

# AVolution

Max For Live Plugin

*An evolution in the solution to audiovisual execution*

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# 1. Introduction

AVolution is the brainchild of Maryland native, producer Daniel Dresner, also known as DR.EZ. As DR.EZ began releasing original music, he was struck with the task of creating visual content to match his productions for both promotion and his live sets. After looking at the current tools on the market to create such content, he was unimpressed with their learning curves and their inability to quickly syncopate the audio and visuals. DR.EZ decided to bring it upon himself to create AVolution, a Max for Live device that synthesizes both audio and visuals all within Ableton Live. The main objective of this project was to advance DR.EZ as producer by creating a unique tool for him to make distinctive content. Therefore he knew that at the end of the day, AVolution needed to do three things: create powerful and expressive sounds, create exceptional visuals that are syncopated with the audio, and be easy to use with integration of Ableton Live (DR.EZ's go to DAW).

AVolution was designed, prototyped, coded and tested over the course of five months. The Max for Live device was broken down into different sections in the design process, each with their own separate functionality. Once a section's user interfaces was designed, it would then be free to be coded and worked through the testing process for quality assurance. As all of the sections became complete, they then were hooked up together to create the device as a whole.

## 2. Review of the State of the Art

Before DR.EZ went to start designing AVolution, he did some research on other audiovisual synthesizers on the market in order to gain some insight that could help down the road. When it was discovered that there was an absence of a distinct audiovisual synthesizers, the research was refined to digital visual synthesizers and to digital audio synthesizers. Unfortunately, digital visual synthesizers were still hard to come by and were usually found in the form of a strung together Max patch that someone posted on an Internet forum.

However DR.EZ did find a few digital video synthesizers in his research, and one in particular that time was spent looked at was the digital video synthesizer Lumen. Lumen is a standalone application for Mac that synthesizes visuals by using either input from a camera or its built in oscillators that oscillate color changes in the video. It then comes with video effects that can be controlled by midi or modulated by its built in LFO's through a modular-type patching screen.<sup>1</sup> DR.EZ bought Lumen to test it out for himself and found that it could yield some cool results, but also noted a few of its downsides. The biggest downside was that it doesn't generate audio and doesn't allow the user to draw parameter automation. Therefore getting video syncopated precisely to specific aspects of a sound the way you could if the audio and visuals were being created in the same plugin is impossible without the tediousness of using a separate application to

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<sup>1</sup> Sharesynth *Create a Video Synthesizer with VSynth and Max/MSP*.  
[www.sharesynth.com/create-a-video-synthesizer-with-vsynth-max-msp/](http://www.sharesynth.com/create-a-video-synthesizer-with-vsynth-max-msp/).

send MIDI CC over an IAC Driver Bus. AVolution will fix this problem by combining the two aspects into one plugin with the ability to be automated directly from Ableton Live.

Some time was also spent looking into the Max package VSynth, a collection of Max modules that can be used to create a visual synthesizer in Max. VSynth is a very powerful tool to create unique visuals through Max patches<sup>2</sup> and is something that DR.EZ would use in the future to advance AVolution's visual capabilities

### 3. Description of the Culminating Experience (The Work)

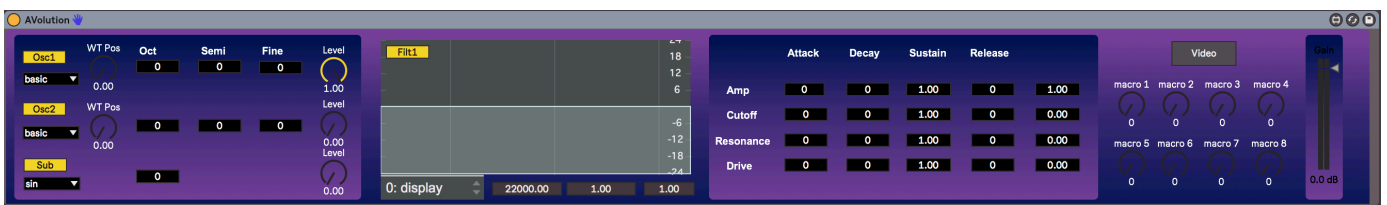


Figure 1: The AVolution user interface

As it was mentioned earlier, AVolution is a Max for Live device that synthesizes both audio and visuals. AVolution's user interface is separated into five distinctly functional sections:

- Oscillator Section: controls the three oscillators of the audio synthesizer

<sup>2</sup> JP "Lumen Software Review." [www.skynoise.net/2016/11/30/lumen-software-review/](http://www.skynoise.net/2016/11/30/lumen-software-review/).

