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Sound design techniques and methodologies in commercial electronic music

Introduction

The aim of this essay is to explore, analyse and assess various sound design techniques and their implementation in the context of commercial electronic music. The current landscape of electronic music is very dynamic and extremely diverse. Many producers blend different styles and influences together, create new, original sounds and textures, and consistently push the boundary of what is possible (Turner, 2017). There is no limit to experimentation. Flume, a Grammy-winning artist and one of the most renowned electronic music producers, admitted to downloading “heaps” of sample packs for the most obscure sounds he could find, such as a Russian set of Foley recordings featuring ten recordings of rocks being thrown down a metal pipe (Barleet, 2016). In his 2019 documentary, “When Everything Was New”, he casually synthesises alien-sounding melodies using a pitch-correction tool, Melodyne, and shares a word of advice about sound design: “everyone has the same gear but it’s all about using the gear in a way it’s not supposed to be used” (Flume, 2019).

To achieve the goal of my project, I have created a portfolio of original music, in which I experiment with a range of basic and advanced techniques. In the next part of this essay, I will provide insight into these methods, I will be looking at how I used these tool in practice, how I combined them to craft unique sounds, and, most importantly, what I learnt about creating a truly original soundscape. I will be breaking down individual sounds from my songs with reference to existing commercial electronic music and assessing the good, the bad and the unexpected.

Synthesis

Synthesis is one of the most powerful sound design tools. In the simplest term, a synthesiser is an electronic instrument that generates audio signals (Shaw, 1973). This signal can then be modulated using different parameters and filters. There are a few key terms to be familiar with when discussing synthesis (Vail, 2014).

Oscillator: produces *waveforms*.

Waveforms: analogue signals of different shape, functions in time, timbres and *harmonics* (such as sine, square, triangle or sawtooth) [see: app. 1].

Fundamental frequency: the root or lowest frequency of a note, typically perceived as its pitch.

Harmonics: overtones, or higher frequencies, in a tone. Multiples of the *fundamental*.

Envelopes: shapes the sound over time. The four most common parameters are attack, decay, sustain, and release [see: app. 2]

- Attack: initial increase of level from zero to peak.
- Decay: run down from the attack level to the designated sustain level.
- Sustain: the designated, sustained level, until the key is released.
- Release: decay from the sustain level to zero, after the key is released.

Low-frequency oscillator: LFO signals create a periodic control signal or sweep, often used to modulate effects over time.

Filter: shapes the sound generated by the *oscillator* by amplifying, subtracting or attenuating selected frequencies.

Nowadays, synthesisers are more powerful than ever, allowing for a number of ways of synthesising sound. In my Project Proposal, I have outlined the main synthesis types and the corresponding tools [see: app. 3].

As planned, I synthesised all sounds in my portfolio, except for drums, vocals and other obvious samples. By doing that, I have learnt to approach synthesis in a very methodological way.

Firstly, I would think of a texture:

- Is the sound mellow or harsh?
- Is it complex or simple?
- Is it gritty or clean?

This would help me identify the waveform to base my sound on. For example, one of the most popular sounds in commercial electronic music is the supersaw, which emulates the sound of multiple, slightly detuned sawtooth oscillators. It was first popularized by Roland's analogue modelling synthesiser, J-P800 in 1996, and quickly became the defining sound of many electronic genres (Shore, 2013). If I aimed to create a very present sound, like the supersaw, I would make sure to pick a harmonically rich waveform. On the other hand, if I was synthesising an 808-inspired bass drum, popular in trap and hip-hop music, I would reach for a sine wave, since its harmonic simplicity guarantees clarity and punch in the low-end. Choosing a strong and appropriate foundation makes the rest of the process much easier than trying to “fix” the sound later on.

Next, I would think of a shape:

- Is the sound short and plucky?
- Is it slow and evolving?
- Is it sustained?

These questions help with defining the shape of the sound over time. A short pluck would normally have a very quick (0-20ms) attack, short decay (usually around 200-300ms), no sustain and little to no release. A pad, on the other hand, would fade in with a slow attack, have almost no decay, a lot of sustain and a long release tail.

Afterwards, I would think of a tone:

- Is it a bass, a lead, a synth pad?
- Is it mono- or polyphonic?

