V-Synth 2.0 Polyphony Breakdown

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Oscillator polyphony

Procedure

I used a V-Synth with version 2.0 of the OS installed, including all the version 2.0 samples and in factory default condition. I then initialized a patch and turned off the Modulator and COSM 1 so that only OSC 1 and the TVA are active. I then selected OSC 1 and made the changes as indicated in the chart below. No other parameters were modified except as noted in the chart in the "Additional Parameters" fields. Polyphony was measured by first holding down the HOLD pedal, then pressing C2 using a high velocity key hit then moving up the chromatic scale using very low velocity key hits, one key at a time (i.e. C2#, D2, D2#, etc) until the C2 note stopped sounding. The "PCM User Smpl" was created by resampling an internal PCM waveform.

Analog Oscillator

Oscillator Setting / Additional Parameters / Polyphony
Saw / none / 24
Square / none / 24
Triangle / none / 24
Sine / none / 24
Ramp / none / 24
Juno / none / 24
HQ-Saw / none / 13
HQ-Square / none / 12
Noise / none / 24
LA-Saw / none / 20
LA-Square / none / 23
Super-Saw / none / 12
Feedback-Osc / none / 12
X-Mod-Osc / none / 22
Saw / Sub Osc enabled / 24
Square / Sub Osc enabled / 22
Triangle / Sub Osc enabled / 24
Sine / Sub Osc enabled / 22
Ramp / Sub Osc enabled / 23
Juno / Sub Osc enabled / 17
LA-Saw / Sub Osc enabled / 16
LA-Square / Sub Osc enabled / 20

PCM Oscillator

Oscillator Setting / Additional Parameters / Polyphony
PCM Pre 001 / none / 11
PCM Pre 001 / Vari Sw, Time Trip Sw, Time Trip Beat Keep / 11
PCM Pre 022 / none / 24
PCM Pre 022 / Vari Sw, Time Trip Sw, Time Trip Beat Keep / 9
PCM Pre 031 / none / 24
PCM Pre 031 / Vari Sw, Time Trip Sw, Time Trip Beat Keep / 9
PCM Pre 054 / none / 11

PCM Pre 054 / Vari Sw, Time Trip Sw, Time Trip Beat Keep / 11
PCM User Smpl / Lite encoding / 24
PCM User Smpl / Vari Sw, Time Trip Sw, Time Trip Beat Keep, Lite encoding / 9
PCM User Smpl / Solo encoding / 24
PCM User Smpl / Vari Sw, Time Trip Sw, Time Trip Beat Keep, Solo encoding / 9
PCM User Smpl / Backing encoding / 11
PCM User Smpl / Vari Sw, Time Trip Sw, Time Trip Beat Keep, Backing encoding / 11
PCM User Smpl / Ensemble encoding / 11
PCM User Smpl / Vari Sw, Time Trip Sw, Time Trip Beat Keep, Ensemble encoding / 11

Observations

With analog oscillators the type of waveform does affect polyphony. The High Quality (HQ), Super-Saw, and Feedback-Osc waveforms halve the polyphony. Adding a sub-oscillator on waveforms that allow it only slightly decrease polyphony, except in the case of the Juno and LA-Saw waveforms in which case adding a sub-oscillator moderately decreases polyphony.

Using PCM oscillators, waveforms that are encoded with Lite or Solo encoding do not affect the maximum polyphony of 24 notes while VariPhrase is turned off. With VariPhrase turned on, however, polyphony of those oscillators is significantly reduced (to 9 notes maximum). In contrast, waveforms encoded with Backing or Ensemble encoding produce polyphony of 11 notes maximum regardless of whether VariPhrase is turned on or off.

Conclusions

I hope this information is helpful for those of you who may be creating patches but are concerned about polyphony. Further testing is needed to see how the Modulator and COSM filters affect polyphony. The polyphony hit from encoding samples as Backing or Ensemble could be particularly useful for people creating patches from user samples and who need to maximize polyphony. If at all possible, in the interest of polyphony, it's best to encode your sample as either Lite or Solo if you aren't going to have VariPhrase enabled for that sample. If you plan on using VariPhrase for the sample all the time, Backing or Ensemble encoding would be best as it gives 2 more notes of polyphony than with Lite or Solo encoding samples while VariPhrase is turned on for the patch.

COSM polyphony

Well, I've completed testing of each COSM filter to determine its effect on polyphony. This procedure took quite a bit longer than just testing waveforms because some of the significant settings within various COSM filter types affect polyphony as well.