- Filter Section: controls the two filters of the audio synthesizer
- Modulation Section: controls the four pre-mapped envelopes
- Video Section: controls the visual synthesis
- Gain Section: controls the final gain of the audio

### 3.1 Oscillator Section

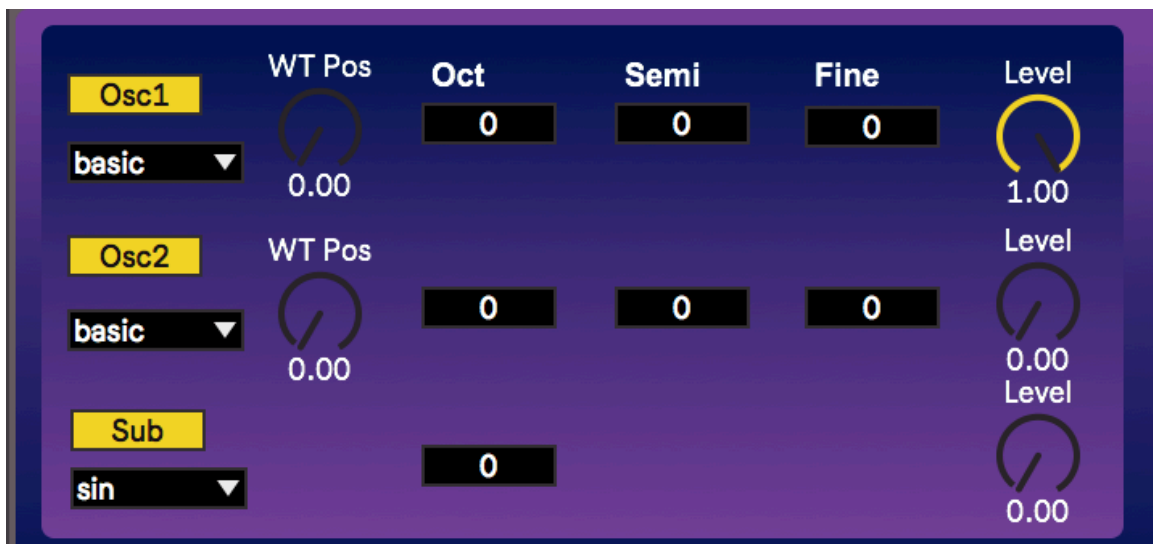


Figure 2: The Oscillator Section

AVolution comes with two main oscillators and a sub oscillator, all of which can be controlled via the Oscillator Section. Inspired by his favorite digital synthesizers Serum by Xfer Records and Massive by Native Instruments, DR.EZ decided to base the AVolution audio synthesizer on wavetable synthesis. The wavetable of the oscillators can be chosen from the drop down menu and swept with the 'WT Pos' knob, with the sub oscillator restricted to the basic wave shapes. The octave, semitone and fine tuning of each oscillator can be set by their respective controls, with the sub oscillator being

restricted again to just octave control. Finally, adjusting their amplitude with their respective 'Level' knobs can set the mixture of the oscillators.

Behind the scenes, the Oscillator Section is constructed by three `cycle~` objects for each oscillator, each with their own `buffer~` object to store the wavetable. Selecting the oscillators' wavetable or wave shape from the drop down menu, loads a new wavetable or waveform into the `buffer~`, with the 'WT Pos' scrolling through the buffer to simulate scrolling through the wavetable positions. The octave and semitone controls work by processing the MIDI note before it gets converted to a frequency for the oscillator, with the fine tune control adjusting the actually frequency after the MIDI to frequency conversion. Finally, the 'Level' knobs attenuate the signal coming out of the oscillators by converting the level of the "level 'knob to an audio signal and multiply it with the oscillator's signal. Then the three audio signals are summed and sent to the Filter Section.

