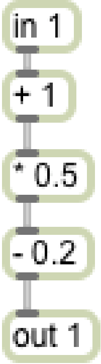
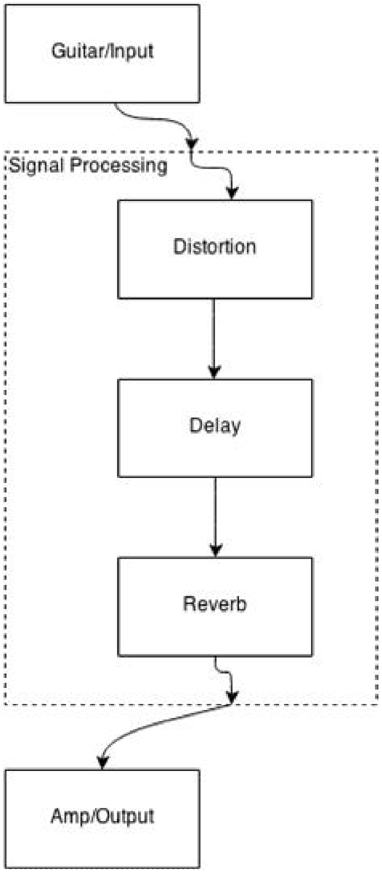
1

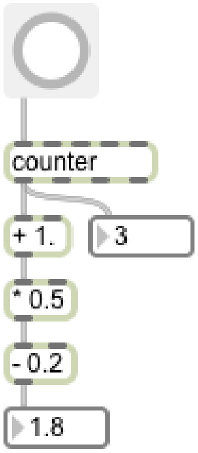
Getting Started with Max

Understanding the basic concepts of Max

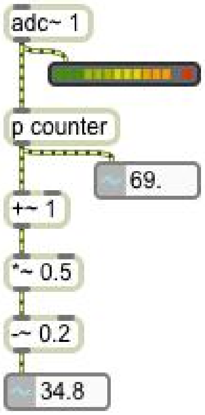


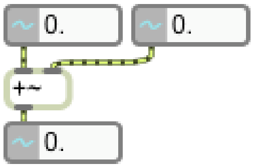

Guitar/Input
Signal Processing
Distortion
Delay
Reverb
Amp/Output

Modular basis for expressions

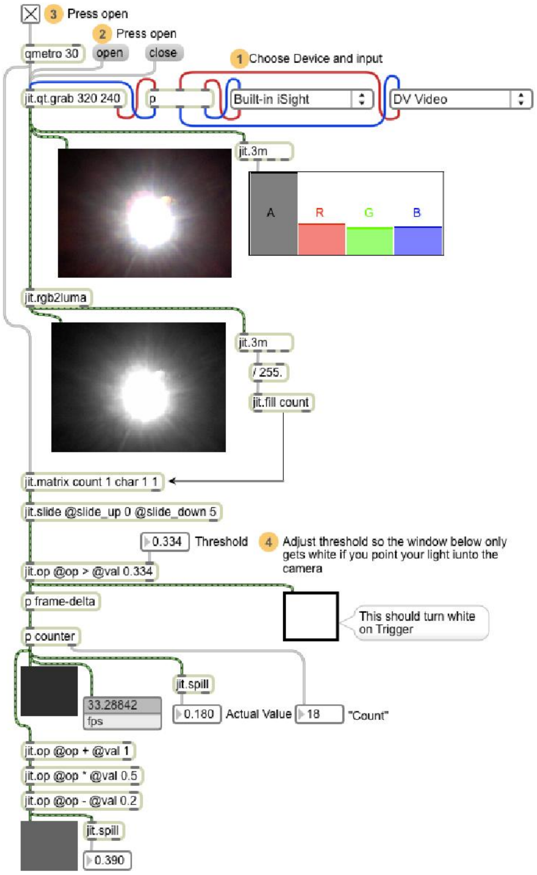


Max Signal Processing





Jitter, Matrix, and Video Processing



3 Press open

2 Press open

1 Choose Device and input

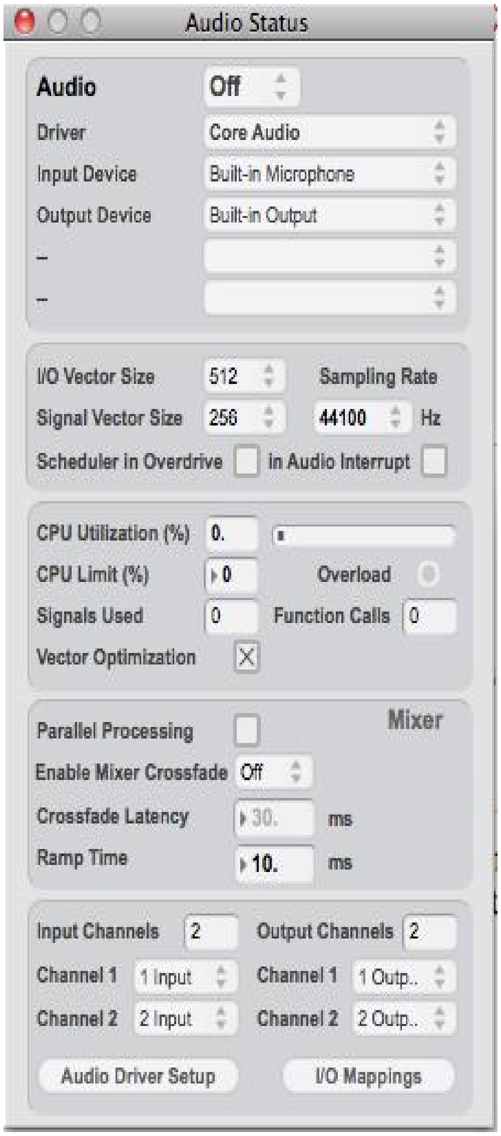
4 Adjust threshold so the window below only gets white if you point your light iunto the camera

This should turn white on Trigger

2
Max Setup and Basics

Setting things up

The audio status window



Audio Status

Audio Off

Driver Core Audio

Input Device Built-in Microphone

Output Device Built-in Output

–

–

I/O Vector Size 512 Sampling Rate

Signal Vector Size 256 44100 Hz

Scheduler in Overdrive □ in Audio Interrupt □

CPU Utilization (%) 0.

CPU Limit (%) 0 Overload ○

Signals Used 0 Function Calls 0

Vector Optimization ☒

Mixer

Parallel Processing □

Enable Mixer Crossfade Off

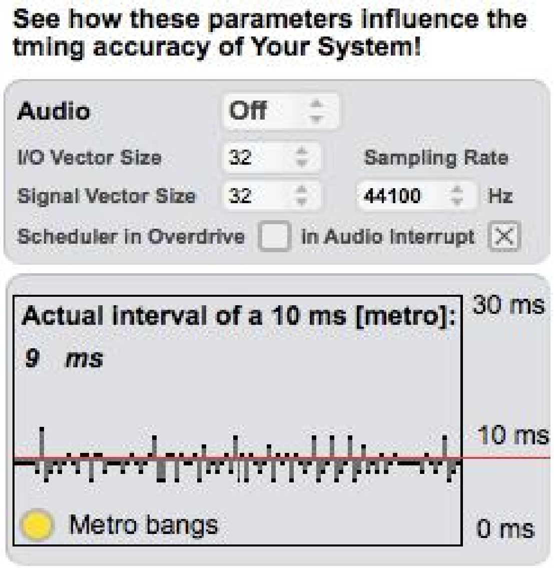
Crossfade Latency 30. ms

Ramp Time 10. ms

Input Channels 2 Output Channels 2

Channel 1 1 Input Channel 1 1 Outp..

Channel 2 2 Input Channel 2 2 Outp..



See how these parameters influence the tming accuracy of Your System!

Audio Off

I/O Vector Size 32

Sampling Rate

Signal Vector Size 32

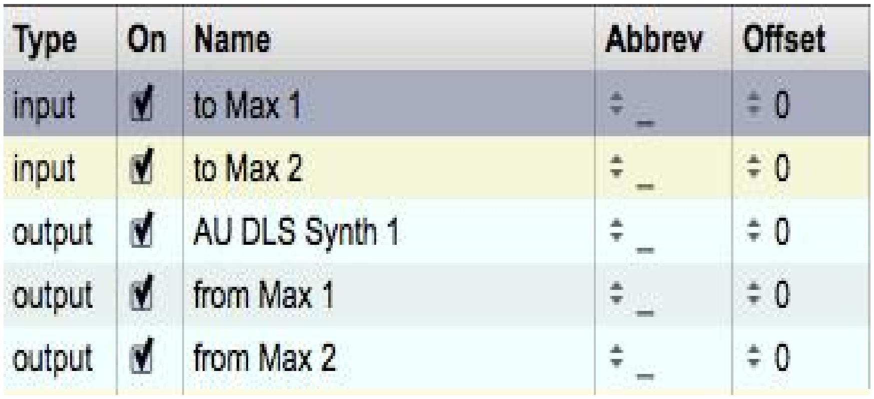
44100 Hz

Scheduler in Overdrive □ in Audio Interrupt ☒

Actual interval of a 10 ms [metro]:

9 ms

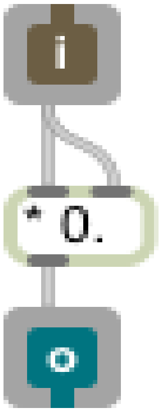
The MIDI setup

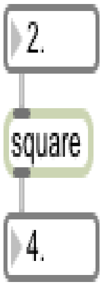


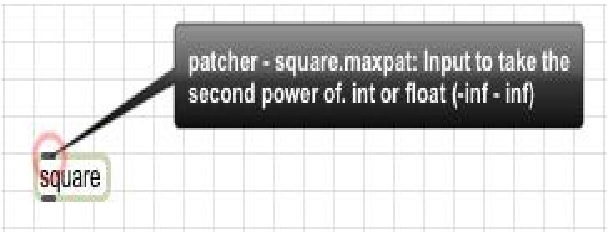
Type	On	Name	Abbrev	Offset
input	✓	to Max 1	_	0
input	✓	to Max 2	_	0
output	✓	AU DLS Synth 1	_	0
output	✓	from Max 1	_	0
output	✓	from Max 2	_	0

Organizing finished code

Abstractions

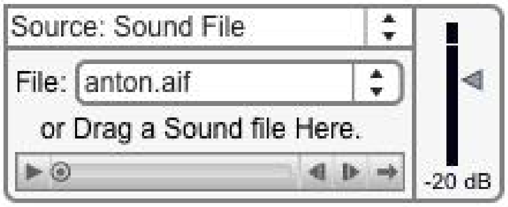






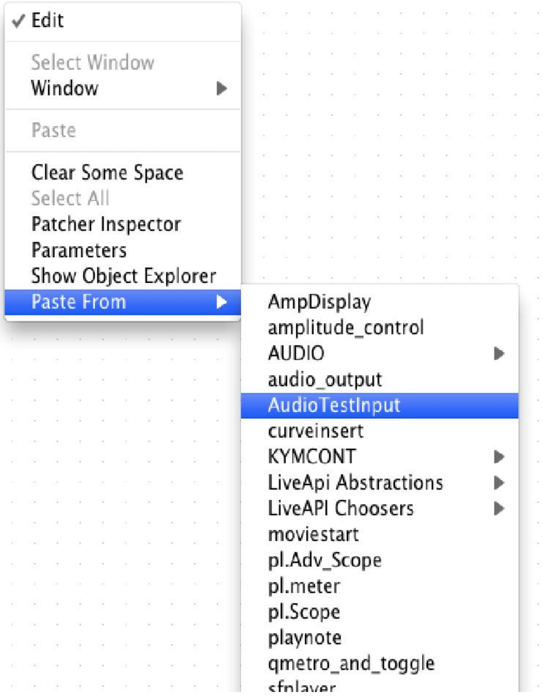
patcher - square.maxpat: Input to take the second power of. int or float (-inf - inf)

Clippings



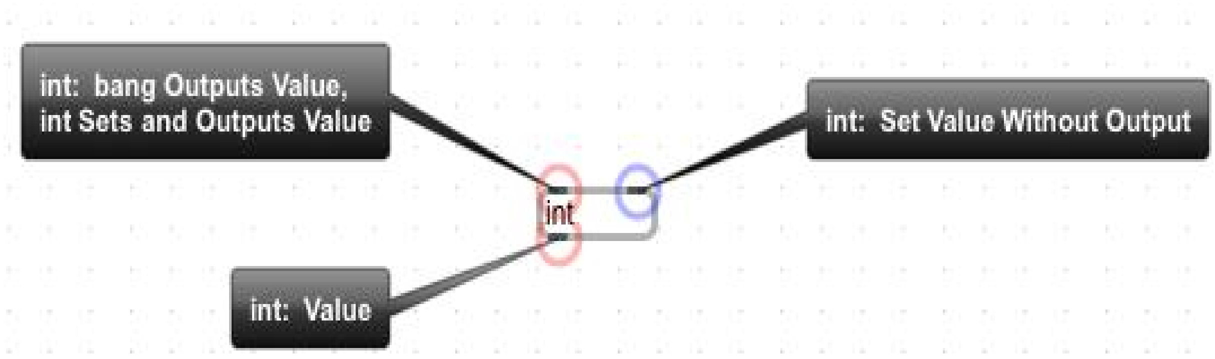
Source: Sound File

File: anton.aif

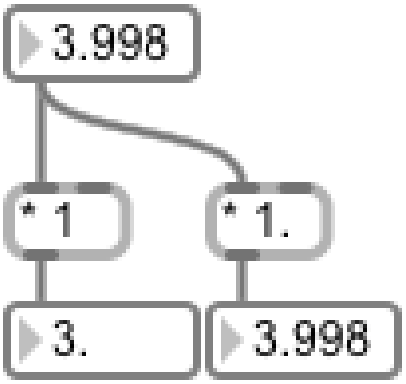


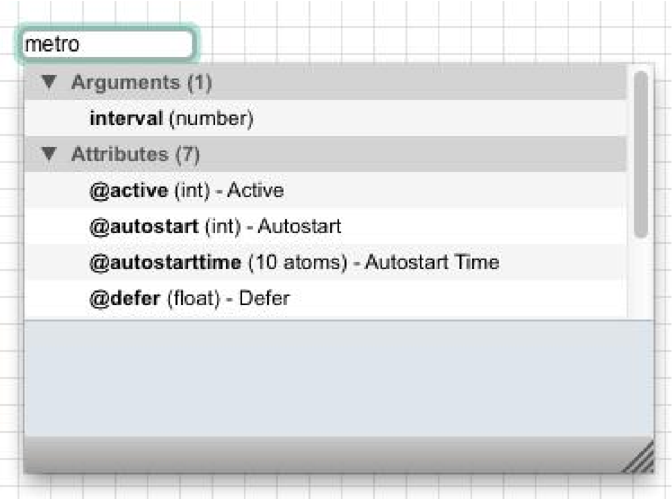
Basic Max patching and GUI

The Max object



Arguments





metro

▼ Arguments (1)

interval (number)

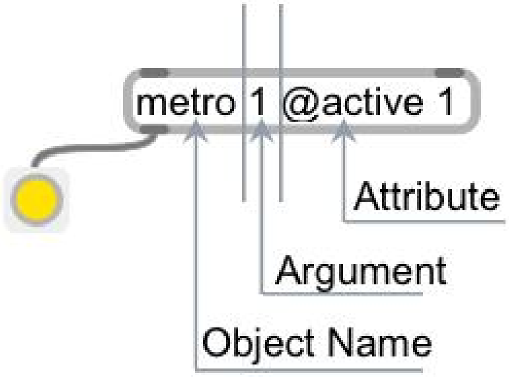
▼ Attributes (7)

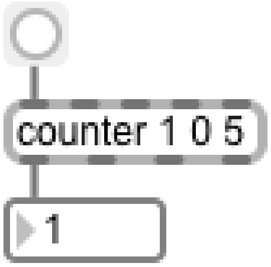
@active (int) - Active

@autostart (int) - Autostart

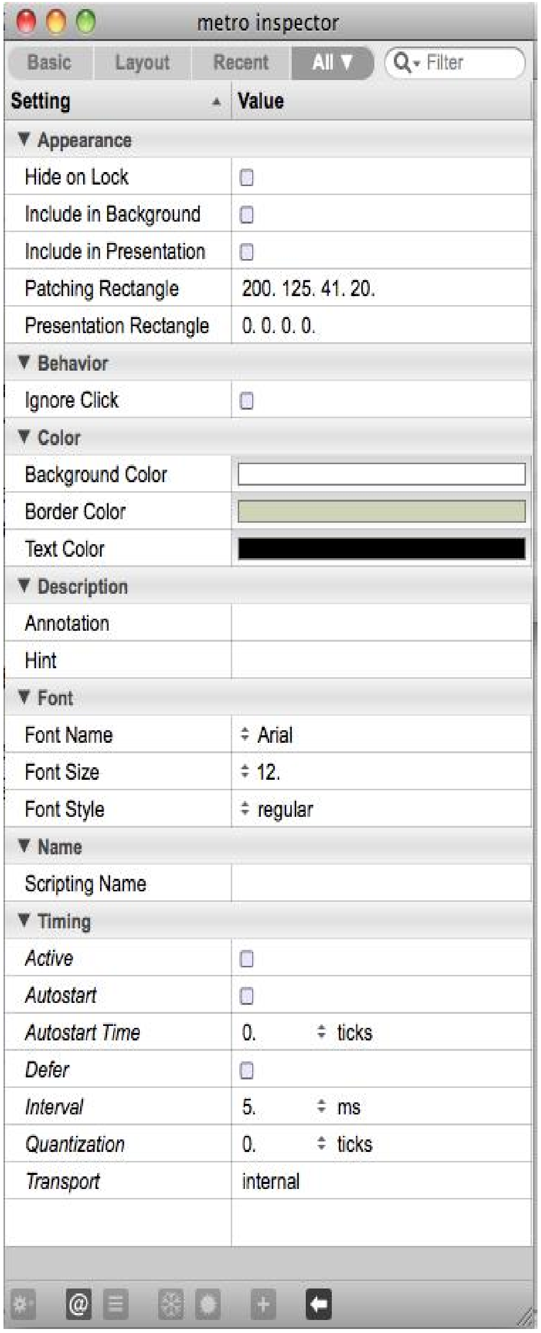
@autostarttime (10 atoms) - Autostart Time

@defer (float) - Defer



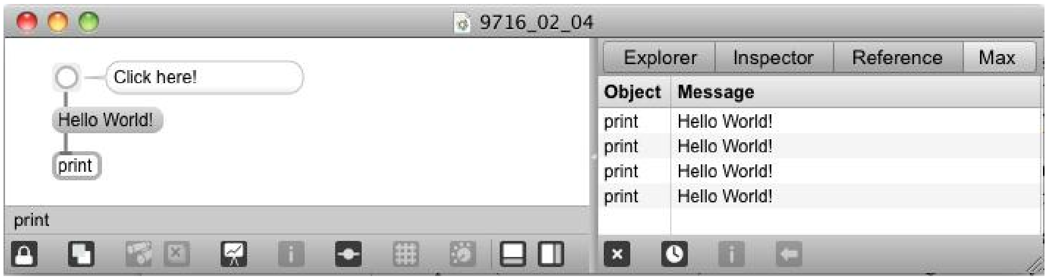


Attributes



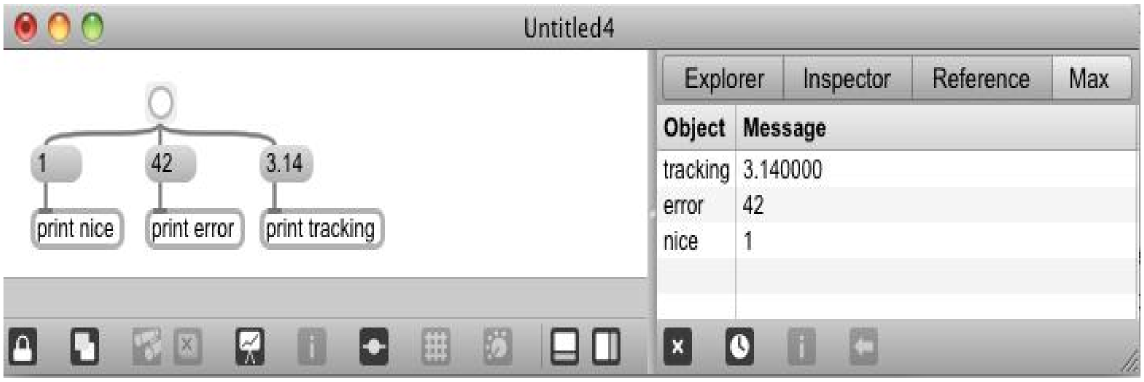
Setting	Value
▼ Appearance	
Hide on Lock	□
Include in Background	□
Include in Presentation	□
Patching Rectangle	200. 125. 41. 20.
Presentation Rectangle	0. 0. 0. 0.
▼ Behavior	
Ignore Click	□
▼ Color	
Background Color	⬜
Border Color	▨
Text Color	⬛
▼ Description	
Annotation	
Hint	
▼ Font	
Font Name	⇕ Arial
Font Size	⇕ 12.
Font Style	⇕ regular
▼ Name	
Scripting Name	
▼ Timing	
Active	□
Autostart	□
Autostart Time	0. ⇕ ticks
Defer	□
Interval	5. ⇕ ms
Quantization	0. ⇕ ticks
Transport	internal

Creating our Hello World program



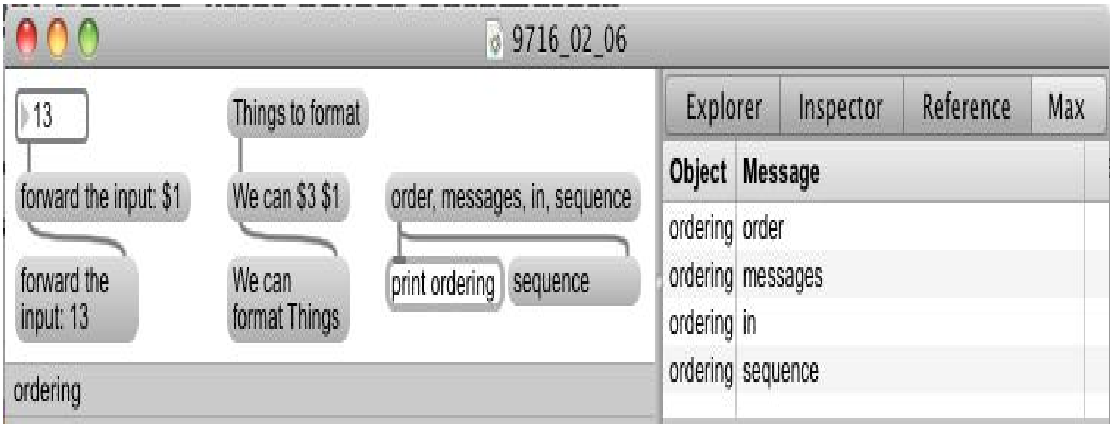
Object	Message
print	Hello World!
print	Hello World!
print	Hello World!
print	Hello World!