This would help me with decisions regarding filtering and voicing. Do I want to play chords or single notes? Do I want to introduce glide or portamento? What kind of filter do I use? Filtering is an extremely important step in synthesis. It can range from simply low- and high-passing the signal, to creating complex textures and movement. For example, one of the most popular filters in dubstep and bass music is the comb filter, which is a series of regularly spaced notches that add a delayed version of a signal to itself, causing constructive and destructive interference (Roger, 2006). It helped develop the signature sound of bass growls, screeches and screams.

Lastly, I would think about modulation:

- Does the sound change over time?
- Is it rhythmic or static?

This would bring me to the final step of synthesising a sound. While there are some popular modulation techniques, this step is truly the one that allows for experimentation with endless possibilities. Many future bass producers route a tempo-synced LFO to the cut-off value of a low-pass filter to create rhythmic synth chords. A popular technique is to then modulate the rate of this LFO with a macro or automation to introduce more variation. It can be heard on hit tracks like “It’s Strange” by Louis The Child and K. Flay or “Lose It” by Flume and Vic Mensa (Lompouridis, Kennett and Flaherty, 2015) (Streten and Mensah, 2016).

To me, modulation is mostly about curiosity and finding out what happens if you link A to B, modulate C with D, or slowly change the amount of E over time. I find the best results come when they are least expected.

Now, let's take a look at specific examples of different sounds in my portfolio and dive into the process of designing them. The main drop lead in "Poncho" is a good example of a fairly simple, yet effective sound. It is a combination of two sawtooth oscillators and a white noise generator. The oscillators have four and eight voices of unison respectively, with the first one playing the original melody and the other playing an octave higher. They are also both slightly detuned. Spreading out the voices by detuning and/or transposing them is a great way to instantly make the sound fuller by occupying more space on a frequency spectrum (Vail, 2014). One important principle to remember is that a human ear loves imperfections because they feel natural and organic. It is especially vital when working with electronic instruments since they can sound almost "too perfect" (DeMers, 2010). That is why introducing those slight "flaws" is such a popular technique in sound design. What truly elevated my lead sound and enhanced its texture was the use of an uncommon Reverb filter. It is actually a feedback delay network which can be used for complex physical modelling effects. Its sound is hard to describe, although some people compared it to hearing "a flanger through a wormhole" (Dysart, 2019). To make it sound even weirder, I added slight modulation to the cut-off value with LFO 1 [see: app. 4]. I also used a number of effects plugins and a few different layers, however I will be looking into these techniques in the latter part of this essay.

The next sounds I want to take a look at are the synth basses in "Hi". There are two main bass sounds in the drop – a mid-range, plucky bass and a pulsating sub bass [see: app. 5]. Bass sounds are usually harmonically simpler than other melodic synth, which leads to a different waveform selection. The mid-range base consists of a PWM waveform which is effectively a blend between a sawtooth and a square wave, and an Acid waveform which is a harmonically

enhanced sine wave. I wanted to introduce some harmonic excitement, since I was aiming for a present and sharp bass tone, while maintaining a decent level of clarity from a sine wave. I mapped a low-pass filter cut-off to a short and plucky envelope to control the shape of the sound and make sure there was not any unnecessary brightness coming through, especially after introducing a bit of white noise. To conform to the idea of desired imperfections, I modulated the fine tune of both oscillators with an LFO. Lastly, I mapped a very short envelope (immediate attack, 60ms decay, no sustain, no release) to the Coarse Pitch value of both oscillators to add a rapid rise and fall in pitch, anytime the sound was triggered [see: app. 6a] It is a very popular way of accentuating the attack of a sound, which is often desired in kick drums, basses or plucks (Snoman, 2014). In order for the two sounds to transition smoothly I used the same Acid waveform for the mid-range bass and the sub. For the latter, however, I blended it with a smooth Rounded Saw wave. I also introduced a simple sine wave Sub oscillator and pitched it two octaves down. To achieve the pulsating rhythm, I mapped LFO 1 with a smooth-edged attack to the cut-off of the low-pass filter, as well as the wavetable position. This introduced the desired amount of movement [see: app. 6b].