### 3.2 Filter Section

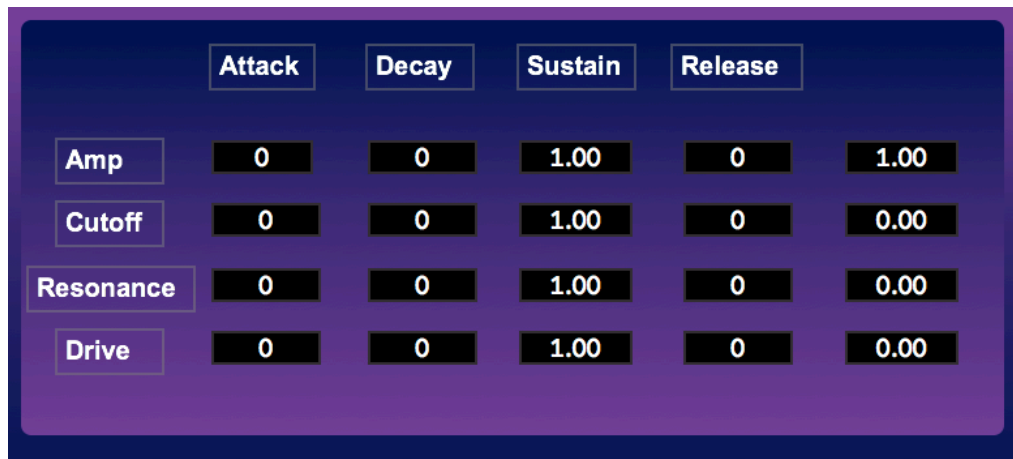


Figure 3: The Filter Section

The Filter Section is composed of two filters with nine different filter types to choose from. The 'Filt1/Filt2' button toggles between the two filters, and the drop down menu on the bottom left of the filter section allows for the selection of filter type. To the right of filter selection drop down menu we have the controls for frequency, drive and Q respectively. Clicking and dragging in the filter window can also control these parameters.

This section was implemented using two biquad~ objects for the filters. Two filtergraph~ objects were then used to display the filters in the user interface and control both biquad~ objects' settings. Toggling the 'Filt1/Filt2' button sends a "Hide" message to one filtergraph~ and a "Show" message to the other, effectively making it look like one filtergraph~ switching between different settings. Audio is then routed through the first biquad~ object, then the second, and finally routed to the Gain Section.

### 3.3 Modulation Section



The image shows a screenshot of a software interface for the Modulation Section. It features a dark blue background with a grid of controls. The controls are organized into a table with four columns: Attack, Decay, Sustain, and Release. Each column has a header button. Below the headers, there are four rows of controls, each with a label button on the left and five numerical value buttons on the right. The values are: Amp (0, 0, 1.00, 0, 1.00), Cutoff (0, 0, 1.00, 0, 0.00), Resonance (0, 0, 1.00, 0, 0.00), and Drive (0, 0, 1.00, 0, 0.00).

	Attack	Decay	Sustain	Release	
Amp	0	0	1.00	0	1.00
Cutoff	0	0	1.00	0	0.00
Resonance	0	0	1.00	0	0.00
Drive	0	0	1.00	0	0.00

Figure 4: The Modulation Section



The Modulation Section is home to the controls of four pre-mapped envelopes that are built in to AVolution. One envelope is mapped to the final gain fader, one to the cutoff of the filter, one to the Resonance or Q of the filter, and the last to the drive of the filter. The attack, decay, sustain and release, of each envelope is set in the corresponding number box in the grid, with the final column signifying the amount that the envelope modulates its destination.

In the backend of the device, these envelopes are represented by four ADSR objects, with each number box in the grid modifying its respective parameter on the respective ADSR object. The final column then attenuates the signal by multiplying it by the number in the number box before sending it along to its predetermined path. When the first envelope reaches the final gain fader it acts as a gain reduction following the path of the envelope that we hear as a volume change. When the second envelope reaches the cutoff of the filter, the envelope value is mapped to a value between the current cutoff level and 22kHz, with variance depending on the value in the last column of the number box grid. The resonance and drive envelopes work in a similar manner, with their envelope values being mapped to [0,20] and [0,12] respectively before reaching their destination.