The [print] object



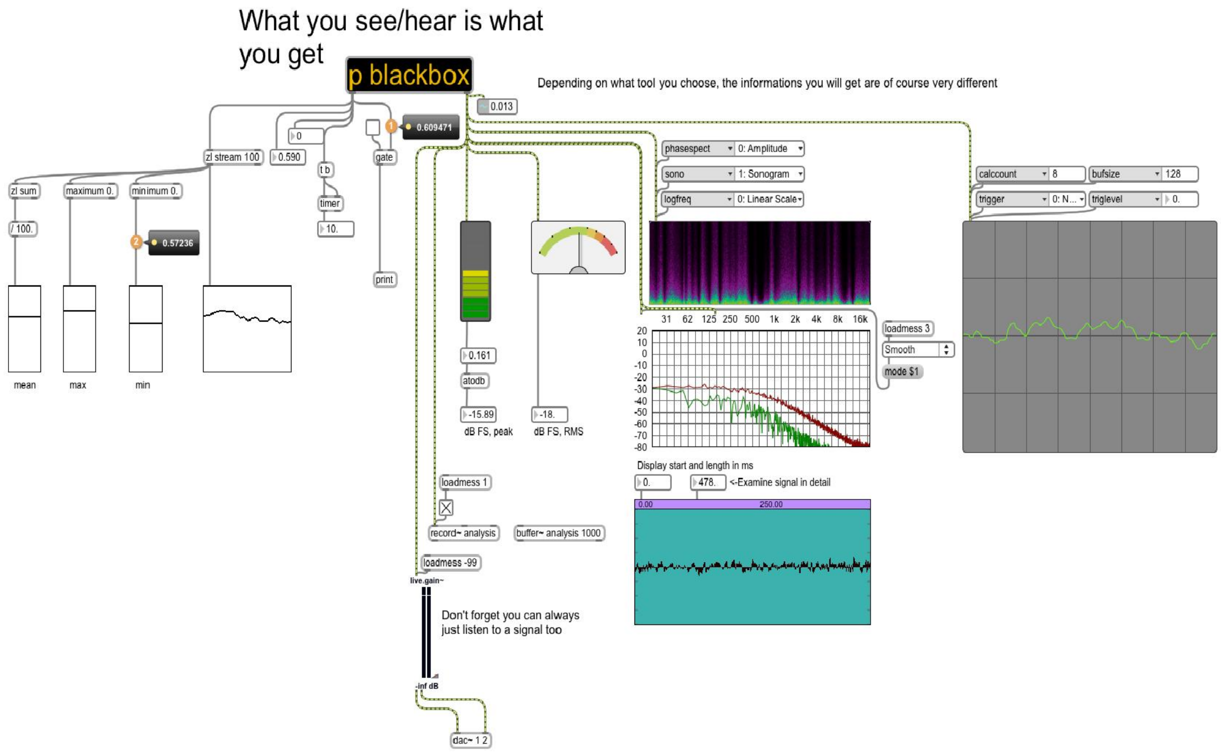
Object	Message
tracking	3.140000
error	42
nice	1

The message box



Object	Message
ordering	order
ordering	messages
ordering	in
ordering	sequence

The MSP-Hello World

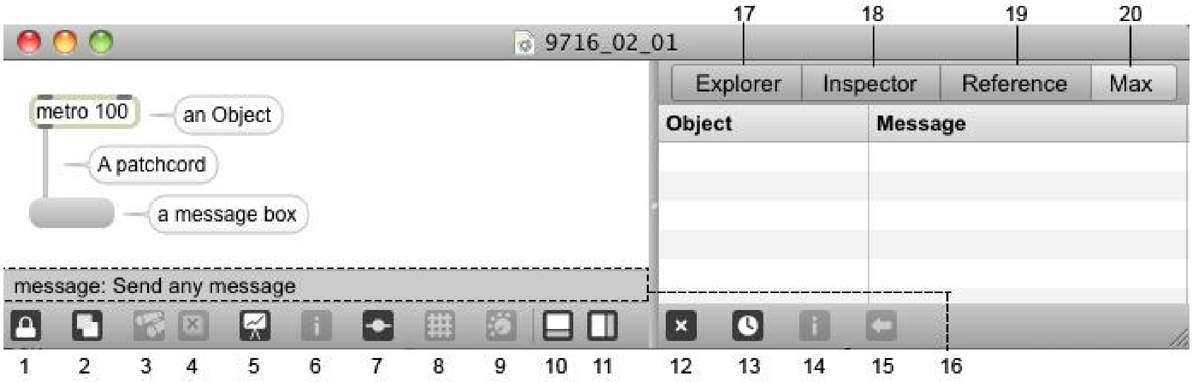


What you see/hear is what you get

Depending on what tool you choose, the informations you will get are of course very different

Don't forget you can always just listen to a signal too

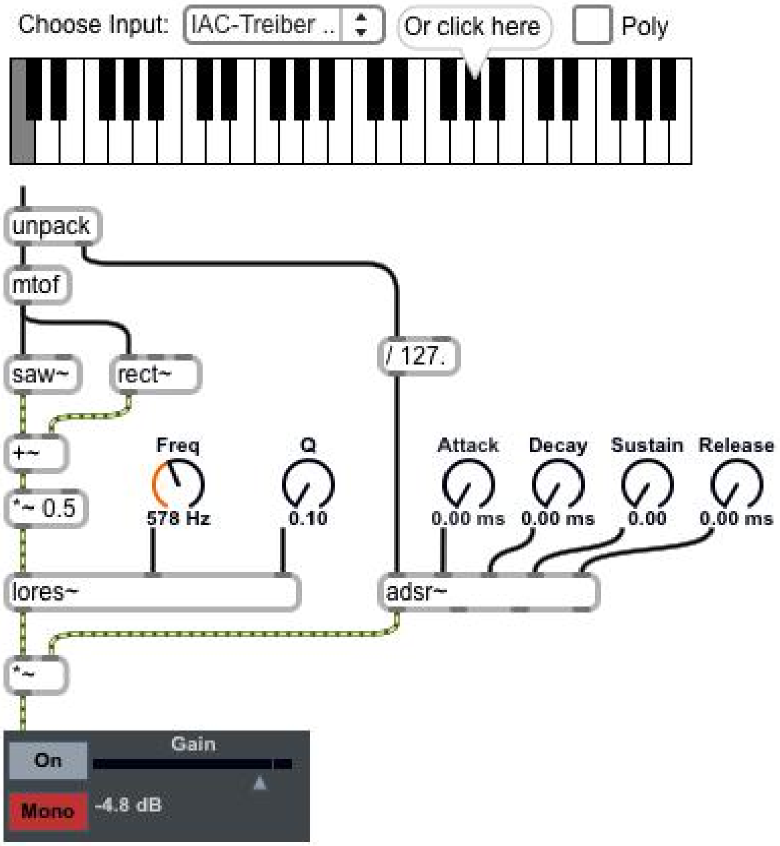
A quick GUI overview



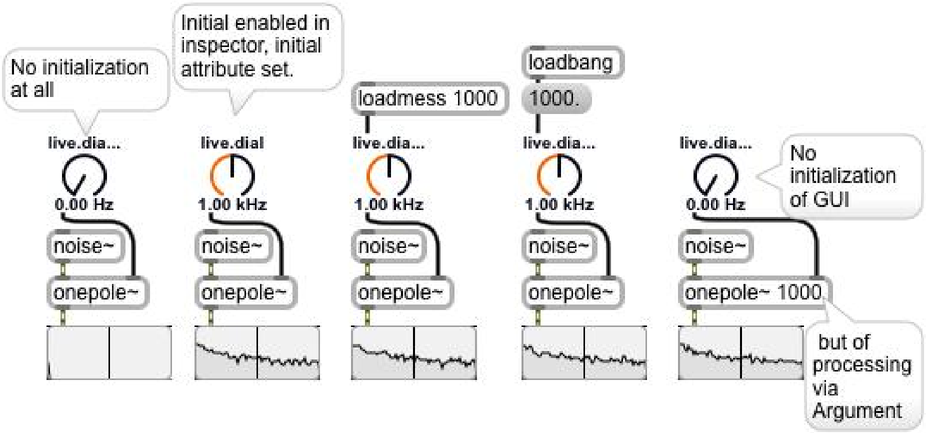
message: Send any message

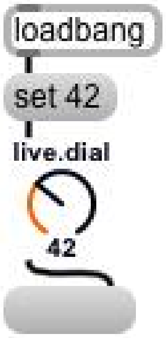
3
Advanced Programming Techniques in Max

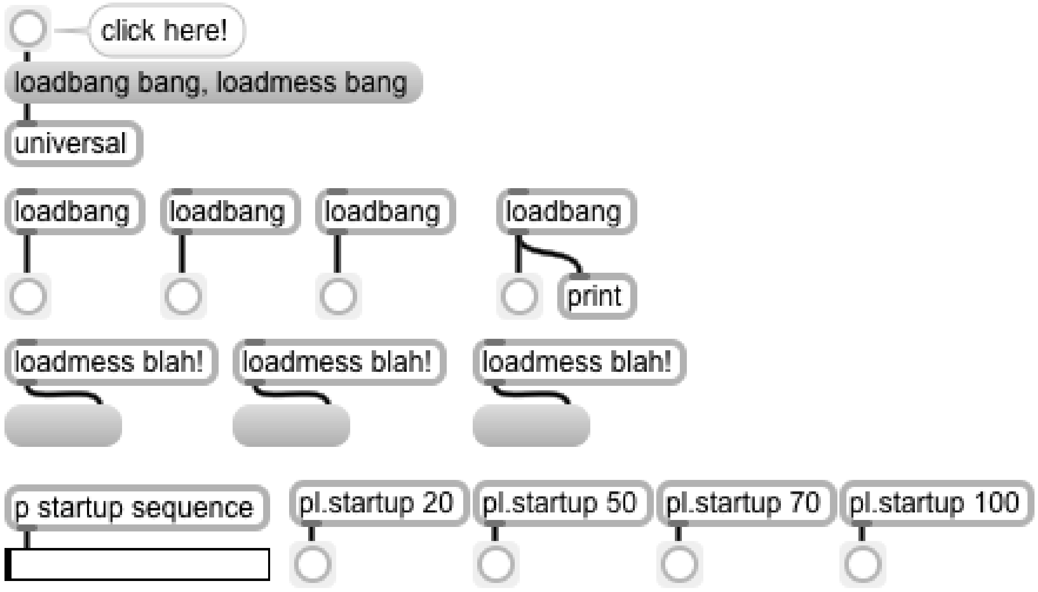
Introducing the synthesizer example



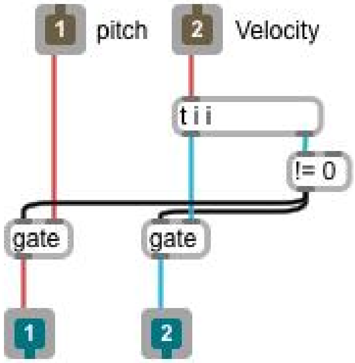
Initializing a patcher

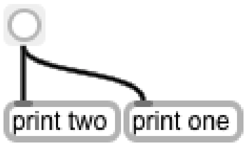


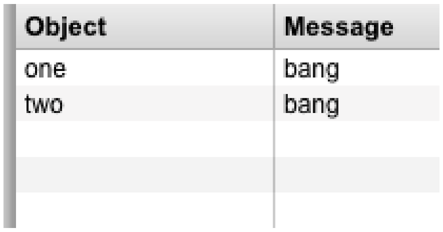




Excursus of microscopic timing and message ordering

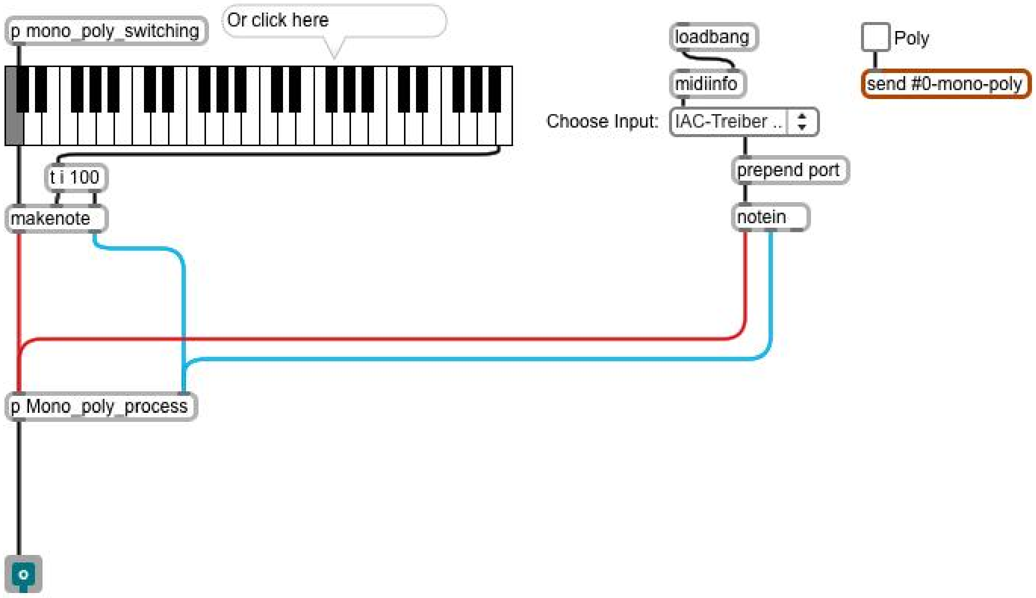




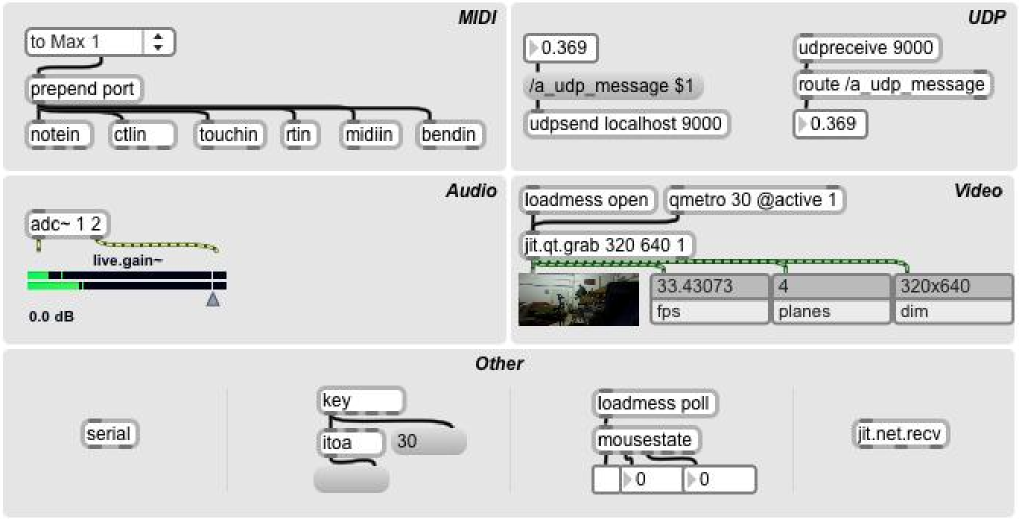


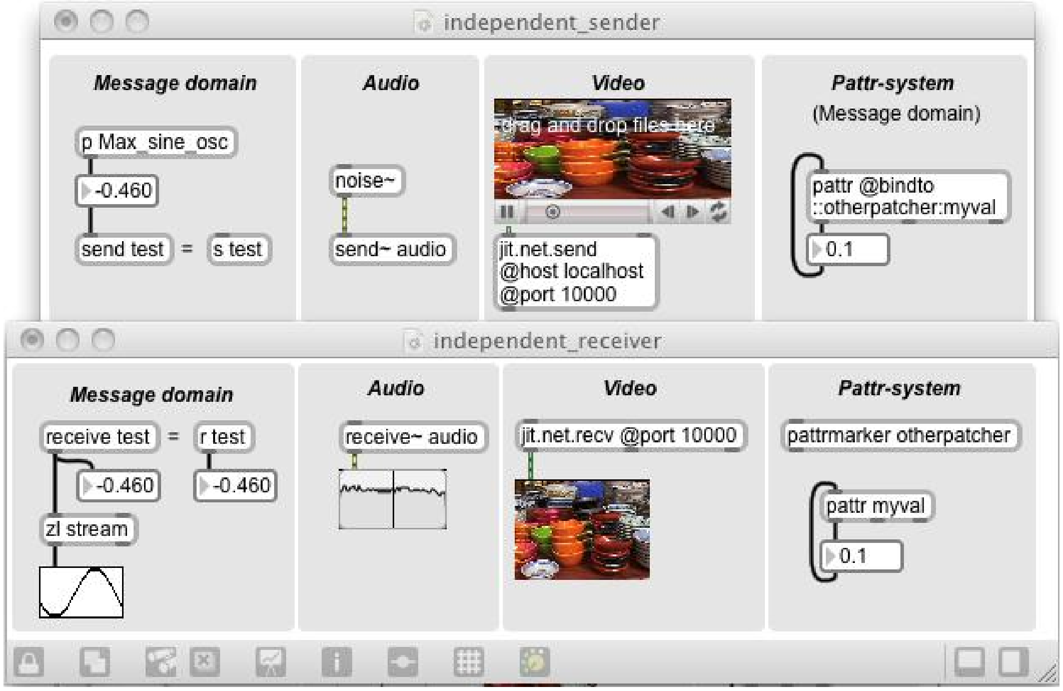
Object	Message
one	bang
two	bang

A bpatcher for MIDI input

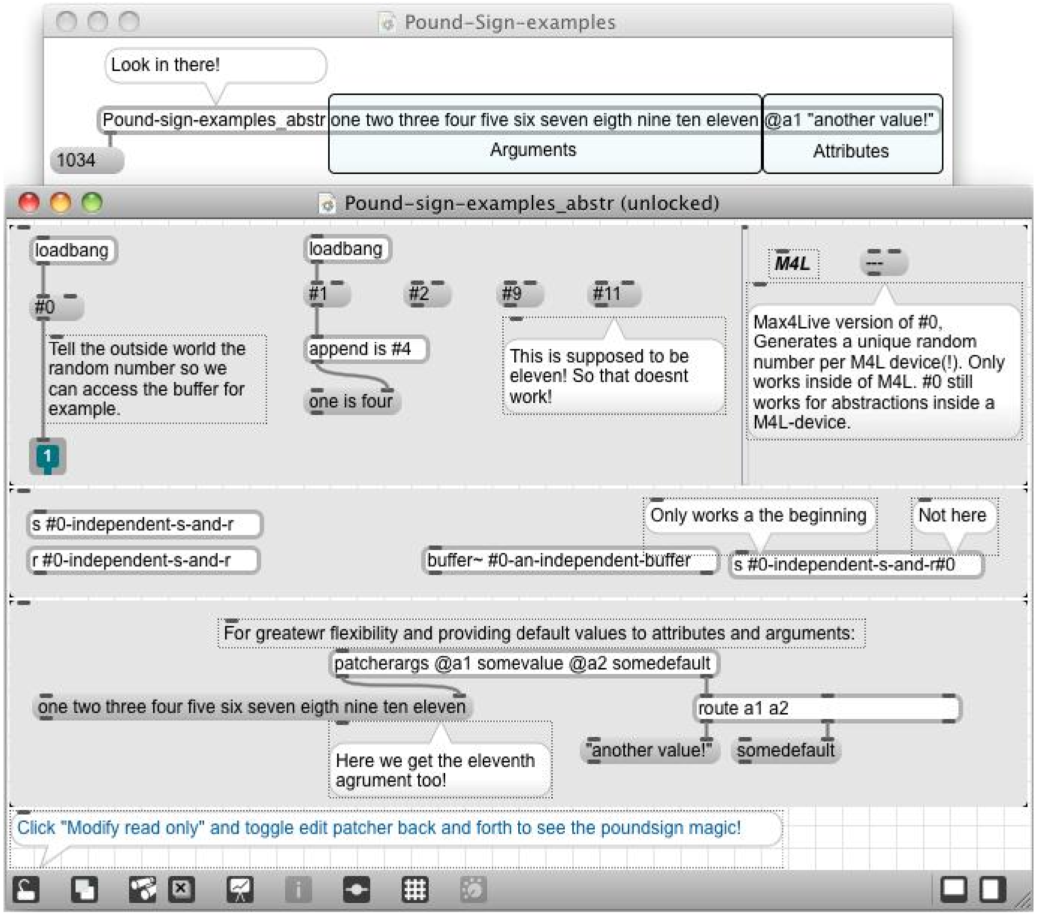


Sending and receiving data




independent_sender
Message domain
p Max_sine_osc
-0.460
send test
=
s test
Audio
noise~
send~ audio
Video
drag and drop files here
jit.net.send
@host localhost
@port 10000
Pattr-system
(Message domain)
pattr @bindto
::otherpatcher:myval
0.1
independent_receiver
Message domain
receive test
=
r test
-0.460
-0.460
zl stream
Audio
receive~ audio
Video
jit.net.recv @port 10000
Pattr-system
pattrmarker otherpatcher
pattr myval
0.1

The #n notation



Pound-Sign-examples

Look in there!