Let's take a look at one more type of sound, the rhythmic synth chords in "Save Ya". The most interesting technique in designing this sound was the creative use of custom LFO shapes within Serum. To introduce the slightly delayed rhythm to the chords in the first two drops, as well as the faster pattern in the third one, I designed my own LFO shape and mapped it to volume of both oscillators, the noise generator and the filter's cut-off frequency [see: app. 7].

Sample manipulation

Manipulating and modulating pre-existing recordings is another common method of sound design. Instead of creating a sound from scratch, warping, slicing, re-pitching, time-stretching or resampling audio files can often lead to unexpected results. There are many available tools, such as Live's warping algorithm, which facilitates sample manipulation. It offers six distinct algorithm types (Ableton, 2020):

Beats: works best for material where rhythm is dominant (e.g. drum loops). The process is optimized to preserve transients in the audio material.

Tones: serves well for stretching material with a more or less clear pitch structure, such as vocals, monophonic instruments and basslines.

Texture: works well for sound textures with an ambiguous pitch contour (e.g., polyphonic orchestral music, noise, atmospheric pads, etc.). It also offers rich potential for manipulating all kinds of sounds in a creative way.

Re-pitch: affects the pitch by adjusting the playback rate to create the desired amount of stretching

Complex: specifically designed to accommodate composite signals that combine the characteristics covered by other Warp Modes; it works well for warping entire songs, which usually contain beats, tones and textures.

Complex Pro: uses a variation of the algorithm found in Complex mode, and may offer even better results (although with an increase in CPU usage).

There are also many third-party tools available to producers. For example, Native Instrument's Kontakt 6 offers a wide selection of resampling modes, from old-school analogue devices to the most modern techniques like granulation. Many world-class electronic producers take advantage of complex sample manipulation as it can often lead to results unachievable by synthesis and other means of sound design (Flume, 2019). There are even online communities dedicated to discovering and deciphering samples in popular electronic tracks (Reddit, 2019).

The vocal lead in "Voices" was created using almost only sample manipulation. I took the original vocal sample and re-pitched it using Melodyne. Then, I used the Texture warp mode to stretch it, and experimented with the Grain Size and Flux to add a metallic texture. Lastly, I resampled it to a separate audio track and warped it again, using the Beats mode. An interesting technique I came across was manually setting the Transient markers within the audio file, keeping the resolution at Preserve Transients and turning off the Transient Loop Mode. Decreasing the Transient Envelope value would then make the audio jump between the set Transient Markers, leading to intentional choppiness (Mr. Bill, 2011). This is how I created the rhythm within the vocal sample.

Many sound effects and fills in "All My Thoughts" were created using sample manipulation. The main vocal chop melody is resampled throughout the track using Kontakt 6's granular mode and changing the algorithm's speed. It appears in the second half of the first verse, in the outro, and also as a pitched-down layer in the second verse. Using a single audio file as a source for multiple sounds in a track is a great way to generate interest and introduce new elements, while keeping the overall soundscape cohesive (DeMers, 2010).

The last interesting example is the pluck in "Dark Side of Me". The original sound was a synthesiser patch I designed, however it was sample manipulation that made it sound unique. First, I copied the main chord MIDI to the pluck channel and used Xfer's Cthulhu to arpeggiate them. Then, while constantly recording the audio from the MIDI channel to a separate audio

track, I kept on changing the arpeggiator's settings, I drew in random note patterns and modulated the speed. The result was a five-minute long audio file of random pluck madness. I spent the next ten or fifteen minutes chopping the audio, gluing the different parts together, and finally came up with a completely new melody which truly elevated the sound of the initial synth patch. Randomization can be a powerful tool in sound design and it is not uncommon for producers to spend hours upon hours recording random audio in hopes of capturing a few interesting sounds (Bartleet, 2016).

Layering

Let's take a look at one of the most important techniques in electronic music production – layering. Skilfully layered sounds can instantaneously make the resulting sound feel more full and dense by filling out the frequency spectrum and enhancing its harmonic content (Snoman, 2014). The pluck in “Wildflower” consists of three main and two supporting layers which seamlessly blend together. The point of this technique is to create a sound which *feels* like one, but muting any one layer would drastically change its sound. Another example of that is the lead sound from the second half of the drop, which consists of a saw wave, a vocal sample and three separate string sounds. The saw wave defines the harshness and the digital character of the sound while the other four layers add depth and warmth. Layering synths with organic samples, like vocals and strings, is a very common technique. From a technical standpoint, they have a similar frequency response to saw wave synthesisers, and so they can easily add a bit of air and subtlety to sterile electronic arrangements, without changing their character (Ferrare, 2019).

