. In this area in particular, I invite those with more scoring knowledge and experience than I to improve on the basic outline demonstrated here.