Pound-sign-examples_abstr one two three four five six seven eigth nine ten eleven @a1 "another value!"

Arguments

Attributes

1034

Pound-sign-examples_abstr (unlocked)

loadbang

#0

Tell the outside world the random number so we can access the buffer for example.

1

loadbang

#1

#2

#9

#11

append is #4

one is four

This is supposed to be eleven! So that doesnt work!

M4L

Max4Live version of #0, Generates a unique random number per M4L device(!). Only works inside of M4L. #0 still works for abstractions inside a M4L-device.

s #0-independent-s-and-r

r #0-independent-s-and-r

buffer~ #0-an-independent-buffer

Only works a the beginning

Not here

s #0-independent-s-and-r#0

For greatewr flexibility and providing default values to attributes and arguments:

patcherargs @a1 somevalue @a2 somedefault

one two three four five six seven eigth nine ten eleven

Here we get the eleventh agrument too!

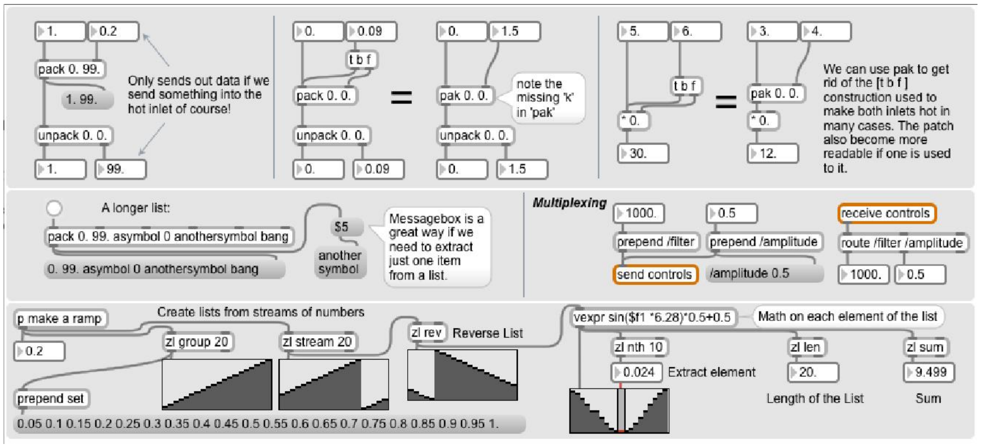
route a1 a2

"another value!"

somedefault

Click "Modify read only" and toggle edit patcher back and forth to see the poundsign magic!

Collections of data



Only sends out data if we send something into the hot inlet of course!

note the missing 'k' in 'pak'

We can use pak to get rid of the [t b f] construction used to make both inlets hot in many cases. The patch also become more readable if one is used to it.

A longer list:

Messagebox is a great way if we need to extract just one item from a list.

Multiplexing

Create lists from streams of numbers

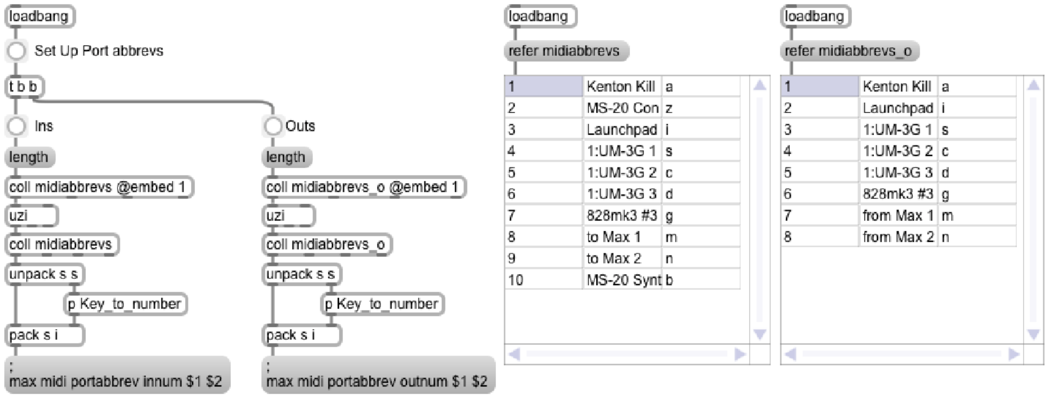
Reverse List

Math on each element of the list

Extract element

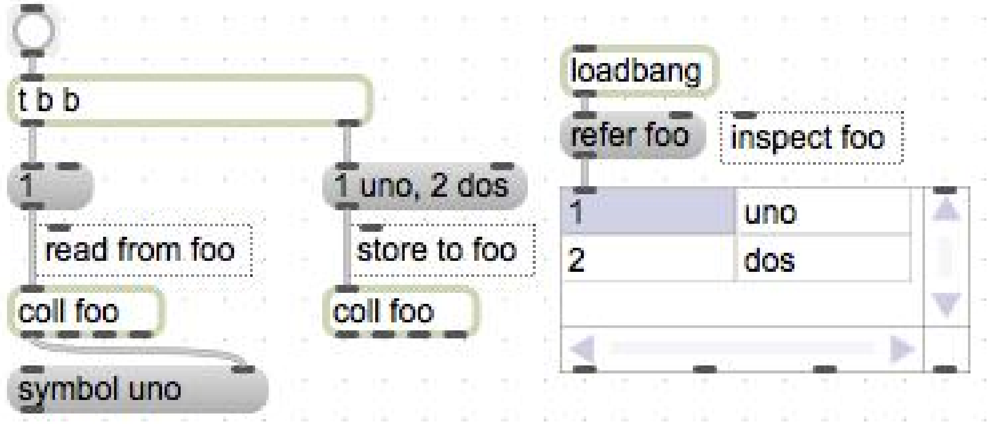
Length of the List

Sum

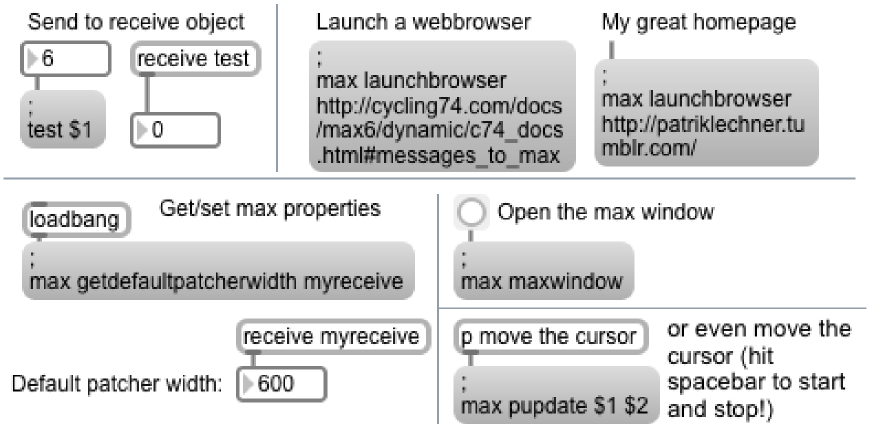


1	Kenton Kill	a
2	MS-20 Con	z
3	Launchpad	i
4	1:UM-3G 1	s
5	1:UM-3G 2	c
6	1:UM-3G 3	d
7	828mk3 #3	g
8	to Max 1	m
9	to Max 2	n
10	MS-20 Synt	b

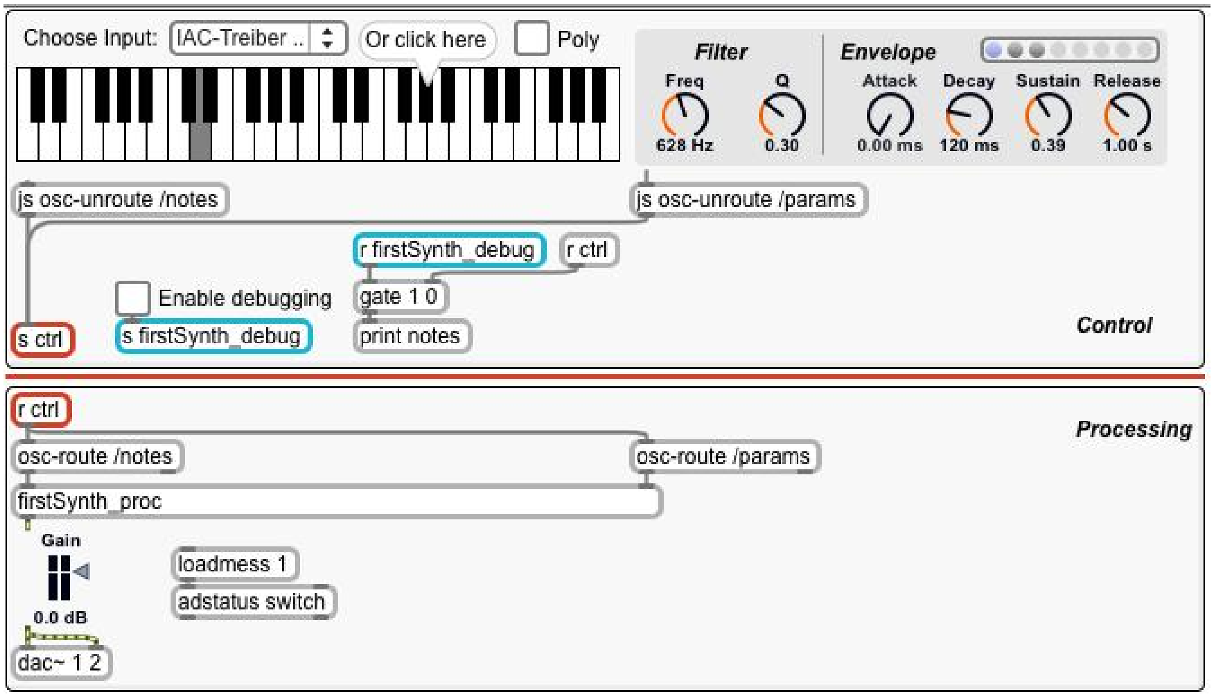
1	Kenton Kill	a
2	Launchpad	i
3	1:UM-3G 1	s
4	1:UM-3G 2	c
5	1:UM-3G 3	d
6	828mk3 #3	g
7	from Max 1	m
8	from Max 2	n

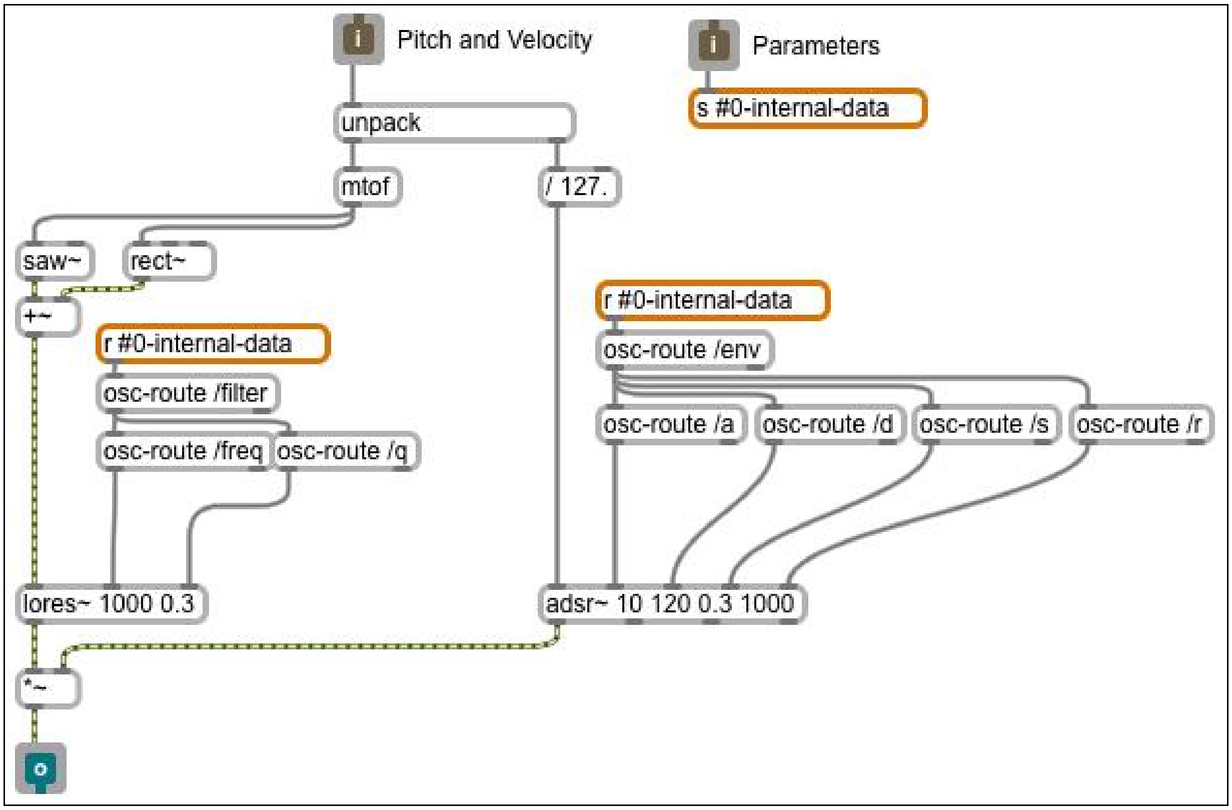


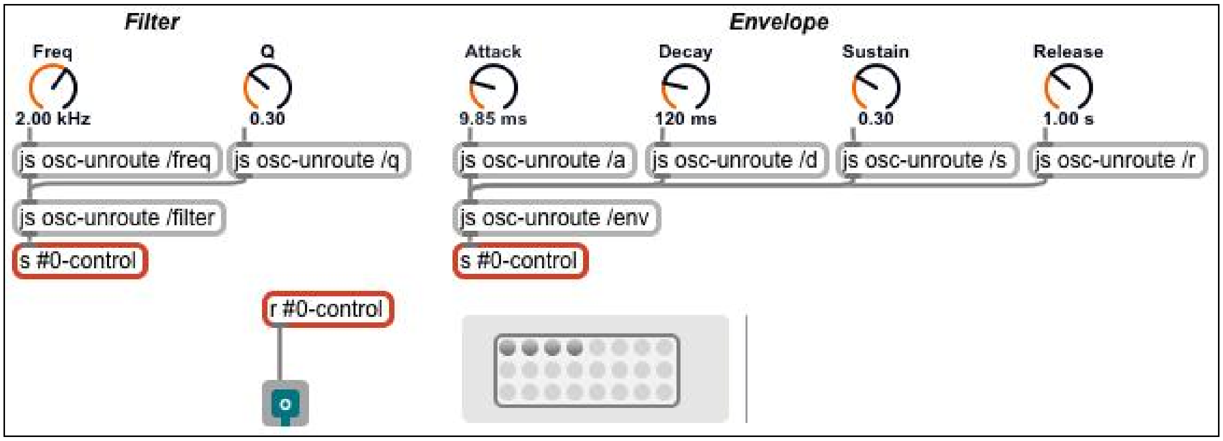
More message box magic


Send to receive object
6
receive test
; test $1
0
Launch a webbrowser
; max launchbrowser http://cycling74.com/docs/max6/dynamic/c74_docs.html#messages_to_max
My great homepage
; max launchbrowser http://patriklechner.tumblr.com/
loadbang
Get/set max properties
; max getdefaultpatcherwidth myreceive
receive myreceive
Default patcher width:
600
Open the max window
; max maxwindow
p move the cursor
; max pupdate $1 $2
or even move the cursor (hit spacebar to start and stop!)

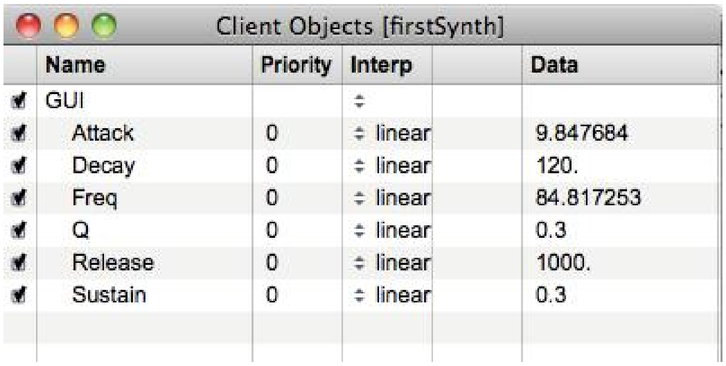
Structuring our patches




Pitch and Velocity
Parameters
s #0-internal-data
unpack
mtof
/ 127.
saw~
rect~
+~
r #0-internal-data
osc-route /filter
osc-route /freq
osc-route /q
r #0-internal-data
osc-route /env
osc-route /a
osc-route /d
osc-route /s
osc-route /r
lores~ 1000 0.3
adsr~ 10 120 0.3 1000
*~

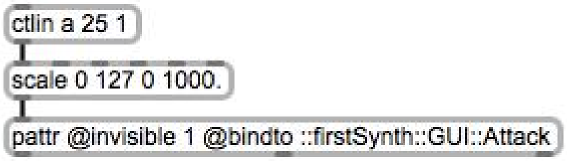

Filter
Envelope
Freq
2.00 kHz
Q
0.30
Attack
9.85 ms
Decay
120 ms
Sustain
0.30
Release
1.00 s
js osc-unroute /freq
js osc-unroute /q
js osc-unroute /a
js osc-unroute /d
js osc-unroute /s
js osc-unroute /r
js osc-unroute /filter
js osc-unroute /env
s #0-control
s #0-control
r #0-control

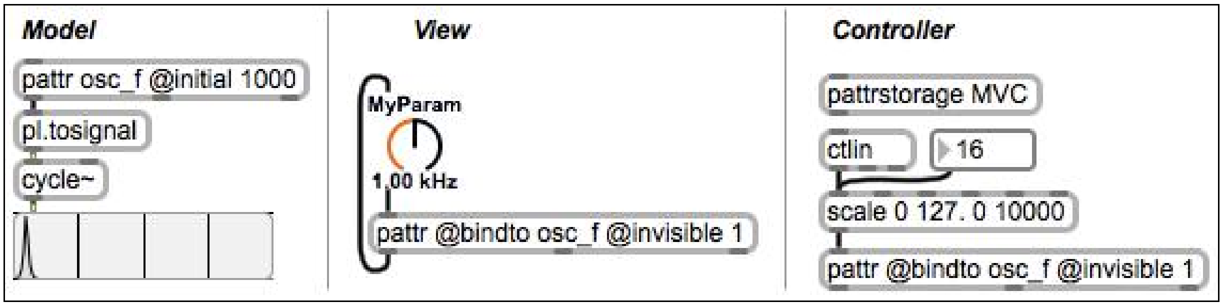
The pattr family – a communication system