Another common use of layering is pairing a distorted mid-range bass with a clean sine sub bass (Seydel, 2016). This creates a very textured and defined bass sound, without muddying up the sub frequencies. Having the separation between a stereo mid-bass and a mono sub bass can also add width to the bass sound, which would be hard to achieve with a single layer. I used this technique across my entire portfolio, most noticeably in the bass drop of “Nostalgia”.

While layering can certainly be very useful, it does not come without its issues. Depending on the type of sound being layered, there are certain frequency ranges which can quickly become problematic due to unwanted frequency build-up. Careful and smart use of EQing is probably the most reliable way to deal with this matter (Seydel, 2016). My approach to this technique is based on the idea of “carving space out”. I identify the “good” frequency bands in each layer, boost them by a couple of decibels, while simultaneously subtracting them from other layers. Subtlety is key, but those small EQ moves can truly help the sounds flow together (Owsinski, 2013). Another tip I found to work really well was routing all layers to a single channel and processing them together with a glue compressor, light saturation and an EQ to shape the sound as one.

Effects & audio processing

The “Wildflower” pluck is also a great example of how post-processing can drastically change the tone and character of the sound. Jem Godfrey (2011), from *Sound on Sound*, lists “plug-in torture” as an extremely efficient way of obtaining unorthodox results in sound design. He describes a few different techniques:

- pushing everyday plug-ins, like a flanger or a phaser, to their extreme
- using the “wrong” plugins on the “wrong” sources, such as a vocoder on a drumbeat or a guitar amp on a synth pad
- using a long chain of plugins in a sequence to systematically craft the desired sound

All the layers in the “Wildflower” pluck are divided into two groups and then processed together in a single channel. The first is the “Clean” group, which adds mild distortion and saturation, OTT (Over The Top) Multiband compression and a bit of chorus for widening. The “Glitchy” group is where the processing gets more creative, as I add two guitar amp plug-ins on the synth pluck and process them through two separate instances of Output’s Portal. Both of these groups are routed to the main Pluck channel which includes heavy compression, EQing, an instance of Primal Tap set to Retro Delay mode, more OTT and MannyM distortion. To make the sound even brighter, harsher and more aggressive, the output of the Pluck channel is sent to a bus with a pitch- and formant-shifting plugin to transpose the audio +12 semitones, and then completely destroyed with an instance of Decapitator set to the “Punish” setting, resulting in a much desired distorted top-end.

Granulation

Granulation is a technique which is quickly gaining popularity in commercial electronic music, after the release of Flume’s Grammy-nominated album “Hi! This is Flume” which saw the Australian producer bring the warped, scattered and chaotic sound of granular synthesis to the mainstream audience (Davies, 2019). The idea of granulation revolves around “grains”. They are short pieces of audio (usually 1 to 50ms) which can be triggered simultaneously at different speeds, volume and frequencies (Roads, 2001). Depending on the playback speed, granulation can result in anything from lush, evolving soundscapes to clusters of audio information, complex rhythms and sound effects (Eckel, Rocha and Becker, 1995). Granular synthesis dates back to the 1960s and the Greek-French composer, Iannis Xenakis. He was supposedly “the first to explicate a compositional theory for grains of sound.. In the attack, body, and decline of a complex sound, thousands of pure sounds appear in a more or less short interval of time” (Roads, 1996).