Brief Description of Procedure

The basic procedure was the same as my first tests. However, as I began to go through the tests with the COSM 1 filter turned on, it became apparent that the effect of the COSM filters was linear. Waveforms with the same polyphony as other waveforms demonstrated equal polyphony reduction when the same COSM filter was applied to it. Thus I decided not to test all oscillator waveforms with all COSM filters. Looking at the data from my previous tests, I picked oscillator settings with progressively decreasing polyphony. Thus, I picked the Analog waveforms Saw, LA-Square, X-Mod-Osc, LA-Saw, Super-Saw, PCM waveforms Preset 001, and Preset 022, both with VariPhrase turned on. All tests were performed with the Modulator turned off and only OSC 1, COSM 1, and TVA turned on. All tests were done using Structure 1.

Test Results

The quantity of data is too large to put into a posting in this forum. However, the data from the tests clearly demonstrate a linear relationship between all COSM filters and polyphony. Each COSM filter affects polyphony slightly differently. May different algorithms in various filters also affect polyphony differently. However, all filters and variations affect polyphony linearly.

From each of the test case data I used Excel to perform a linear regression of the data and find the slope and y-intercept of the the regression line. Using this slope coefficient and y-intercept you can accurately calculate polyphony based on the COSM filter type and sub-algorithm used (to within +/- 1 note). Using the basic algebraic linear equation

y = ax + b

(or)

FINAL POLYPHONY = SLOPE x ORIGINAL POLYPHONY + Y-INTERCEPT

you can find the final polyphony after it has been affected by the COSM filter, regardless of the source of the original polyphony (be it strait from an oscillator, from the modulator, or from another COSM filter). Below is a list of slope and y-intercept values for each COSM filter and sub-algorithm within each filter (if applicable).

Filter Name (Algorithm) / Slope / Y-Intercept

OD/DS (OD) / 0.52 / 2.73
OD/DS (DS) / 0.68 / 1.70
W-Shape (Type 1) / 0.58 / 2.06
W-Shape (Type 2 and 3) / 0.65 / 1.78
W-Shape (Types 4, 5, and 6) / 0.68 / 1.70
Amp (all types) / 0.38 / 3.63
Speaker (all types) / 0.49 / 1.71
Resonator (all types) / 0.51 / 2.19
SBF1 / 0.38 / 2.63
SBF2 / 0.38 / 3.63
Comb / 0.57 / 2.62
Dual (all types) / 0.73 / 1.45
TVF (all types, all slopes*) / 0.91 / 0.49
Dyn TVF (all types, all slopes*) / 0.86 / 0.74
Comp / 0.70 / 1.77
Limiter (all ratios) / 0.73 / 1.45
F-Shift / 0.38 / 2.63
Lo-Fi / 0.73 / 1.18
TB Filter / 0.68 / 1.45

* Using a -24 dB/octave cutoff slope can reduce polyphony by at most 1 note, depending on source waveform. Using a -6 dB/octave cutoff slope can increase polyphony by at most 1 note, depending on source waveform.

Basic guidelines for reading this data: the smaller the slope value, the more profoundly the filter reduces polyphony.

Examples of Equation Usage

I am using Structure 1 with OSC 1 for a Super-Saw analog waveform with COSM1 set to SBF1 and COSM 2 set to Dyn TVF (OSC 2 and MOD are turned off). How much polyphony will I have?

From my first data, a Super-Saw waveform has a maximum polyphony of 12 notes. COSM 1 is a SBF1 (Side-Band Filter 1). From the data above, a SBF1 filter has an equation slope of 0.38 and a y-intercept of 2.63. The polyphony coming out of COSM 1 will be...

Poly after COSM 1 = 0.38 x 12 + 2.63 = 7.19

We round down to 7 notes of polyphony (my test data verifies this result, by the way). Now we have COSM 2 which uses a Dyn TVF (Dynamic Time Variant Filter). The input polyphony for COSM 2 is going to be the output polyphony from COSM 1 (because we're using Structure 1). Let's calculate the polyphony coming out of COSM 2. Look up the equation slope and y-intercept for a Dyn TVF in the above data. Now...

Poly after COSM 2 = 0.86 x Poly after COSM 1 + 0.74 = 0.86 x 7 + 0.74 = 6.76

We'll round 6.76 up to 7 notes. If you've been following along on your V-Synth, you'll find that indeed your polyphony is 7 notes at this point.

Conclusions

Of course, sometimes you'll get one more note or one less note of polyphony than your equation predicts. The equations have not been tested with Structures other than Structure 1 and it's not yet clear how the Modulator affects polyphony. More testing is required to determine how the Modulator and Structures affect polyphony. Additionally, the use of LFOs could also reduce polyphony which also has not been tested. There is also not yet an equation for predicting polyphony when 2 oscillators are on, though it seems that each oscillator and/or filter has a predictable CPU load and thus a predictable impact on overall polyphony. In an informal test I found that when only 2 oscillators are active with no modulator or COSM filters, polyphony seems to be determined by a weighted load average. For instance, combining an analog Super-Saw with an analog Saw (on OSC 1 and 2 respectively) maximum polyphony is 10. When only the Super-Saw oscillator is active, polyphony is 12. When only the Saw oscillator is active, polyphony is 24.