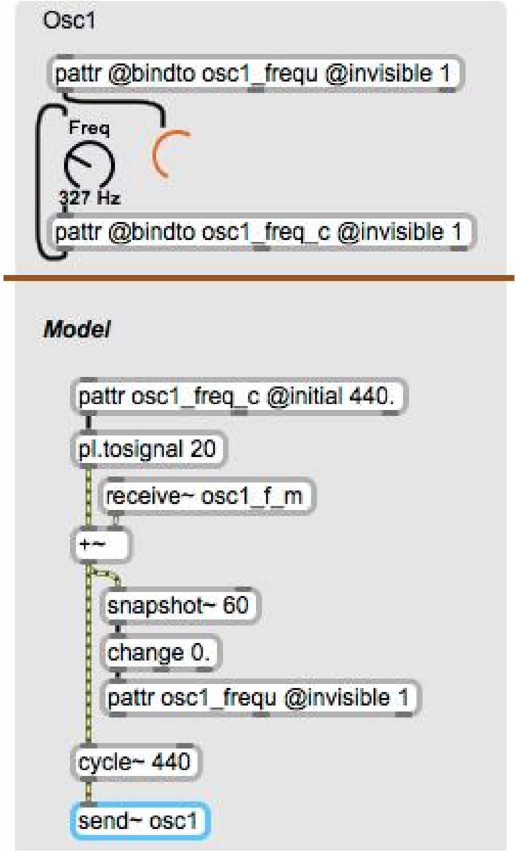


Client Objects [firstSynth]

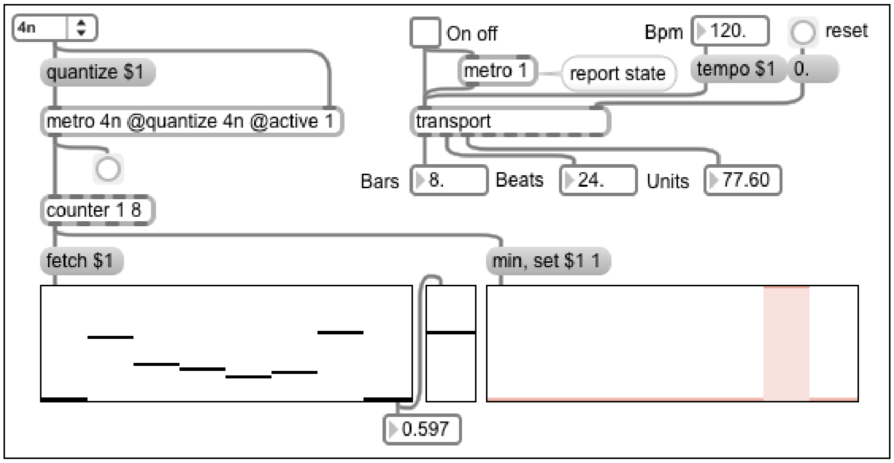
	Name	Priority	Interp		Data
✓	GUI		⇕		
✓	Attack	0	⇕ linear		9.847684
✓	Decay	0	⇕ linear		120.
✓	Freq	0	⇕ linear		84.817253
✓	Q	0	⇕ linear		0.3
✓	Release	0	⇕ linear		1000.
✓	Sustain	0	⇕ linear		0.3

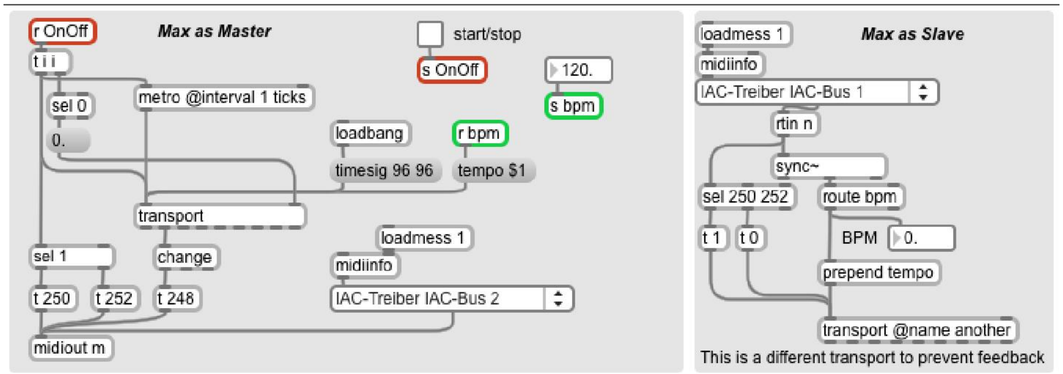


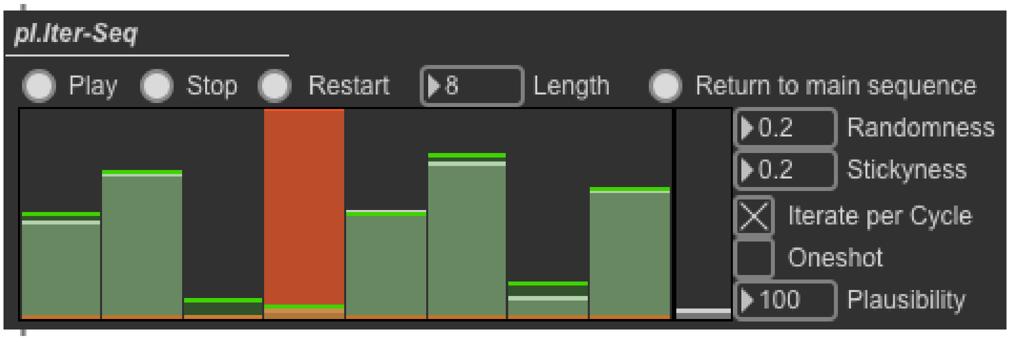


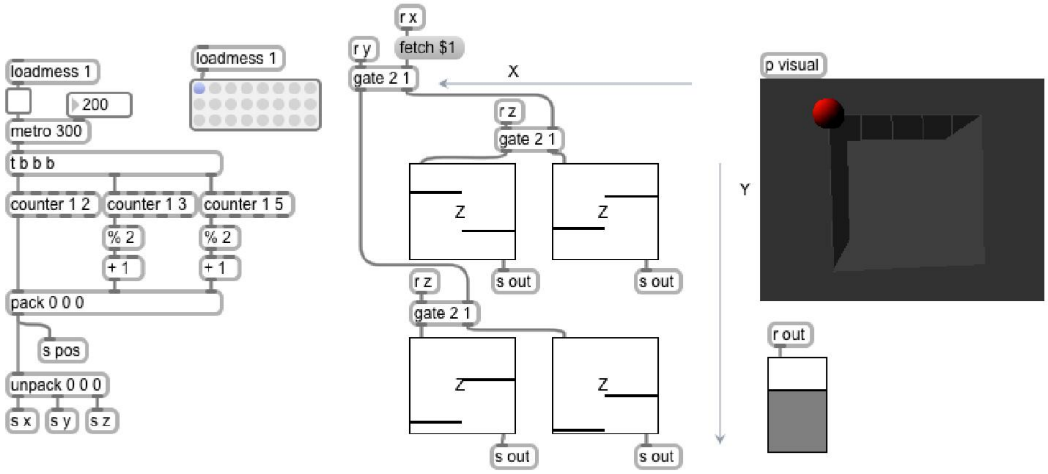

Osc1
pattr @bindto osc1_frequ @invisible 1
Freq
327 Hz
pattr @bindto osc1_freq_c @invisible 1
Model
pattr osc1_freq_c @initial 440.
pl.tosignal 20
receive~ osc1_f_m
+~
snapshot~ 60
change 0.
pattr osc1_frequ @invisible 1
cycle~ 440
send~ osc1

Timing in Max



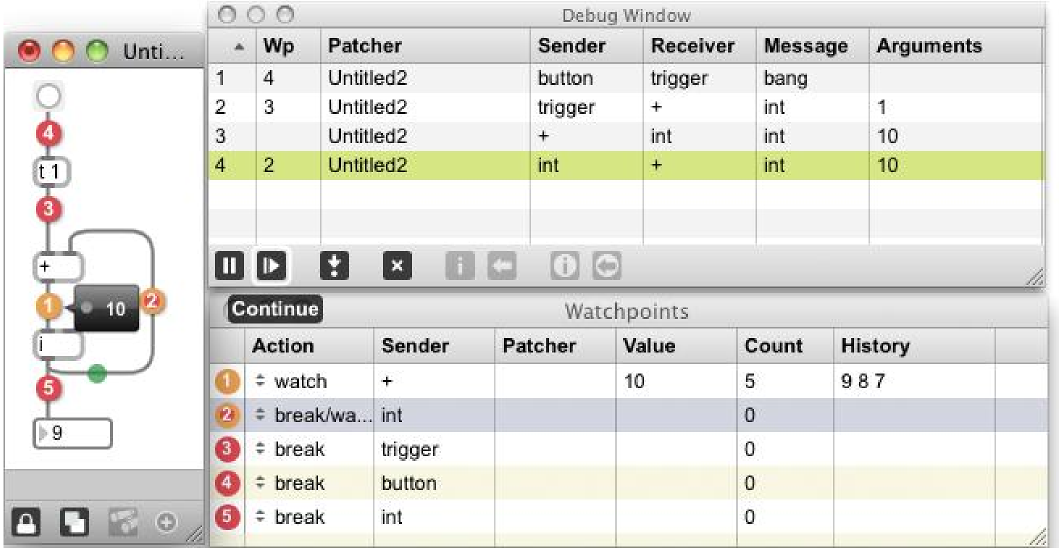

Max as Master
r OnOff
t i i
sel 0
0.
metro @interval 1 ticks
start/stop
s OnOff
120.
s bpm
loadbang
r bpm
timesig 96 96
tempo $1
transport
sel 1
change
loadmess 1
midiinfo
t 250
t 252
t 248
IAC-Treiber IAC-Bus 2
midiout m
Max as Slave
loadmess 1
midiinfo
IAC-Treiber IAC-Bus 1
rtin n
sync~
sel 250 252
route bpm
t 1
t 0
BPM
0.
prepend tempo
transport @name another
This is a different transport to prevent feedback


pl.Iter-Seq
Play
Stop
Restart
8
Length
Return to main sequence
0.2
Randomness
0.2
Stickyness
Iterate per Cycle
Oneshot
100
Plausibility


loadmess 1
200
metro 300
t b b b
counter 1 2
counter 1 3
counter 1 5
% 2
% 2
+ 1
+ 1
pack 0 0 0
s pos
unpack 0 0 0
s x
s y
s z
loadmess 1
r x
r y
fetch $1
gate 2 1
X
r z
gate 2 1
Z
Z
s out
s out
r z
gate 2 1
Z
Z
s out
s out
Y
p visual
r out

Debugging

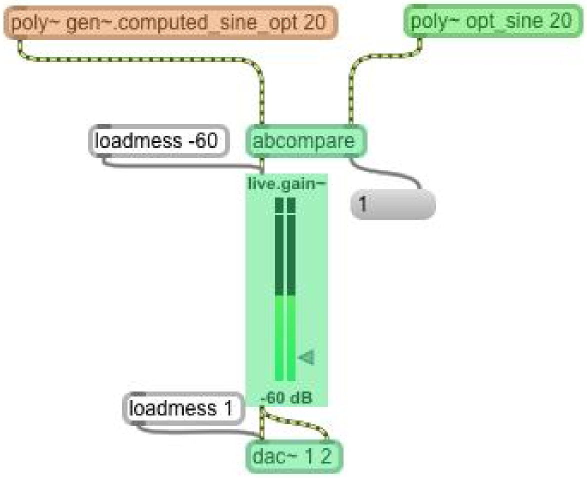
The debugger



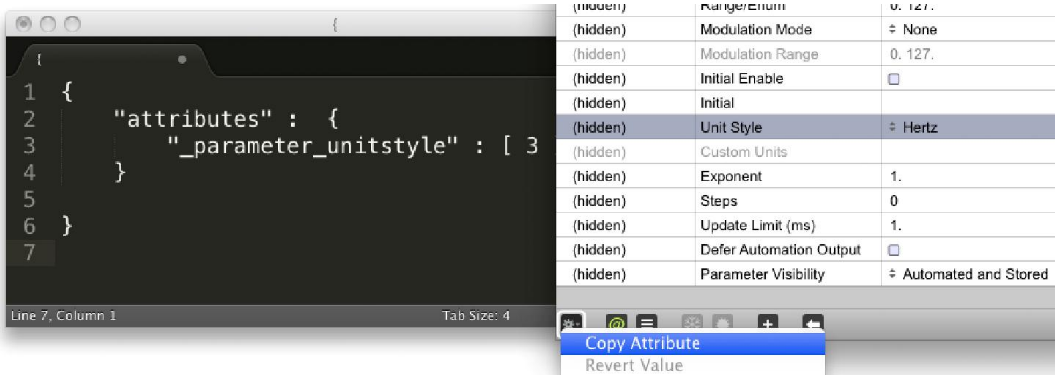
	Wp	Patcher	Sender	Receiver	Message	Arguments
1	4	Untitled2	button	trigger	bang	
2	3	Untitled2	trigger	+	int	1
3		Untitled2	+	int	int	10
4	2	Untitled2	int	+	int	10

	Action	Sender	Patcher	Value	Count	History
1	watch	+		10	5	9 8 7
2	break/wa...	int			0	
3	break	trigger			0	
4	break	button			0	
5	break	int			0	

Optimizing



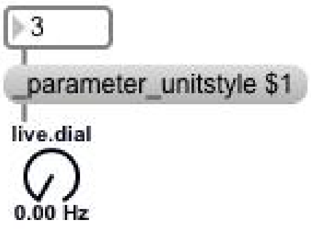
Scripting and the this patcher

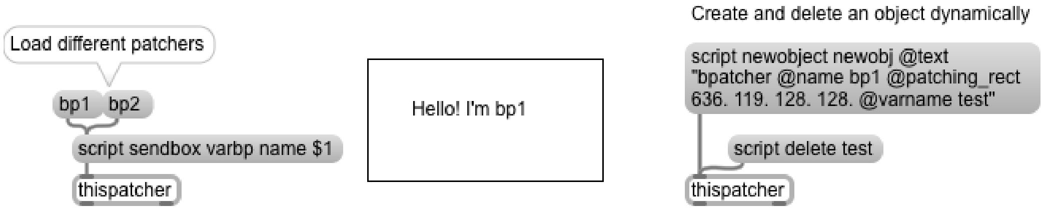


```
{
    "attributes" :  {
        "_parameter_unitstyle" : [ 3
    }

}

```

Line 7, Column 1 Tab Size: 4

(hidden)	Range/Enum	0. 127.
(hidden)	Modulation Mode	÷ None
(hidden)	Modulation Range	0. 127.
(hidden)	Initial Enable	□
(hidden)	Initial	
(hidden)	Unit Style	÷ Hertz
(hidden)	Custom Units	
(hidden)	Exponent	1.
(hidden)	Steps	0
(hidden)	Update Limit (ms)	1.
(hidden)	Defer Automation Output	□
(hidden)	Parameter Visibility	÷ Automated and Stored

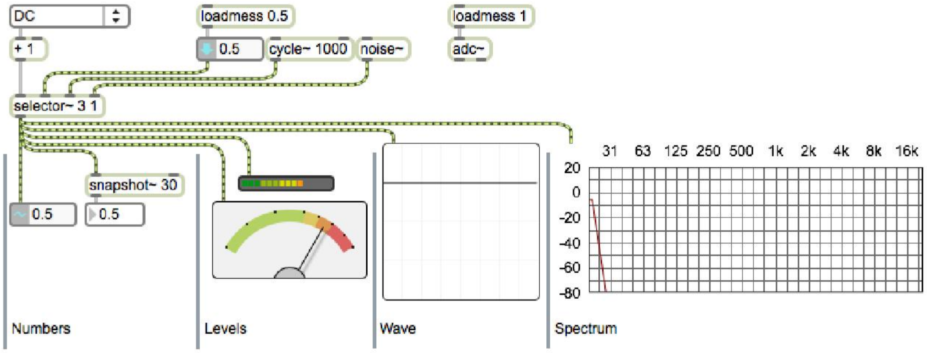



Load different patchers
bp1
bp2
script sendbox varbp name $1
thispatcher
Hello! I'm bp1
Create and delete an object dynamically
script newobject newobj @text "bpatcher @name bp1 @patching_rect 636. 119. 128. 128. @varname test"
script delete test
thispatcher

4

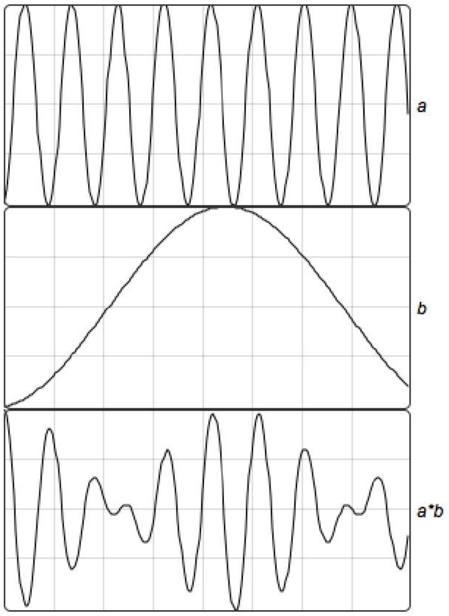
Basic Audio in Max/MSP

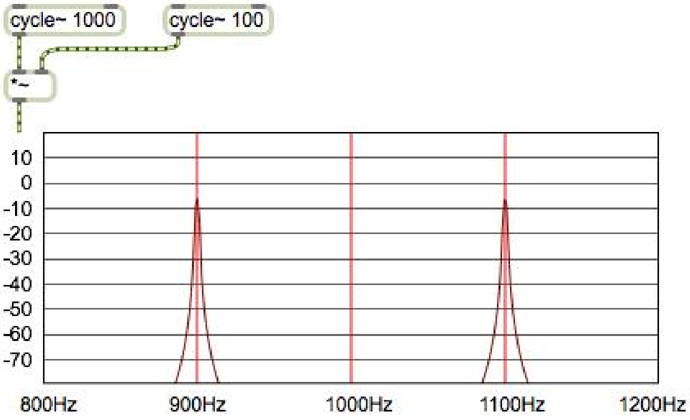
Basic audio principles

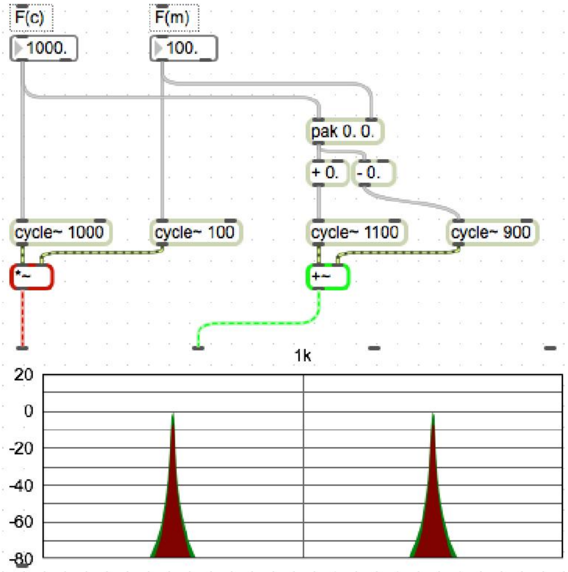


Audio synthesis

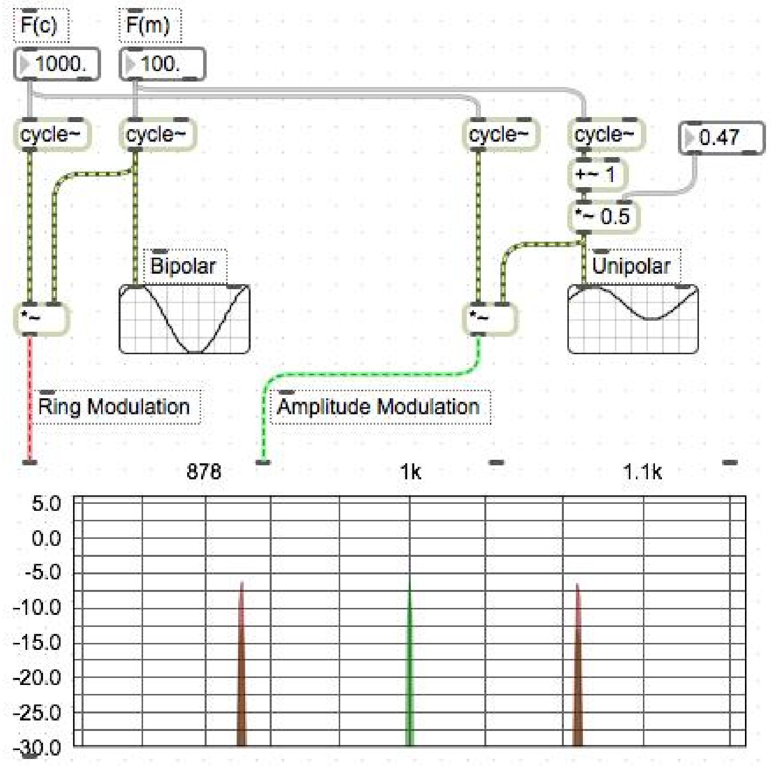
Amplitude modulation






F(c)
F(m)
1000.
100.
pak 0. 0.
+ 0.
- 0.
cycle~ 1000
cycle~ 100
cycle~ 1100
cycle~ 900
*~
+~
1k
20
0
-20
-40
-60
-80