I have implemented elements of granulation in almost all tracks in my portfolio. I found it to be a great way to generate unique ideas and elevate otherwise “boring” sounds. The two prime examples I want to take a look at, are the verse melodies in “Nostalgia” and the atmospheric, evolving synths in the build-up of “Poncho”. The former were created almost exclusively with granular synthesis. The main tools I used were Ableton’s Granulator II, Audio Damage’s Quanta and Output’s Portal. “Nostalgia” began with a simple synth loop which I put inside Granulator II and modulated using the Grain and Spray parameters. One popular technique to quickly generate original, textured melodies is to automate the File Position. This makes the grain engine scan through different parts of the sample, which adds a lot of unpredictable movement to the sound (see: app. 8). Then, I resampled the resulting melody to a separate audio track and granulated it even more using Quanta. At this point, I introduced yet another simple, but effective technique. A good method of adding a bit of texture to any sound is to simply scan it in real time with a granular synthesiser and tweak the parameters. As the sample plays from its beginning until end, at 100% speed, this technique does not change its melodic content. It simply adds background grains of audio to the source material which can instantaneously introduce unique colour. The verse lead in “Nostalgia” is also granulized, not with a synthesiser but with a granular effects plug-in – Portal. Portal creates overlays of original audio at different speeds, rates and pitch. When pushed to the extreme, it can result in true sonic mayhem where the sample is stretched, torn apart and put back together, only to be destroyed again. When used with caution, it can be a great tool to spark interest in a selected source. It also offers a dry/wet control which helps level out the amount of grain artefacts in the sound (see: app. 9).

Potential improvements

Due to the ongoing pandemic, it was much harder to collaborate with other writers, especially vocalists. Some of the tracks in my portfolio (like Voices, Save Ya or Hi) were done with a singer or a rapper in mind but, for one reason or another, these collaborations fell through and could not have been completed in time. Although I have done online writing sessions, via Zoom or other platforms, I found them to be rarely productive. In my opinion, the lack of organic interaction and a troublesome workflow drastically hinder the creative process.

Another aspect which I feel could use some improvement is the mixing. I have found it particularly challenging to mix some of these sounds together. For one, I spent hours upon hours designing them to my liking so when it came to being critical in the mixing stage, I was far too biased and used to the original sound to make any bold mixing decisions. Also, some of these sounds had very strange textures and frequency responses which were challenging to balance out with the rest of the mix, without making them too dull or too overpowering. I believe taking the necessary time off and revisiting some of those tracks with fresh ears will greatly facilitate this process. One important mixing note I always try to keep in the back of my mind is questioning *why* I am taking a certain action. Especially when working in the box, applying a new plugin on an audio track is a very simple thing to do. It is important, however, to know the reasoning behind every single one of them (Musician On A Mission, 2018).

Personal development plan

What are my BIG goals?	What NEEDS to happen first?	WHEN do I want to achieve it?	What OBSTACLES might get in my way?	How can I improve my chances?	Where can I find support?
Signing my experimental electronic project to an influential label (FFC, Future Classic, Bitbird)	Write and produce a body of work of electronic music which I am proud of Research the labels and obtain contact details of people in power	I would like to have a record deal by September 2021	Creative block and exhaustion Lack of response from chosen labels	Keep learning about sound design and electronic music production Collaborate with talented writers and producers Attend networking events, get myself and my music in front of people	Tileyard community and alumni programme Music solicitors
Setting up my own recording studio and production company	Do an internship at a recording studio or a production company to learn the craft Save up money to invest into space and equipment	I want to set up my own company by the age of 27	Not having enough of a starting budget (insufficient savings/no loan) Paperwork and legal issues Unforeseen circumstances which could forbid me from being tied down to one place (touring etc.)	Learn about business management and how to sustain a recording studio Slowly set money aside to invest Meet like-minded people to get advice from and/or work with	Tileyard community and alumni programme Financial advisors Bank Parents Friends who run their own music businesses