### **3.4 Video Section**

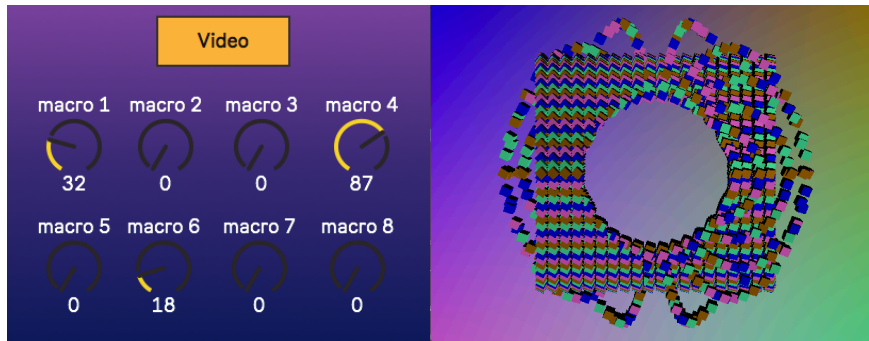


Figure 5: The Video section and its visual output

This section controls our video synthesis. The ‘Video’ button toggles on the video synthesis and opens up a window containing the visual output, which contains a grid of geometric shapes that we can manipulate. The video controls include eight macro knobs each manipulating a different aspect of the visualization. The first knob controls the rotation of the geometric grid. The second knob zooms the grid in and out and the third knob changes the geometric shapes that make up the grid. The fourth knob creates an explosion in the center of the grid, blowing the shapes out from the grid as the knob is swept (this can be seen in Figure 5). The fifth knob exacerbates the explosion and causes the path of the shapes in the explosion to scatter. The sixth knob introduces a colorful background and continues to change the colors as the knob is swept. The seventh knob rotates this colorful background, and last the eighth knob changes the alignment of the shapes in the grid.

The video engine in A**V**olution’s runs in a `jit.world` object. Using the `jit.mo` package and the `jit.mo.grid` object, a grid of `jit.gl.gridshape` is constructed in the video window. The macro knobs are then links to different parameters around the patch. For instance, using the `jit.mo.field` object, the fourth macro knob changes the force and radius of this object which creates the explosion effect. Other parameters that the macro knobs

effect range from the camera rotation to the shape of the jit.gl.gridshape to color of the background in the jit.world object and more.

### 3.4 Gain Section



Figure 6: The Gain Section

The Gain Section contains a final gain fader in the audio signal flow of AVolution. It takes the input from the gain fader and attenuates the signal from the filters before sending it to the audio output of the device.

## 4. Innovative Aspects of the Work

- Seamless integration of audio and visual synthesis in one plugin
- Being a Max for Live plugin, video automation is programmable straight from Live, circumventing the need for tedious MIDI routing and allowing you to use the macro knobs from Ableton Live's Instrument Rack to control audio and visual parameters with simultaneously with one control

## **5. New Skills Acquired**

There were a few new skills that were acquired into throughout the process of this culminating experience:

- Max Programming
- Synthesis Creation
- Video Content Creation

## **6. Challenges, Expected and Unexpected**

There were a few challenges that were run into throughout the process of this culminating experience, some were expected and some were not. For instance, it was expected (as with all software development) for there to be some bugs when coding the device, and it turned out that there were some bugs that were run encountered. These bugs included:

- Envelope destination assignment would get routed to incorrect destinations
- ‘WT Pos’ knob would stutter when sweeping the wavetable
- Secondary video generators would be incompatible with the first

However there were also a few unexpected challenges too, the first being how time consuming the encountered bugs would take to fix. As DR.EZ’s time at Berklee was running out, he had to prioritize the bugs and work around them to still have a complete product at the end of the school year. This led to the ‘WT Pos’ bug ultimately getting

fixed. To workaroud the other bugs, the design of the synthesizer adapted to what it is today where the envelopes have predetermined destinations and there is only one video generator.

## **7. Future Ramifications and/or Plans for The Work**

When DR.EZ began this culminating experience, he set out to create a tool for him to use that will enable him to create unique audiovisual content, leaving a distinct footprint on today's music industry. And now with AVolution, he has done exactly that. AVolution is a personal tool for DR.EZ so there are no plans on releasing this to public, however there are some future ramifications and advancements to AVolution that DR.EZ plans to carry out after Berklee. First and foremost, to fix the remaining bugs with the original design would be at the top of the list. This would make the envelopes map-able to any parameter, as well as add other video generators with their own unique macro controls. In addition to these bug fixes, adding the ability to create unique wavetables directly from AVolution is something else DR.EZ would like to add.

## **8. Conclusion**

This project from start to finish has been an extremely constructive experience

that will never be forgotten. Not only was a valuable set of new skills gained from undergoing this process, but a new tool was constructed that will excel DR.EZ in the future and give him a leg up in today's music industry.

## 9. Bibliography

Sharesynth “Create a Video Synthesizer with VSynth and Max/MSP.” *Sharesynth*, 1 Aug. 2016, [www.sharesynth.com/create-a-video-synthesizer-with-vsynth-max-mp/](http://www.sharesynth.com/create-a-video-synthesizer-with-vsynth-max-mp/).

JP “Lumen Software Review.” *Skynoise*, 30 Nov. 2016, [www.skynoise.net/2016/11/30/lumen-software-review/](http://www.skynoise.net/2016/11/30/lumen-software-review/).