Ring modulation versus amplitude modulation

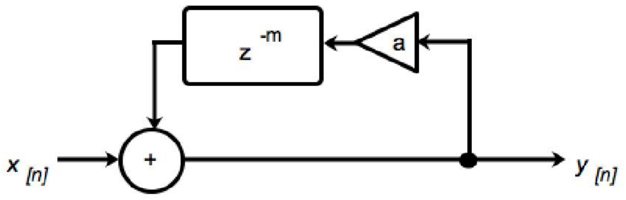


Tremolo

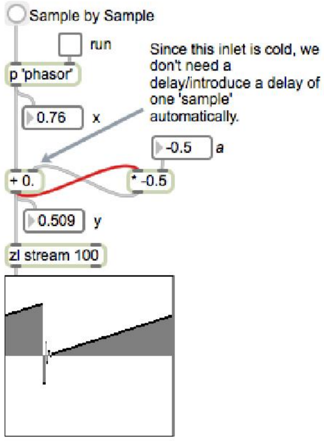
$$\cos(\theta)\cdot\cos(\varphi)=\frac{\cos(\theta-\varphi)+\cos(\theta+\varphi)}{2}$$

$$\varphi=\omega t=2\pi 1000t$$

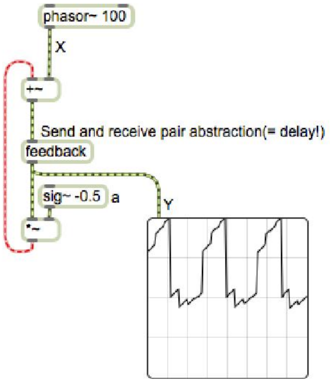
Feedback



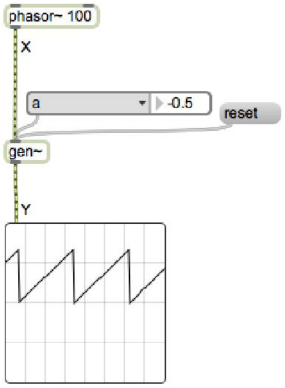
$$y[n] = x[n] + a \cdot y[n-m]$$

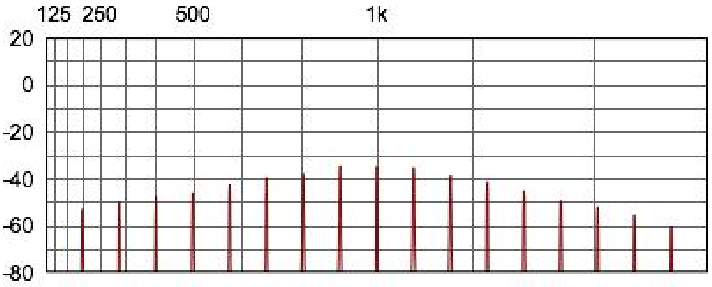


Since this inlet is cold, we don't need a delay/introduce a delay of one 'sample' automatically.

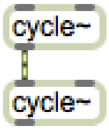


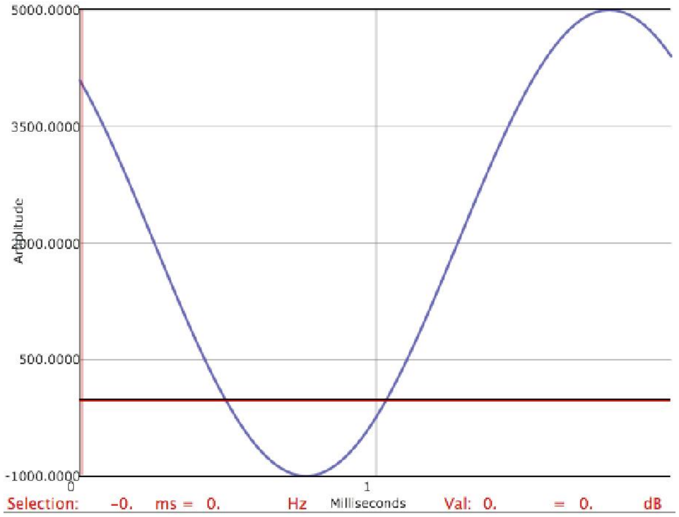
Send and receive pair abstraction(= delay!)

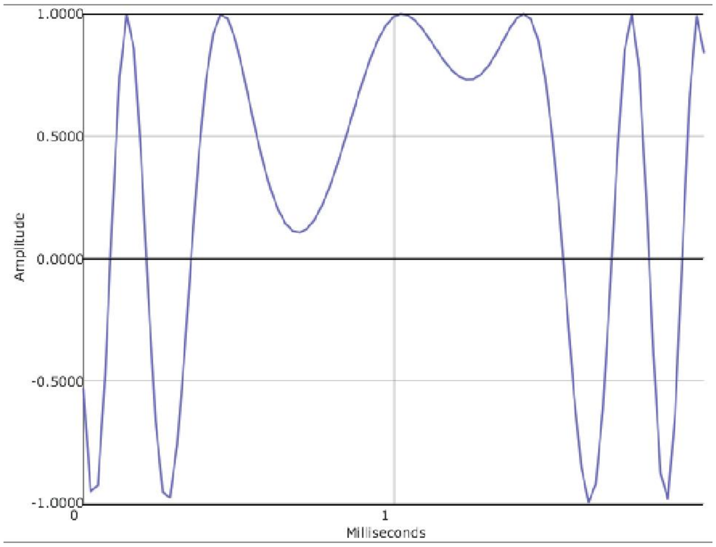


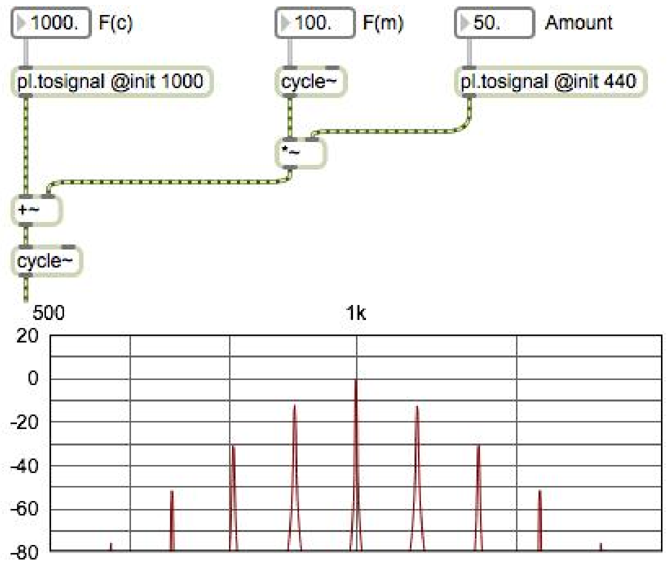


Frequency modulation

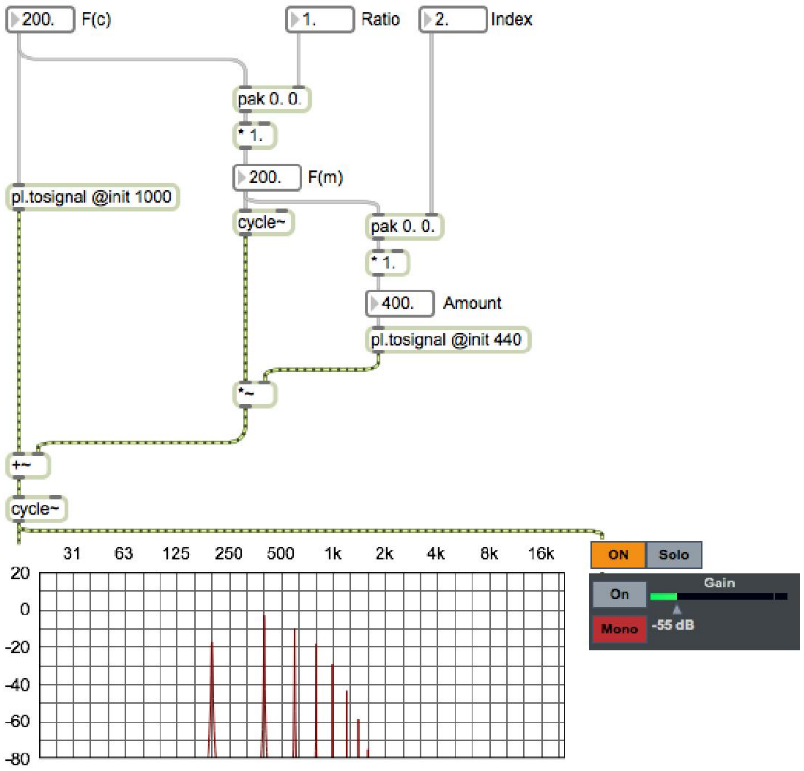



5000.0000
3500.0000
2000.0000
500.0000
-1000.0000
Amplitude
0
1
Milliseconds
Selection: -0. ms = 0. Hz
Val: 0. = 0. dB


1.0000
0.5000
0.0000
-0.5000
-1.0000
Amplitude
0
1
Milliseconds



Controlling FM



200. F(c)

1. Ratio

2. Index

pak 0. 0.

* 1.

200. F(m)

pl.tosignal @init 1000

cycle~

pak 0. 0.

* 1.

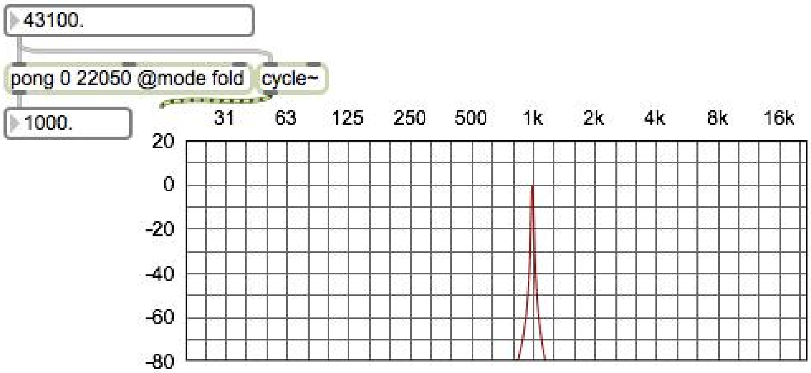
400. Amount

pl.tosignal @init 440

*~

+~

cycle~

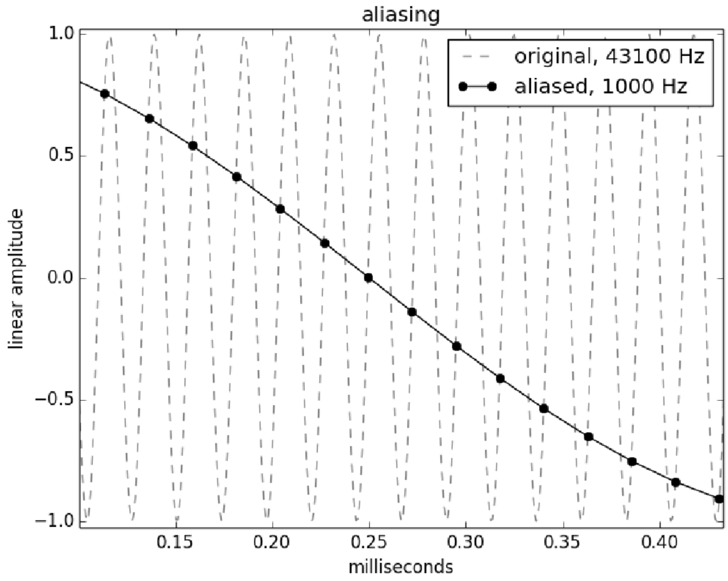


43100.

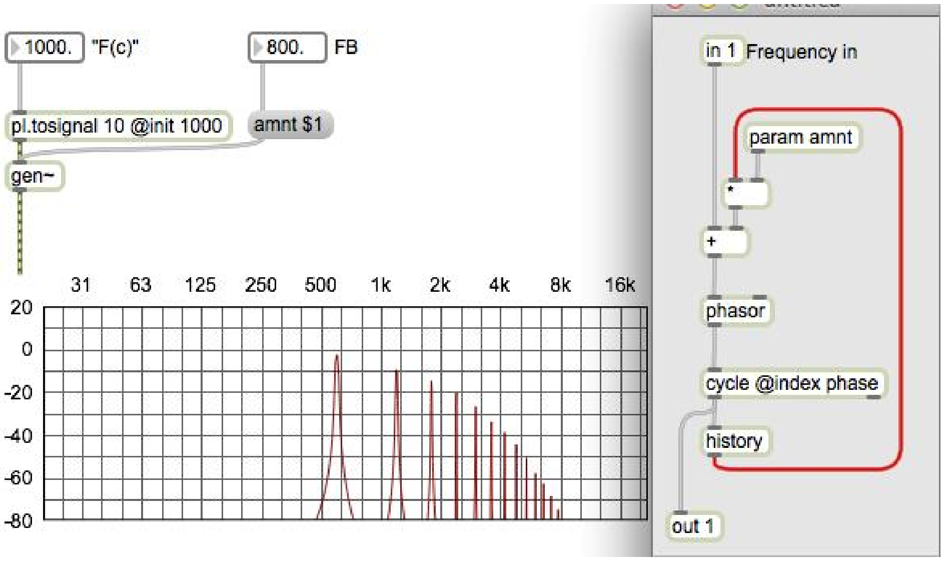
pong 0 22050 @mode fold

cycle~

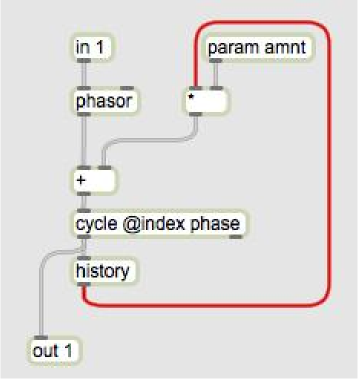
1000.


aliasing
original, 43100 Hz
aliased, 1000 Hz
1.0
0.5
0.0
−0.5
−1.0
linear amplitude
0.15
0.20
0.25
0.30
0.35
0.40
milliseconds

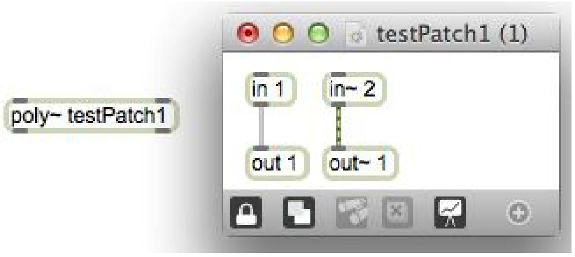
Feedback

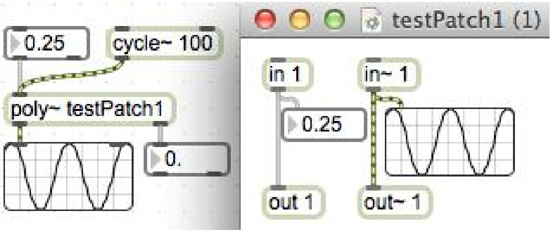

1000.
"F(c)"
800.
FB
pl.tosignal 10 @init 1000
amnt $1
gen~
31
63
125
250
500
1k
2k
4k
8k
16k
20
0
-20
-40
-60
-80
in 1
Frequency in
param amnt
*
+
phasor
cycle @index phase
history
out 1

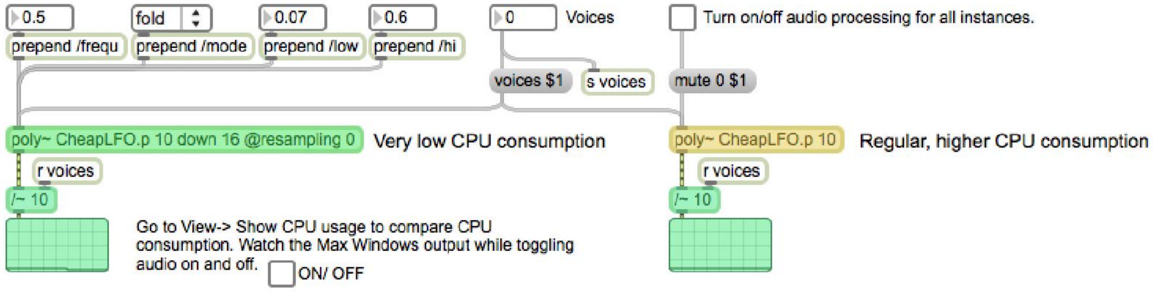
Phase modulation



The poly~ object







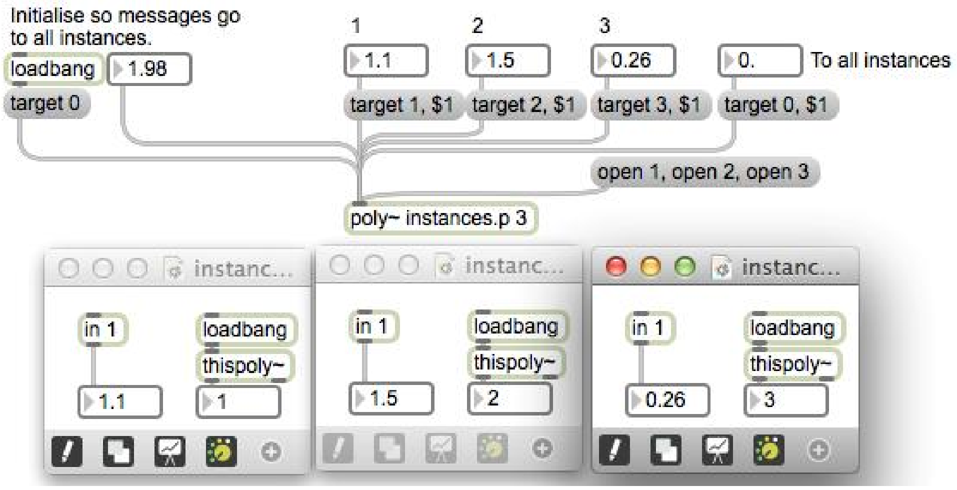
Turn on/off audio processing for all instances.

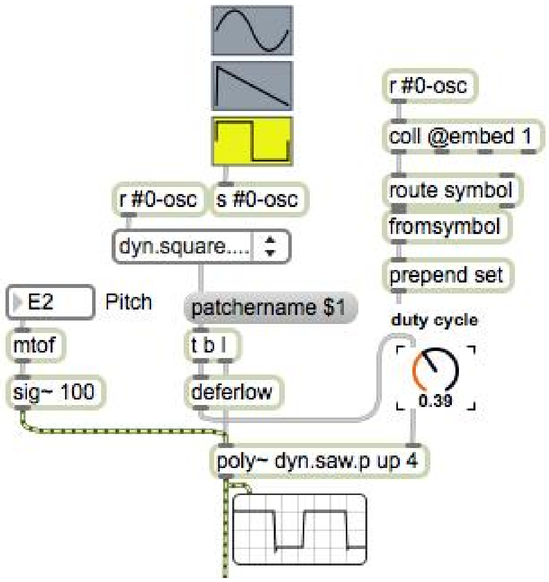
Very low CPU consumption

Regular, higher CPU consumption

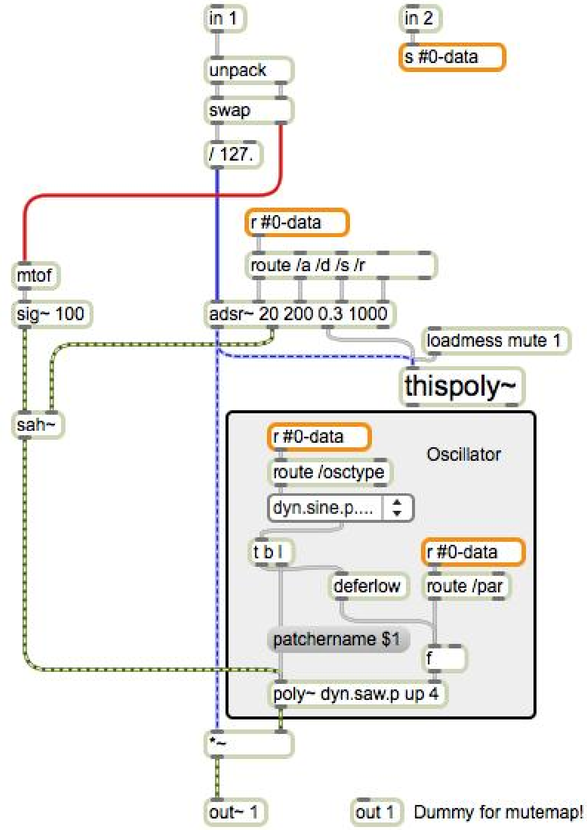
Go to View-> Show CPU usage to compare CPU consumption. Watch the Max Windows output while toggling audio on and off.