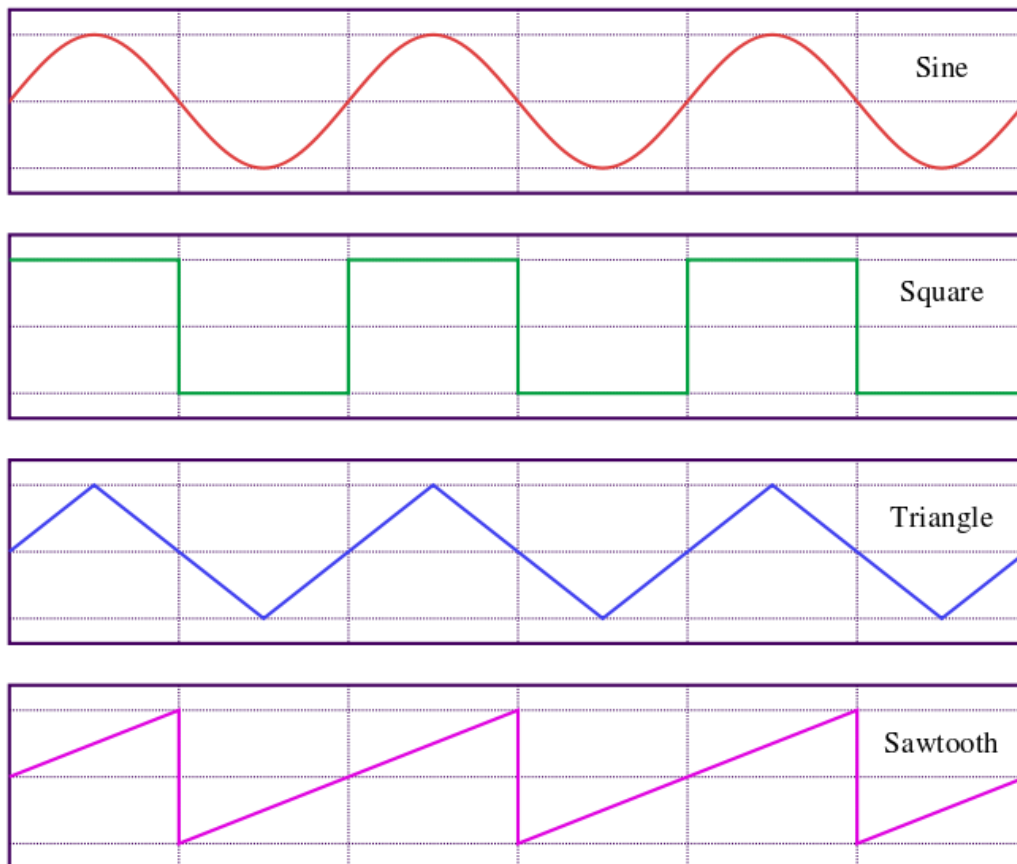
Conclusion

Sound design is a very complex field where knowledge and lack thereof can be equally beneficial. Sometimes it is important to simply let go and expect the unexpected, however there are certain techniques and methods which can make the process far more enjoyable and efficient. Without any knowledge, sound design could simply lead to a lot of senseless noise. Joanna DeMers (2010) makes an interesting point in her book “Listening Through The Noise: The Aesthetics Of Experimental Electronic Music”. She brings up an importance of *meaning* to the sound. She argues that what distinguishes electronic music from other media, is a concern with the meaningfulness of sound. In her opinion, recent electronic music is obsessed with the question of whether sound, in itself, bears meaning.

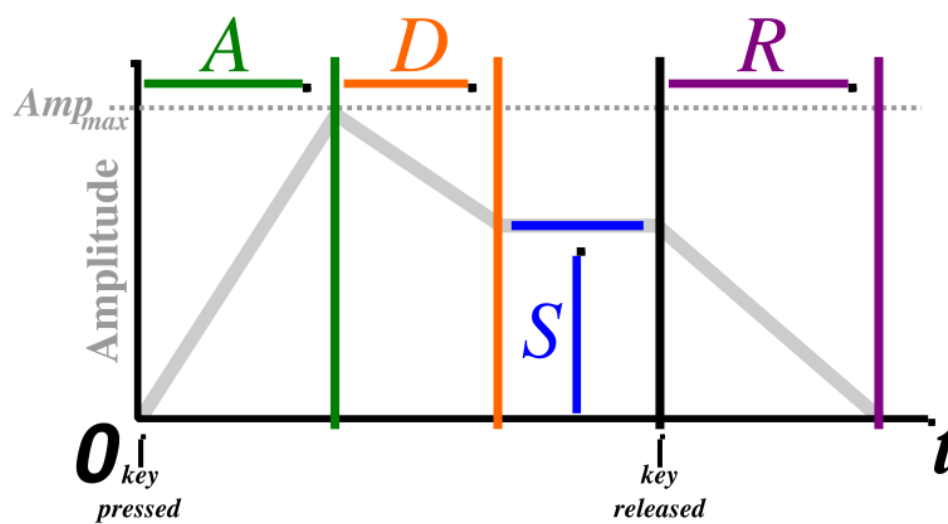
As a result of my project, not only have I learnt more about sound design tools, methods, techniques and capabilities, but also about developing my own artistic voice. Being in full control of my sound was always one of my musical goals, which I feel I am closer than ever to achieving. Of course, there is always more to discover and learn but successfully completing my original portfolio was a huge milestone in my creative journey. I have developed a solid understanding of sound design and I cannot wait to experiment even more and discover new sounds, new textures and new techniques to implement in my productions.

Appendix

App. 1



App. 2



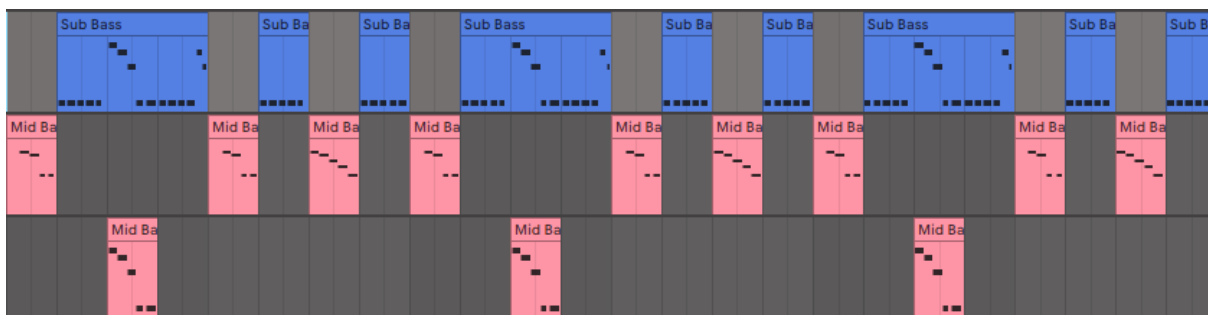
App. 3

Synthesis type	Description	Synthesiser
Subtractive	<i>Usually</i> harmonically rich signal is attenuated by a filter, subtracting frequencies and shaping the timbre (Lindh, 2018)	u-He <u>Diva</u>
Additive	Output of multiple sine wave generators is added together to create timbre, overtones, harmonic and inharmonic partials (Iverson, 2019)	Native Instruments <u>Razor</u>
Wavetable	Arbitrary, single-cycle waveforms are reproduced periodically and modified or varied by different parameters (Roads, 1996)	Xfer <u>Serum</u> Native Instruments <u>Massive X</u> Arturia <u>Pigments</u>
FM	The frequency of an oscillator is being modulated by a modulator in accordance with the amplitude of the modulating signal (Dodge and Jerse, 1997)	Xfer <u>Serum</u> Native Instruments <u>FM8</u>
Granular	Short fragments of audio (usually around 50ms) are triggered simultaneously at different speeds, volume and frequencies (Roads, 2001) to create evolving, unpredictable sounds (Eckel, Rocha and Becker, 1995)	Audio Damage <u>Quanta</u> Ableton <u>Granulator II</u>
Sample-based	Instead of a fixed wavetable and a single-cycle waveform, a large, sample-based wavetable is being scanned to create rich, time-varying sounds (Russ, 2004)	Izotope <u>Iris 2</u> Arturia <u>Pigments</u>