Managing instances and patcher loading

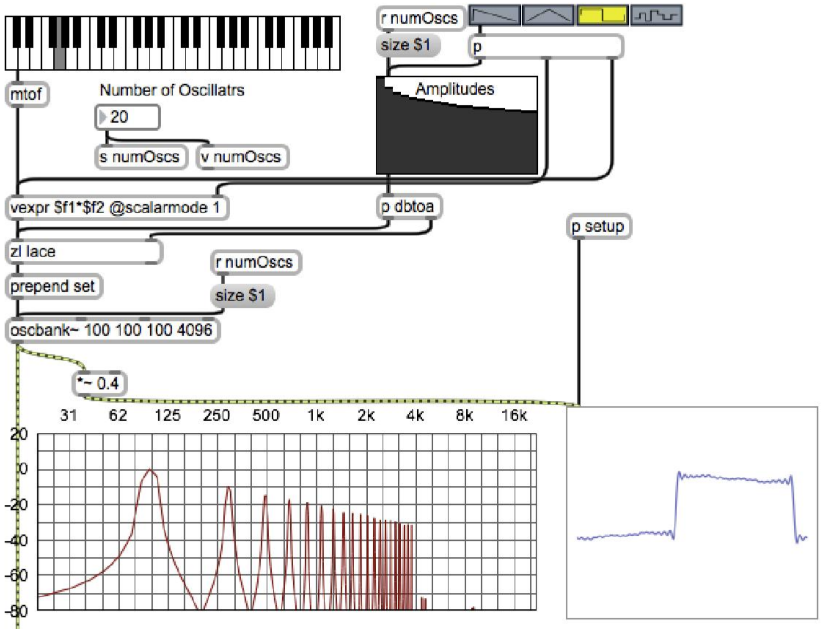




Polyphony and voice allocation

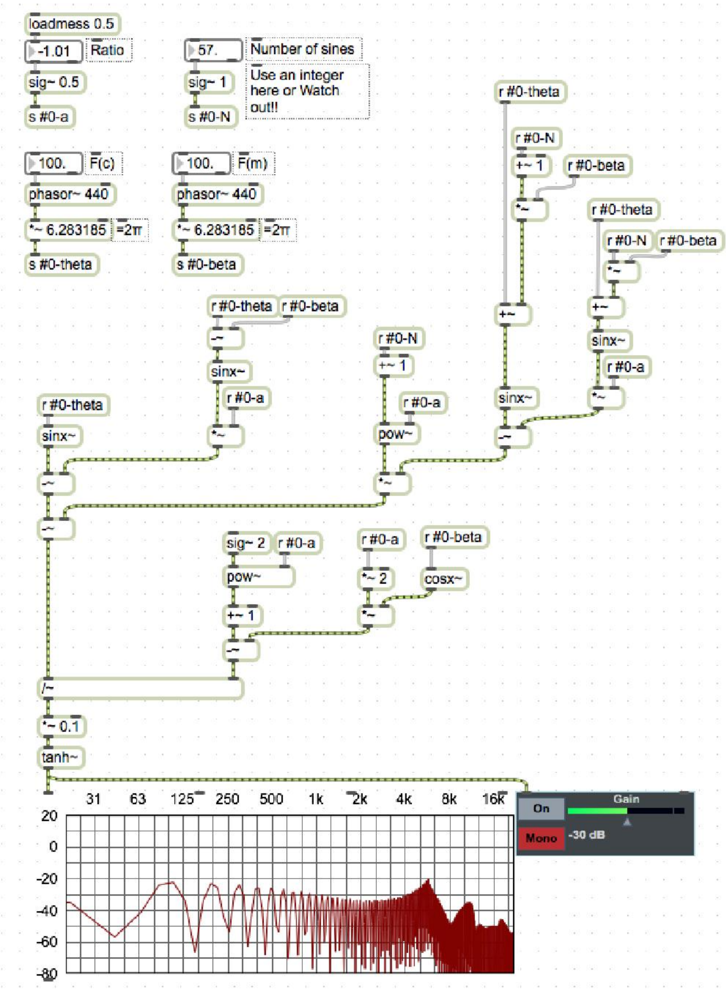


Additive synthesis



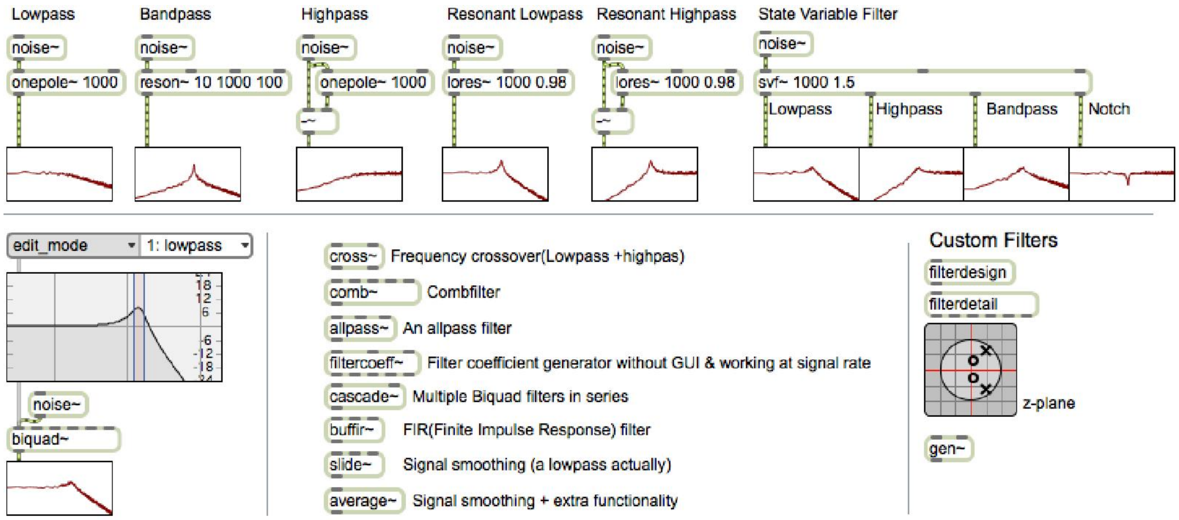
Discrete summation formulae

$$\sum_{k=0}^{N} a^k \cdot \sin(\theta + k\beta) = \frac{\sin(\theta) - a\cdot \sin(\theta - \beta) - a^{N+1}\cdot [\sin\{\theta + (N+1)\beta\} - a\cdot \sin(\theta + N\beta)]}{1 + a^2 - 2a\cdot \cos(\beta)}$$



$$\sum_{k=0}^{\infty} a^k \sin(\theta + k\beta) = \frac{\sin(\theta) - a\cdot \sin(\theta - \beta)}{1 + a^2 - 2a\cdot \cos(\beta)}$$

Subtractive synthesis and filtering



Lowpass

noise~

onepole~ 1000

Bandpass

noise~

reson~ 10 1000 100

Highpass

noise~

onepole~ 1000

-~

Resonant Lowpass

noise~

lores~ 1000 0.98

Resonant Highpass

noise~

lores~ 1000 0.98

-~

State Variable Filter

noise~

svf~ 1000 1.5

Lowpass Highpass Bandpass Notch

edit_mode 1: lowpass

noise~

biquad~

cross~ Frequency crossover(Lowpass +highpas)

comb~ Combfilter

allpass~ An allpass filter

filtercoeff~ Filter coefficient generator without GUI & working at signal rate

cascade~ Multiple Biquad filters in series

buffir~ FIR(Finite Impulse Response) filter

slide~ Signal smoothing (a lowpass actually)

average~ Signal smoothing + extra functionality

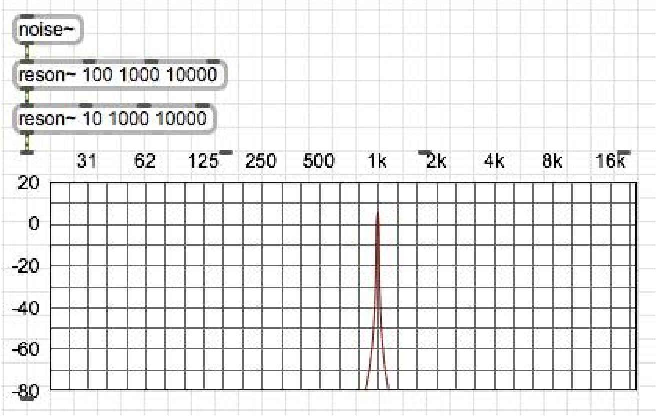
Custom Filters

filterdesign

filterdetail

z-plane

gen~

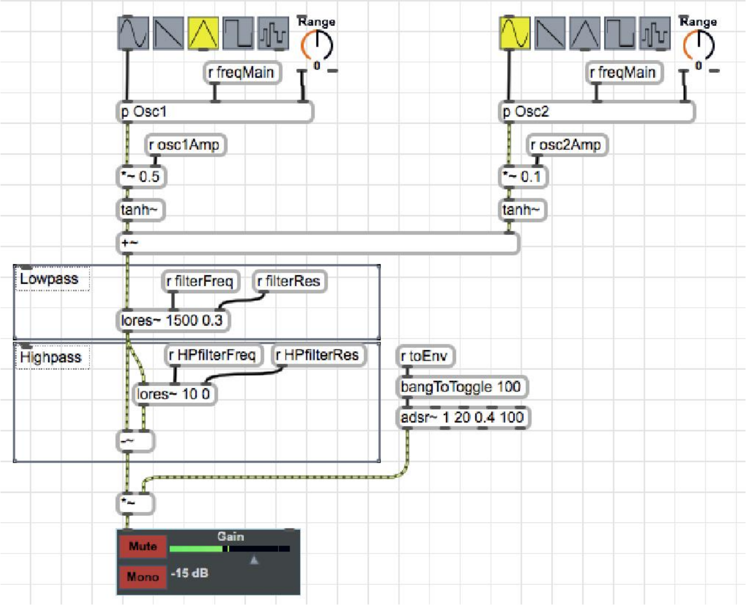


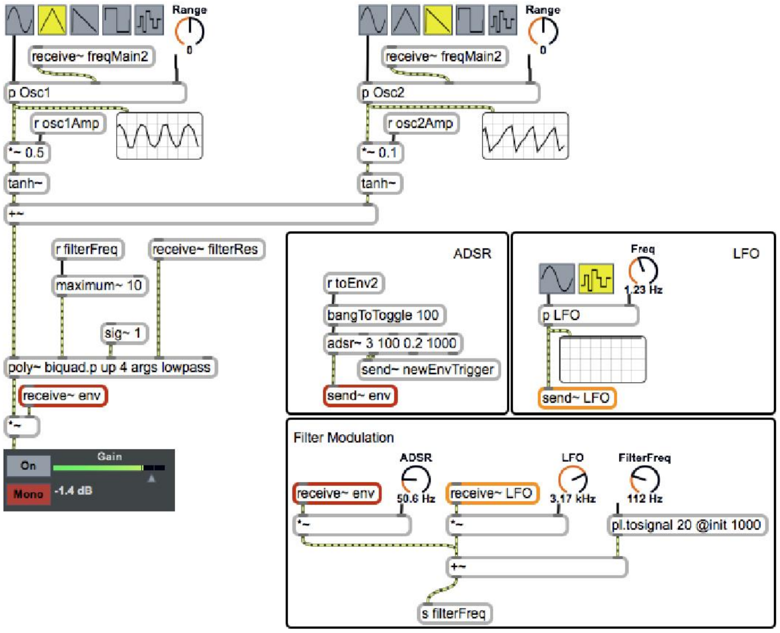
noise~

reson~ 100 1000 10000

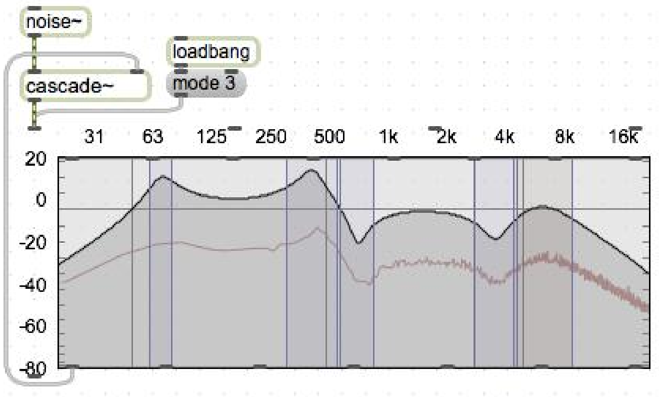
reson~ 10 1000 10000

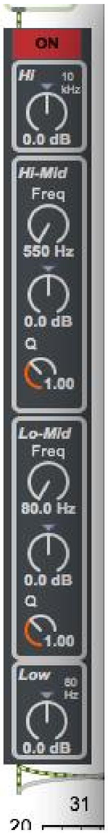
The classic approach

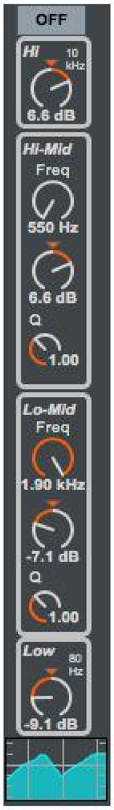




Building an equalizer







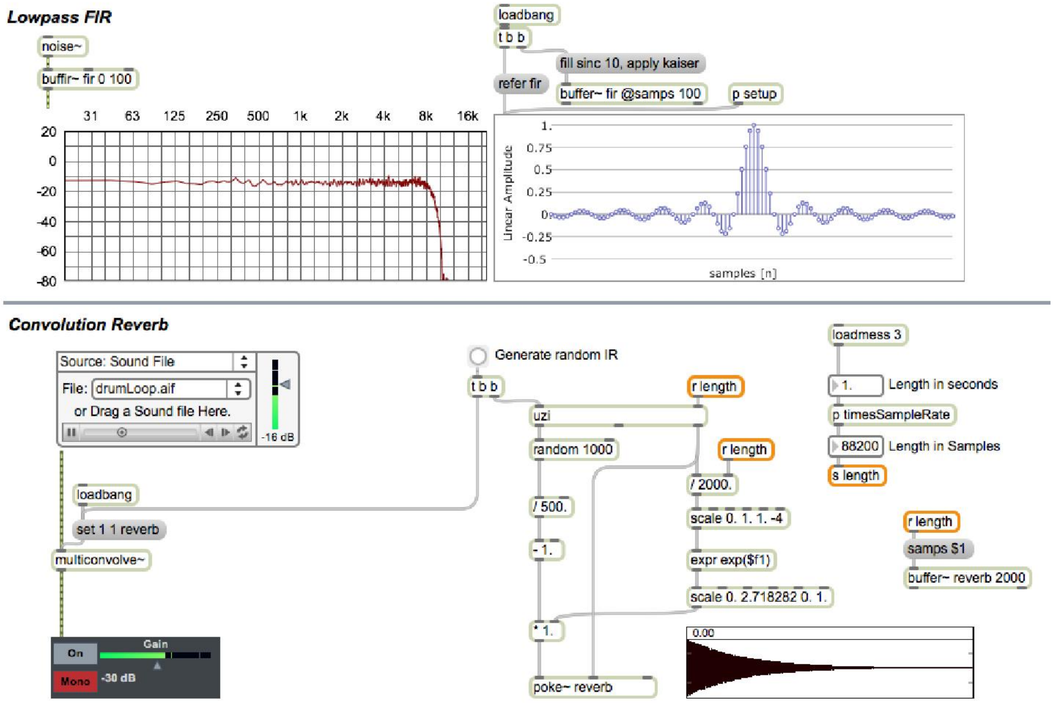
The filter theory: an introduction

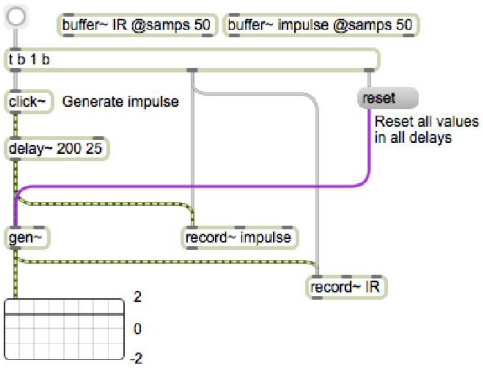
$$y[n] = x[n] + x[n-1]$$

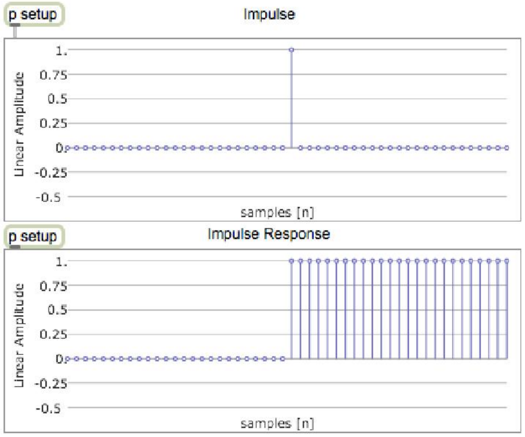
$$y[n] = 0.5\cdot\ x[n] + 0.5\cdot\ x[n-1]$$

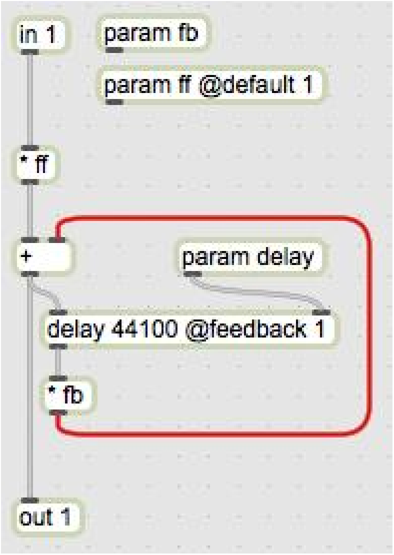
$$y[n] = a_0x[n] + a_1x[n-1] + a_2x[n-2] + \mathrm{K}\ + a_mx[n-m]$$

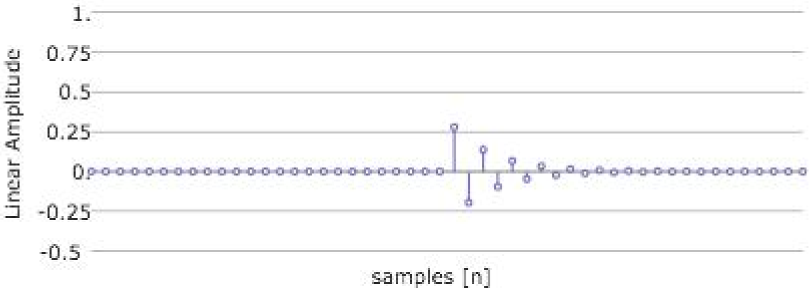
$$y[n] = \sum_{i=0}^{m} a_i\cdot\ x[n-i]$$



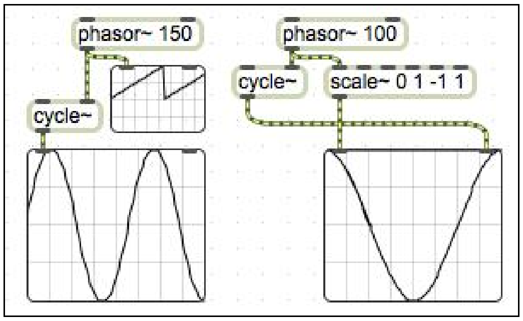

buffer~ IR @samps 50
buffer~ impulse @samps 50
t b 1 b
click~
Generate impulse
reset
Reset all values
in all delays
delay~ 200 25
gen~
record~ impulse
record~ IR
2
0
-2

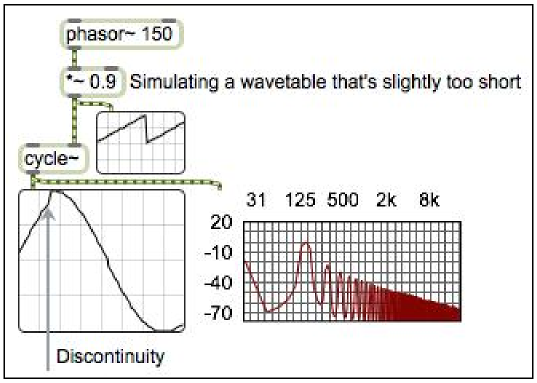

p setup
Impulse
1.
0.75
0.5
0.25
0
-0.25
-0.5
Linear Amplitude
samples [n]
p setup
Impulse Response
1.
0.75
0.5
0.25
0
-0.25
-0.5
Linear Amplitude
samples [n]

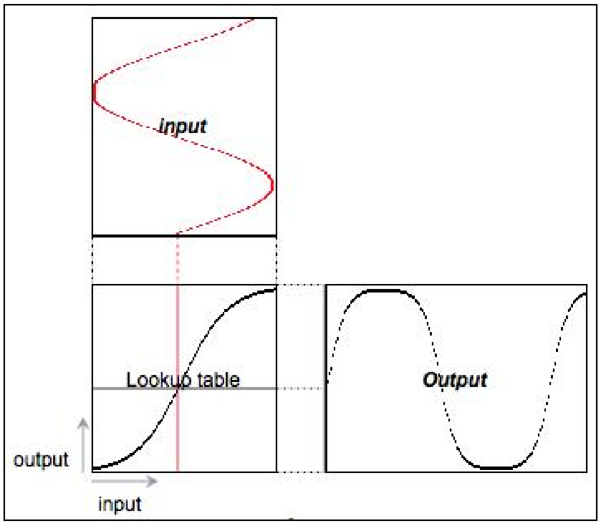

in 1
param fb
param ff @default 1
* ff
+
param delay
delay 44100 @feedback 1
* fb
out 1

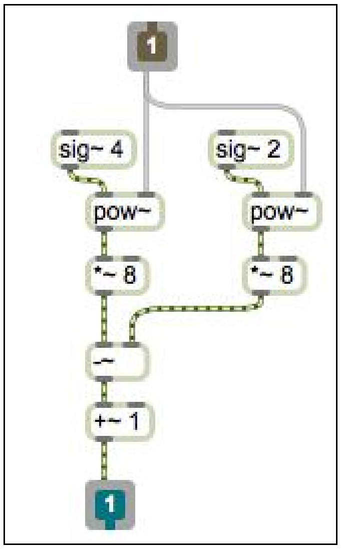

1.
0.75
0.5
0.25
0
-0.25
-0.5
Linear Amplitude
samples [n]

Waveshaping

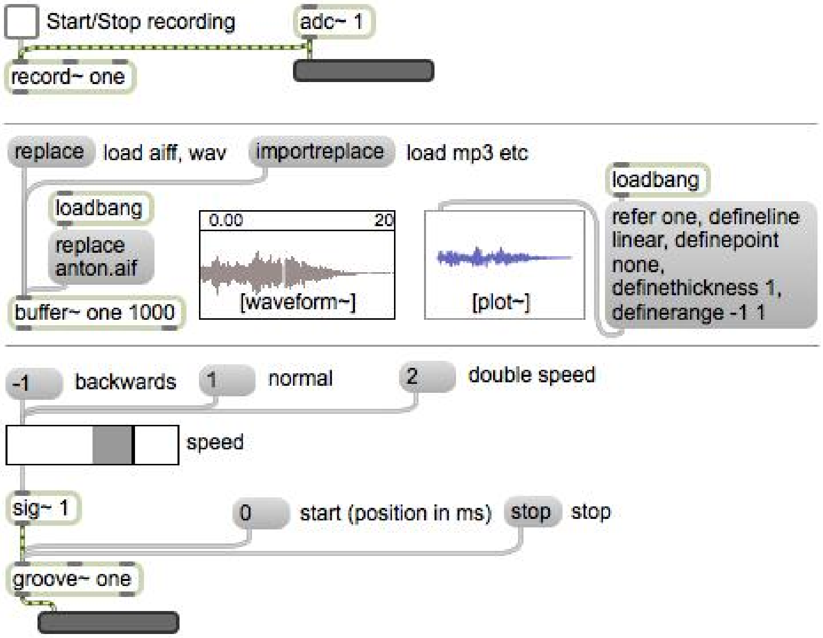


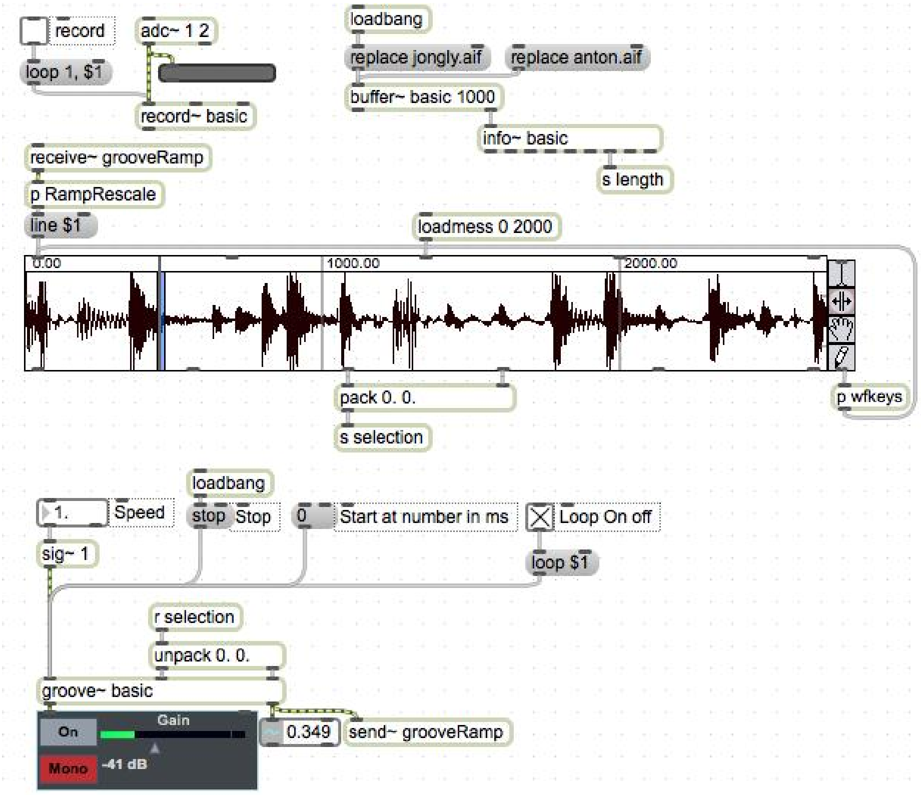

Simulating a wavetable that's slightly too short

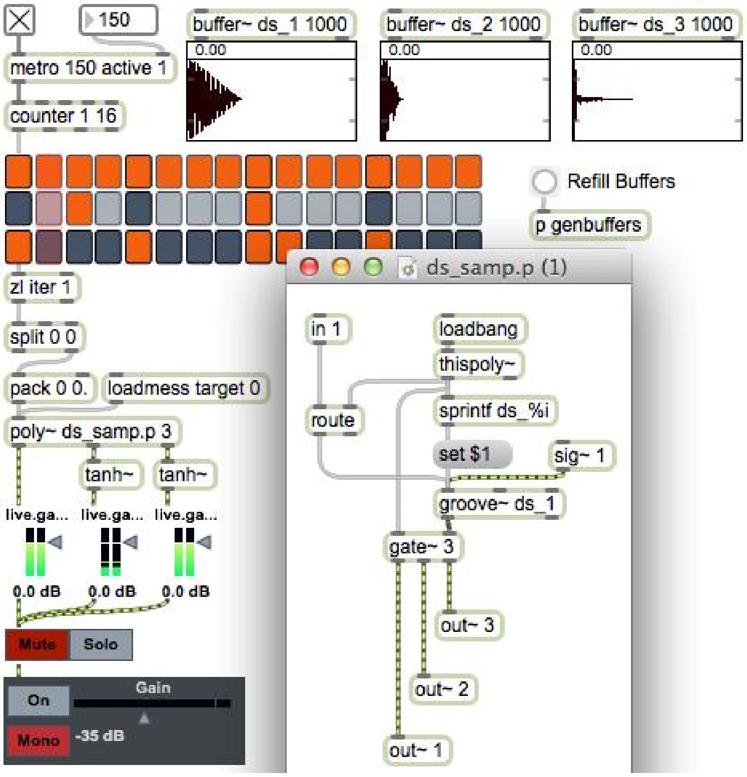




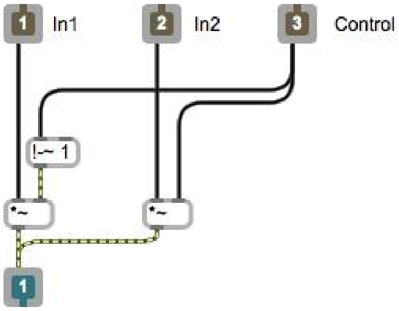
Sampling and audio file playback

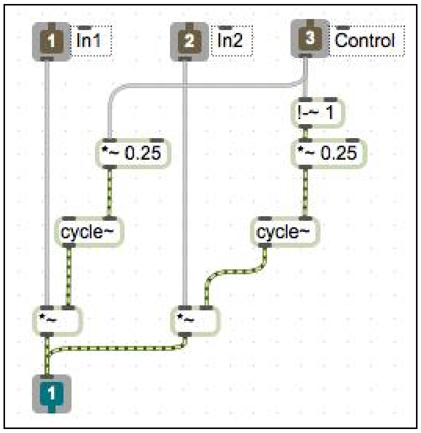


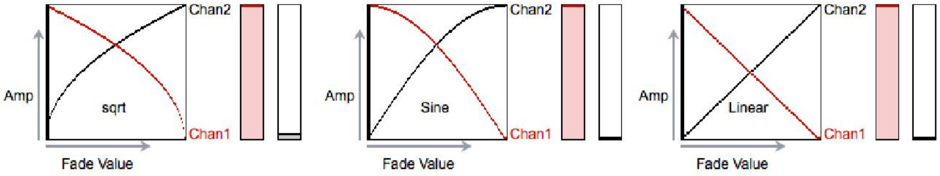

record
loop 1, $1
adc~ 1 2
record~ basic
loadbang
replace jongly.aif
replace anton.aif
buffer~ basic 1000
info~ basic
s length
receive~ grooveRamp
p RampRescale
line $1
loadmess 0 2000
0.00
1000.00
2000.00
pack 0. 0.
s selection
p wfkeys
1.
Speed
loadbang
stop
Stop
0
Start at number in ms
Loop On off
sig~ 1
loop $1
r selection
unpack 0. 0.
groove~ basic
On
Gain
Mono
-41 dB
0.349
send~ grooveRamp