App. 4



App. 5



App. 6a



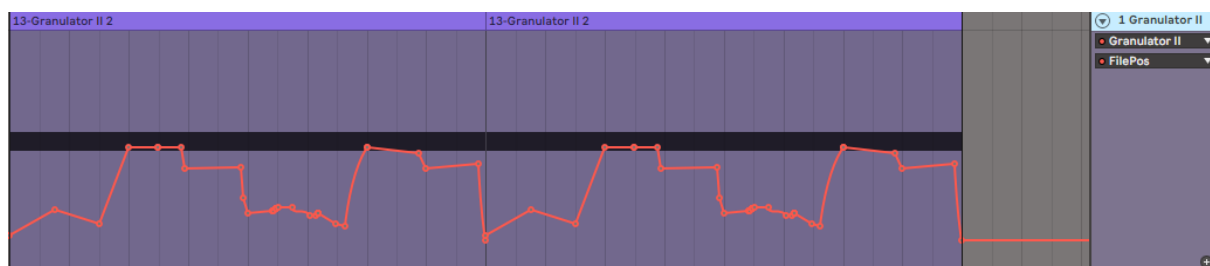
App. 6b



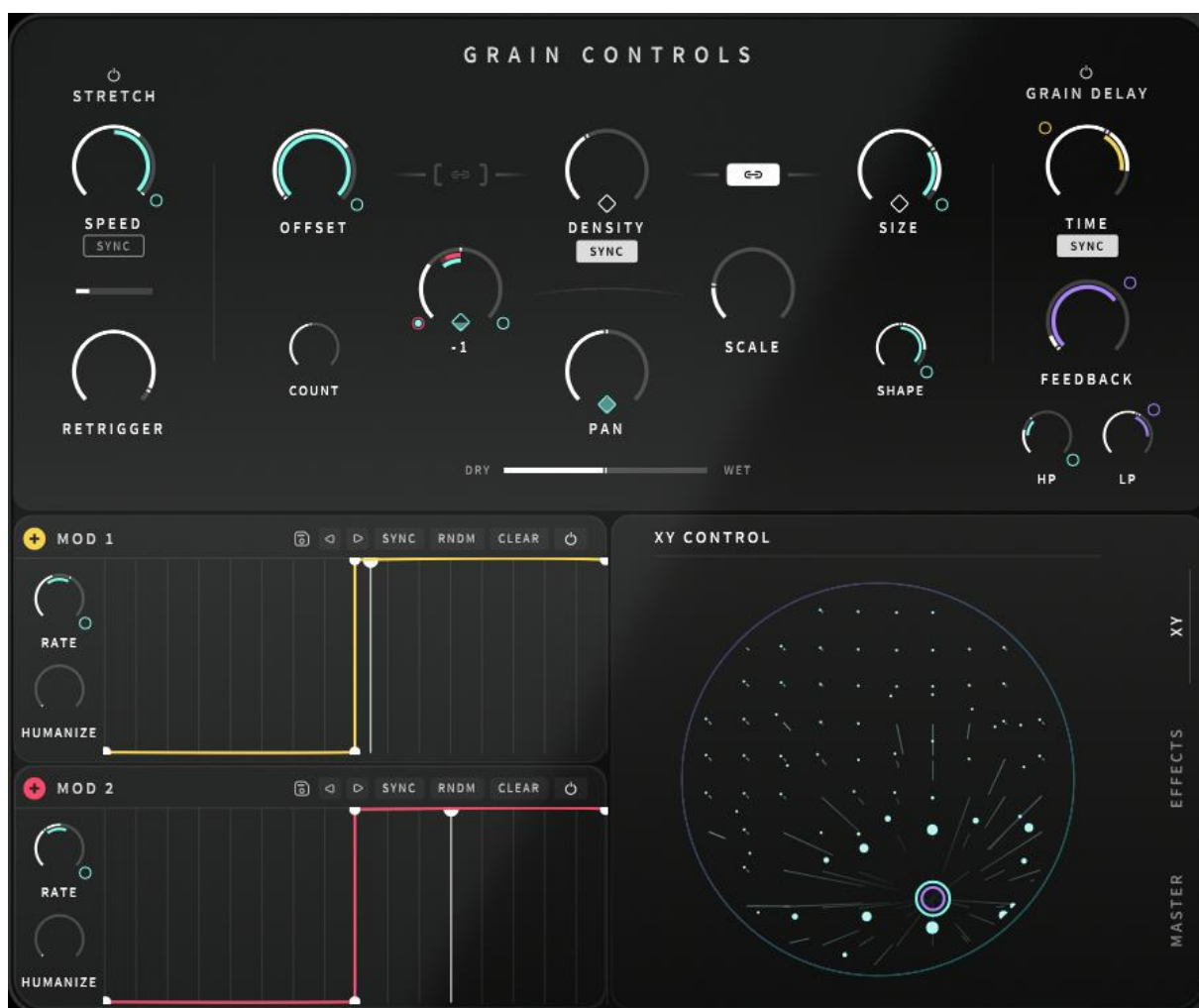
App. 7



App. 8



App. 9



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