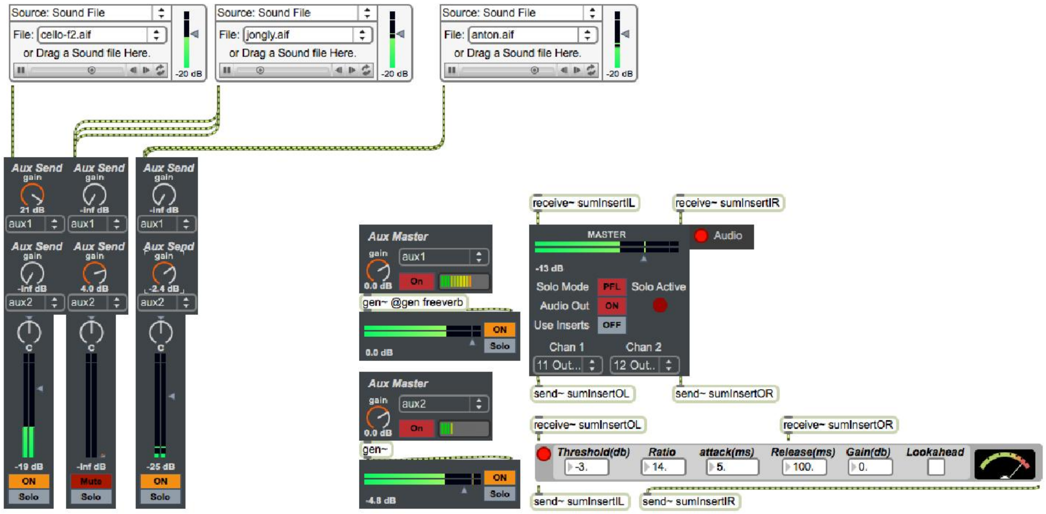
Mixing and signal routing







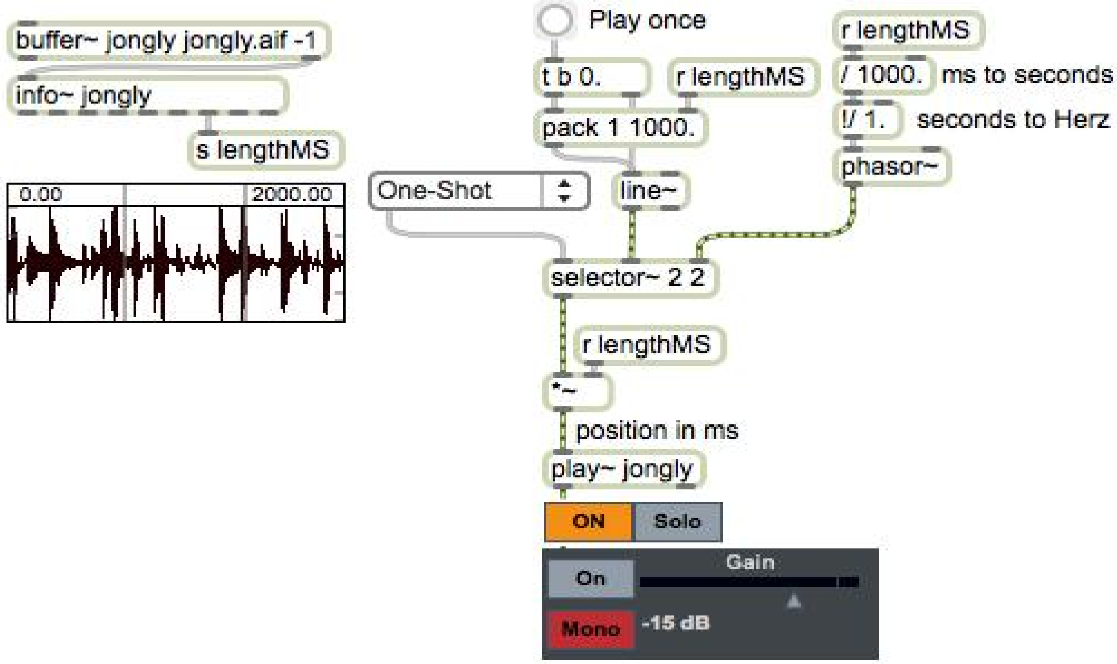
Conventional mixing

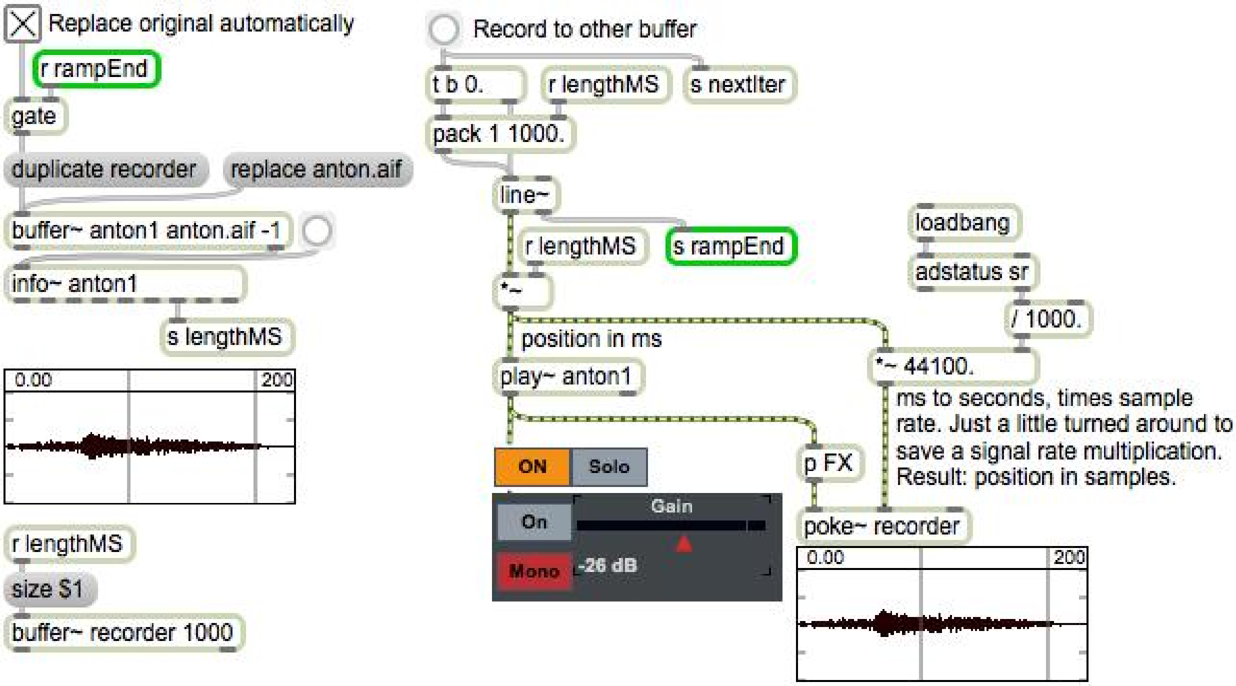


5

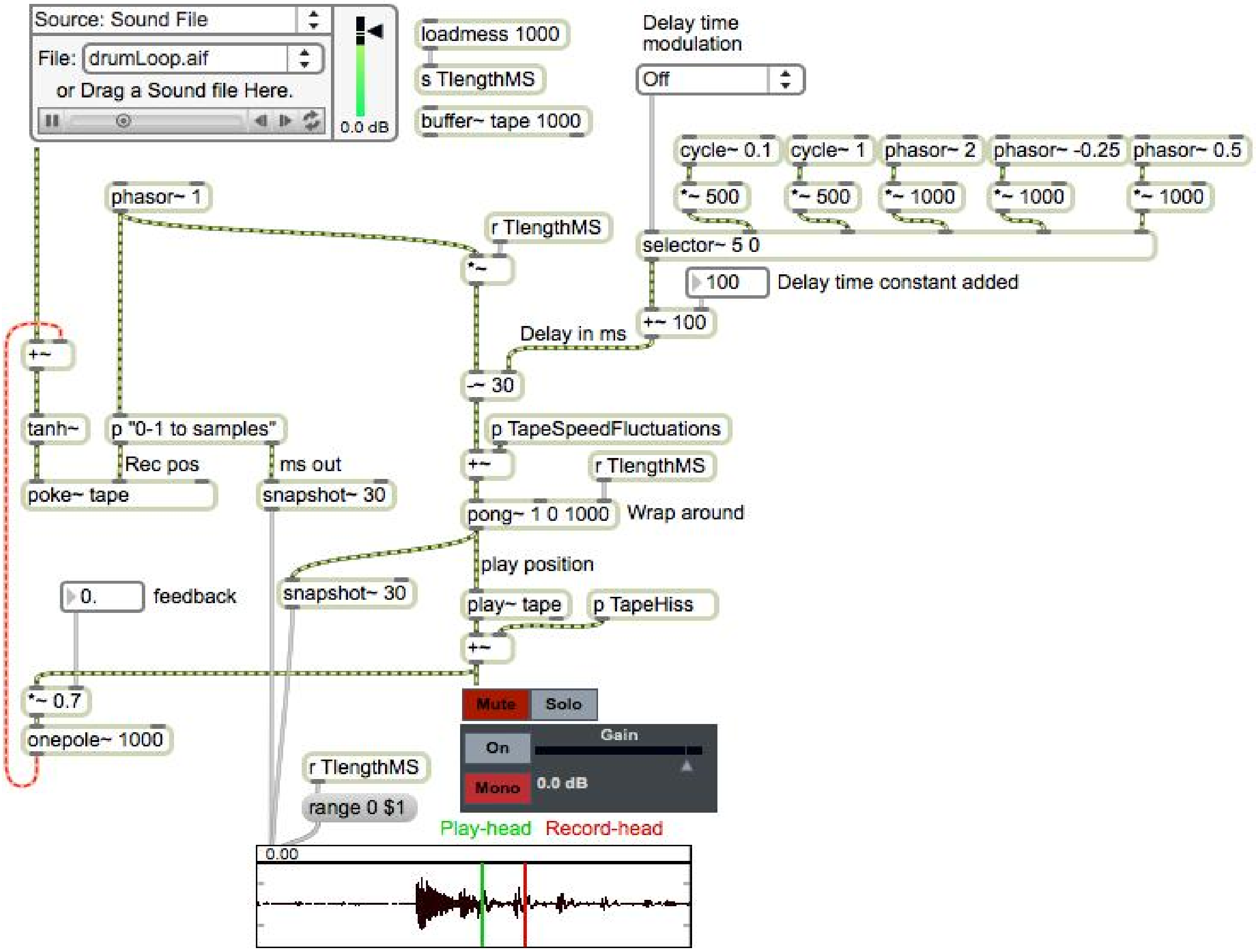
Advanced Audio in Max/MSP

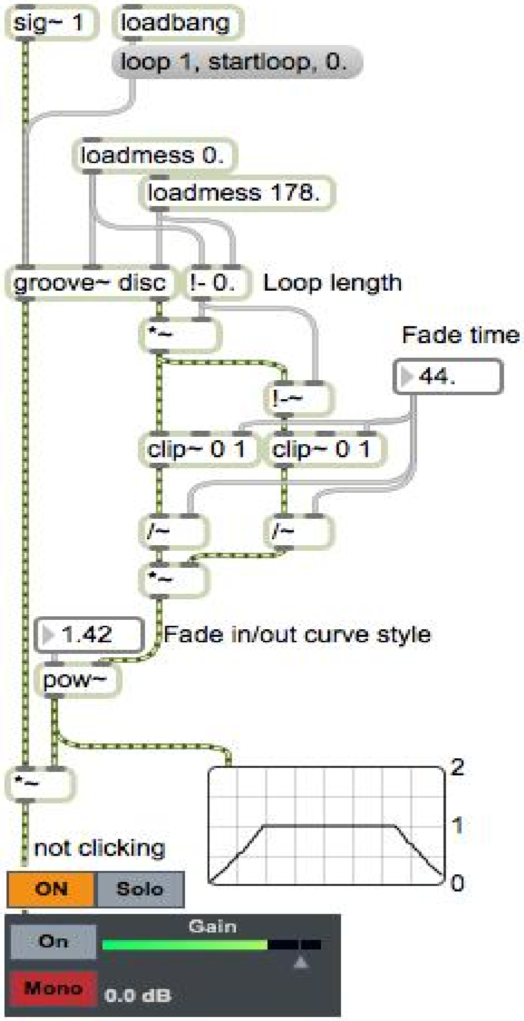
More sampling



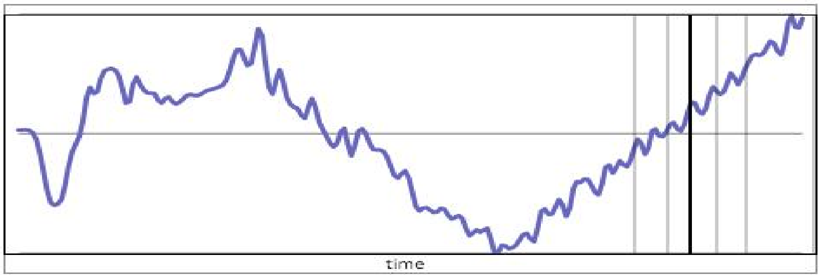


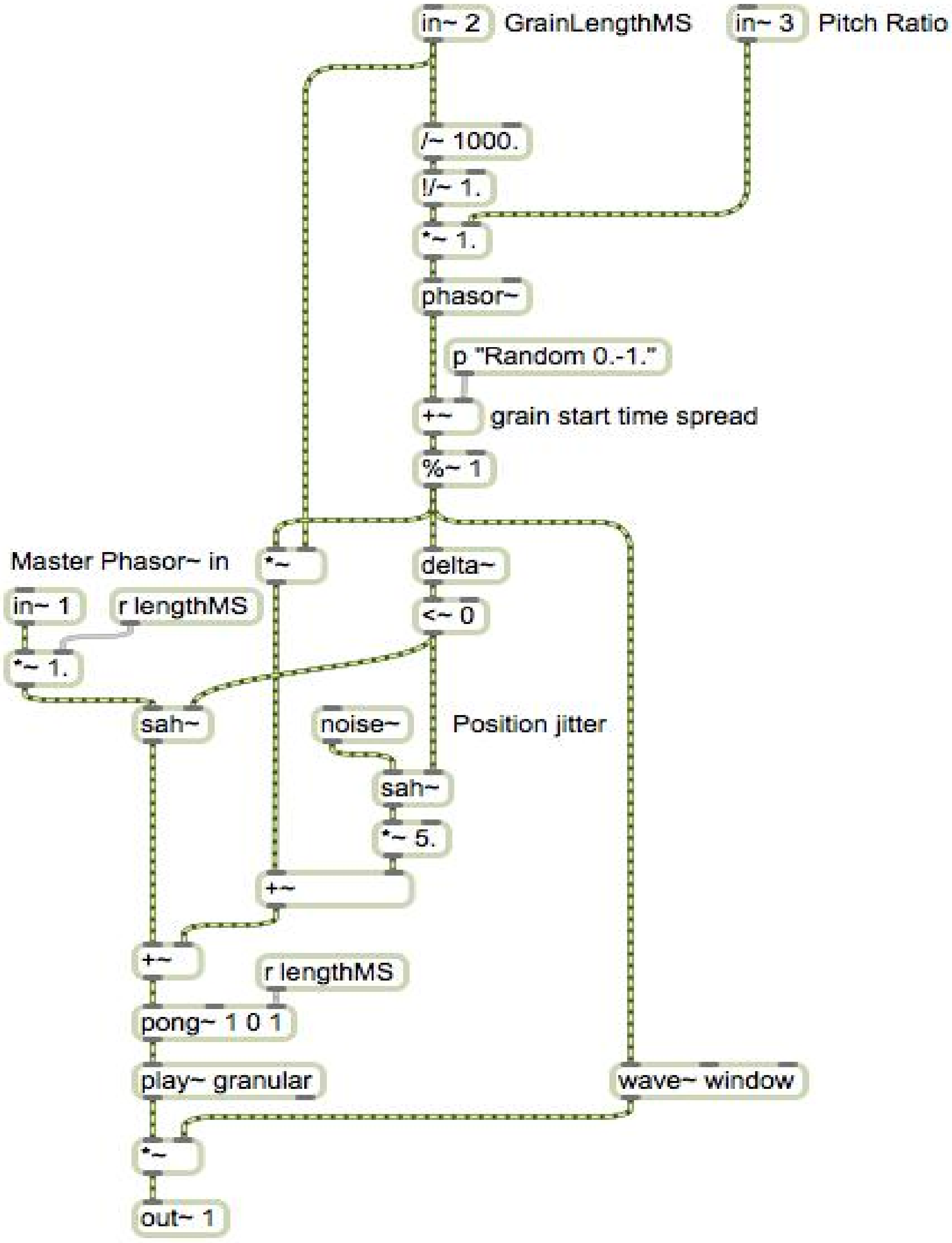
ms to seconds, times sample rate. Just a little turned around to save a signal rate multiplication. Result: position in samples.

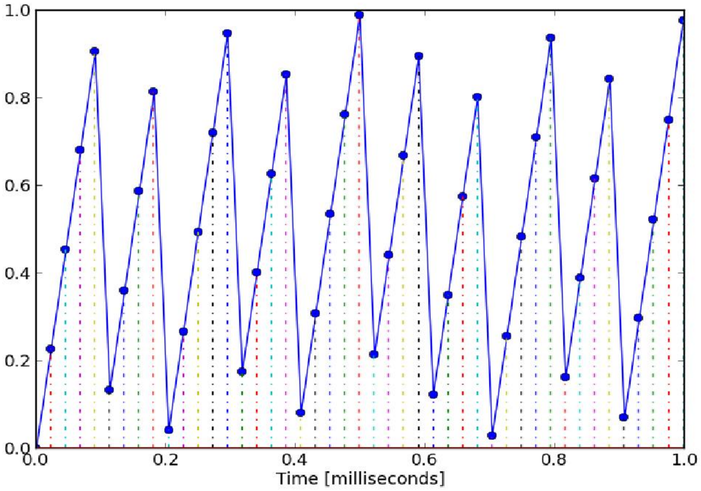

Source: Sound File
File: drumLoop.aif
or Drag a Sound file Here.
0.0 dB
loadmess 1000
s TlengthMS
buffer~ tape 1000
Delay time modulation
Off
cycle~ 0.1
cycle~ 1
phasor~ 2
phasor~ -0.25
phasor~ 0.5
*~ 500
*~ 500
*~ 1000
*~ 1000
*~ 1000
phasor~ 1
r TlengthMS
selector~ 5 0
*~
100
Delay time constant added
+~ 100
Delay in ms
+~
-~ 30
tanh~
p "0-1 to samples"
p TapeSpeedFluctuations
Rec pos
ms out
+~
r TlengthMS
poke~ tape
snapshot~ 30
pong~ 1 0 1000
Wrap around
play position
0.
feedback
snapshot~ 30
play~ tape
p TapeHiss
+~
*~ 0.7
Mute
Solo
onepole~ 1000
On
Gain
Mono
0.0 dB
r TlengthMS
range 0 $1
Play-head
Record-head
0.00

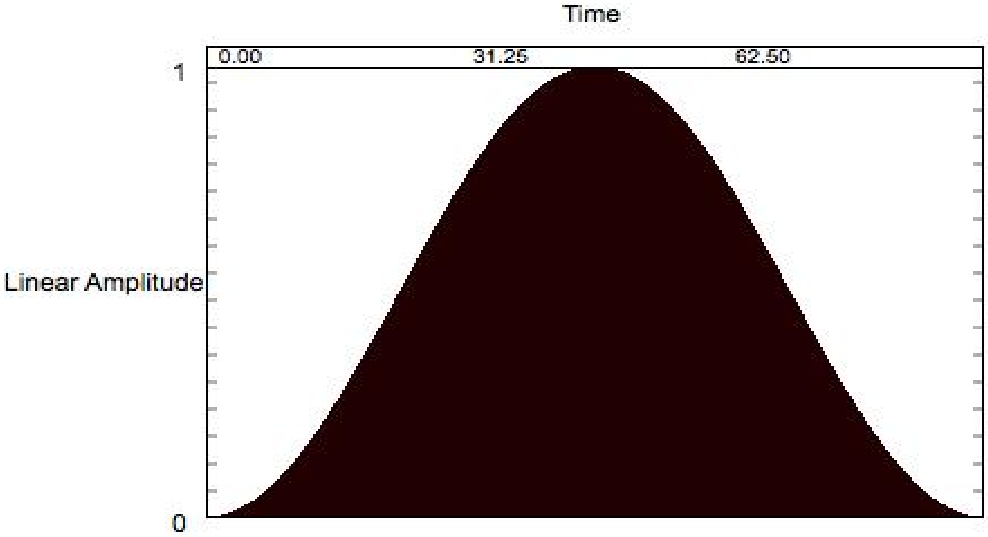

sig~ 1
loadbang
loop 1, startloop, 0.
loadmess 0.
loadmess 178.
groove~ disc
!- 0.
Loop length
*~
Fade time
44.
!-~
clip~ 0 1
clip~ 0 1
/~
/~
*~
1.42
Fade in/out curve style
pow~
*~
2
1
0
not clicking
ON
Solo
On
Gain
Mono
0.0 dB

Granular sampling



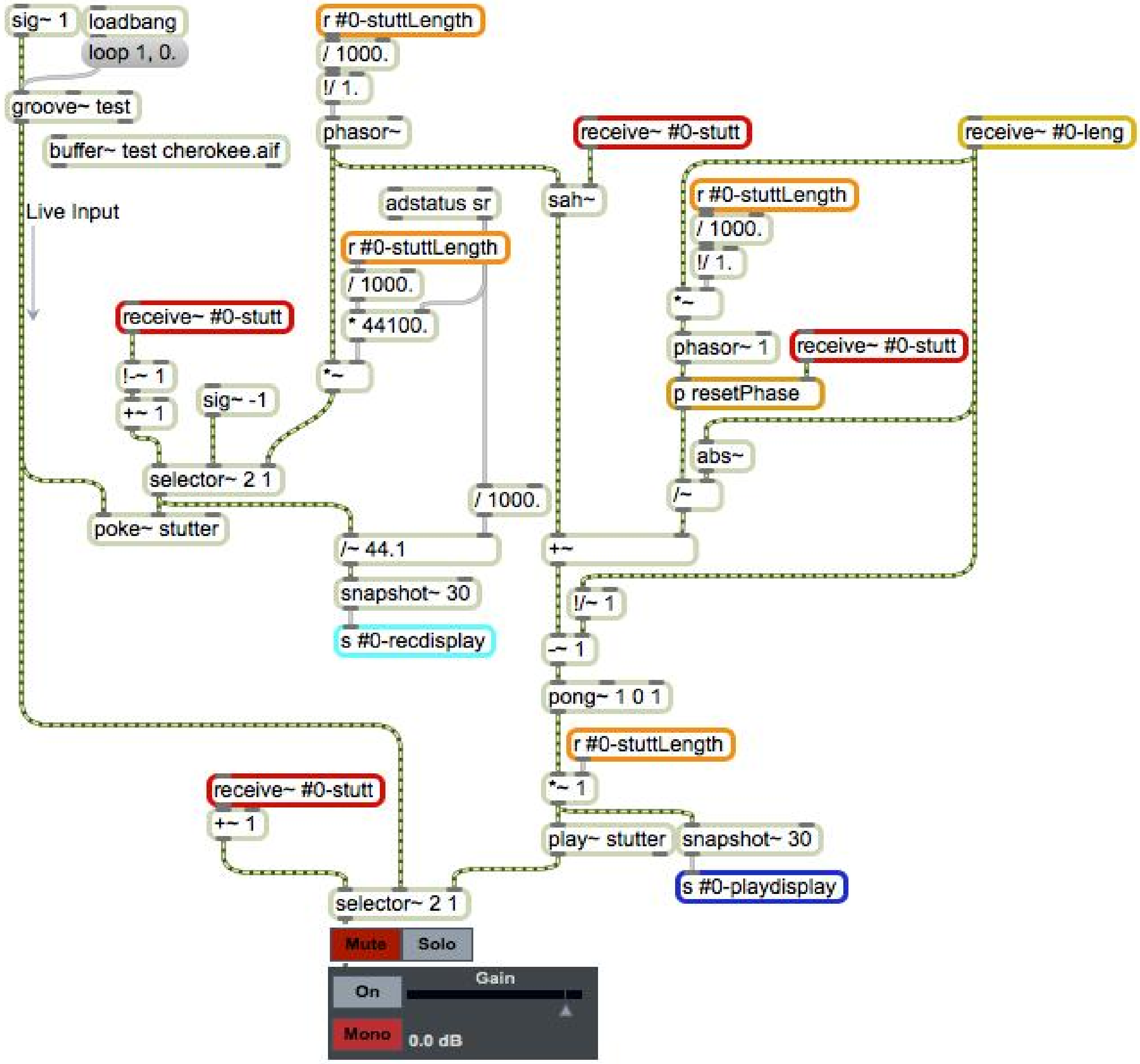

in~ 2
GrainLengthMS
in~ 3
Pitch Ratio
/~ 1000.
!/~ 1.
*~ 1.
phasor~
p "Random 0.-1."
+~
grain start time spread
%~ 1
Master Phasor~ in
*~
delta~
in~ 1
r lengthMS
<~ 0
*~ 1.
sah~
noise~
Position jitter
sah~
*~ 5.
+~
+~
r lengthMS
pong~ 1 0 1
play~ granular
wave~ window
*~
out~ 1

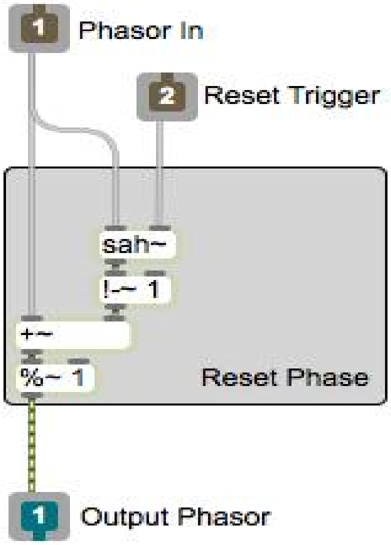

1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Time [milliseconds]


Time
0.00
31.25
62.50
1
Linear Amplitude
0

FX

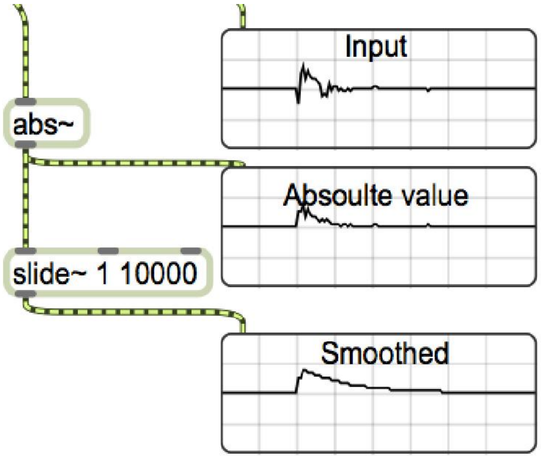
Stutter

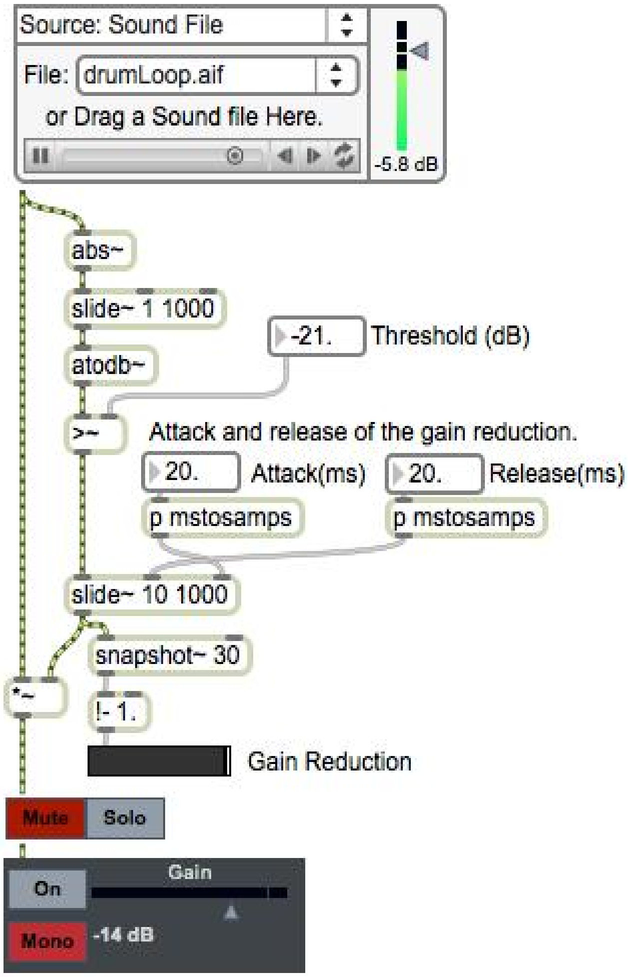

sig~ 1
loadbang
loop 1, 0.
groove~ test
buffer~ test cherokee.aif
Live Input
receive~ #0-stutt
!-~ 1
+~ 1
sig~ -1
selector~ 2 1
poke~ stutter
r #0-stuttLength
/ 1000.
!/ 1.
phasor~
adstatus sr
r #0-stuttLength
/ 1000.
* 44100.
*~
/ 1000.
/~ 44.1
snapshot~ 30
s #0-recdisplay
receive~ #0-stutt
sah~
receive~ #0-leng
r #0-stuttLength
/ 1000.
!/ 1.
*~
phasor~ 1
receive~ #0-stutt
p resetPhase
abs~
/~
+~
!/~ 1
-~ 1
pong~ 1 0 1
r #0-stuttLength
*~ 1
play~ stutter
snapshot~ 30
s #0-playdisplay
receive~ #0-stutt
+~ 1
selector~ 2 1
Mute
Solo
On
Gain
Mono
0.0 dB



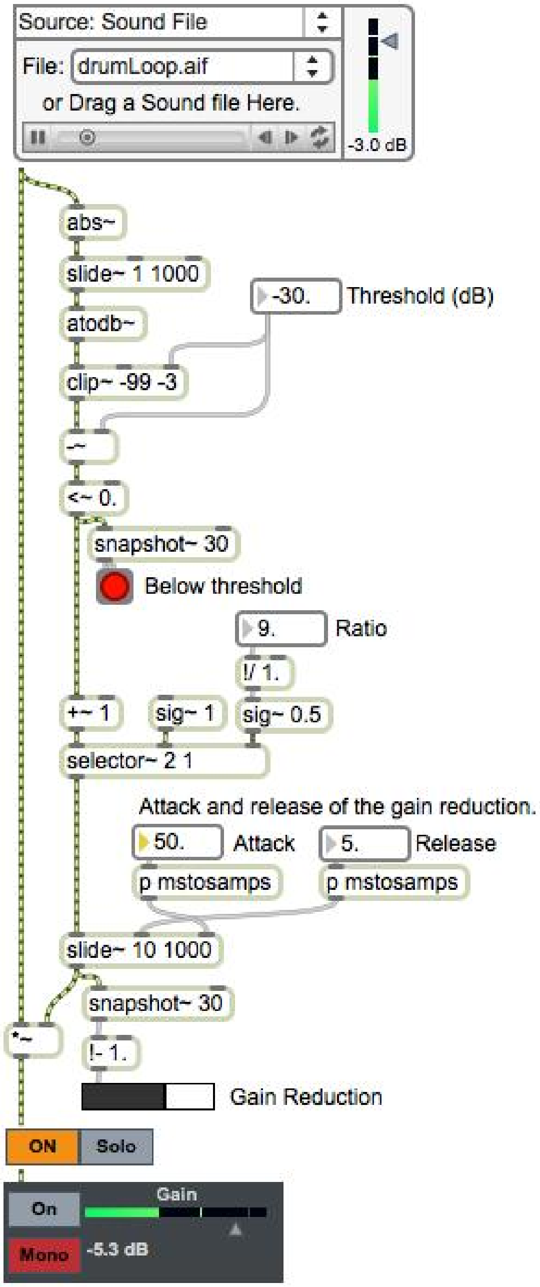
Dynamics

Noise gate

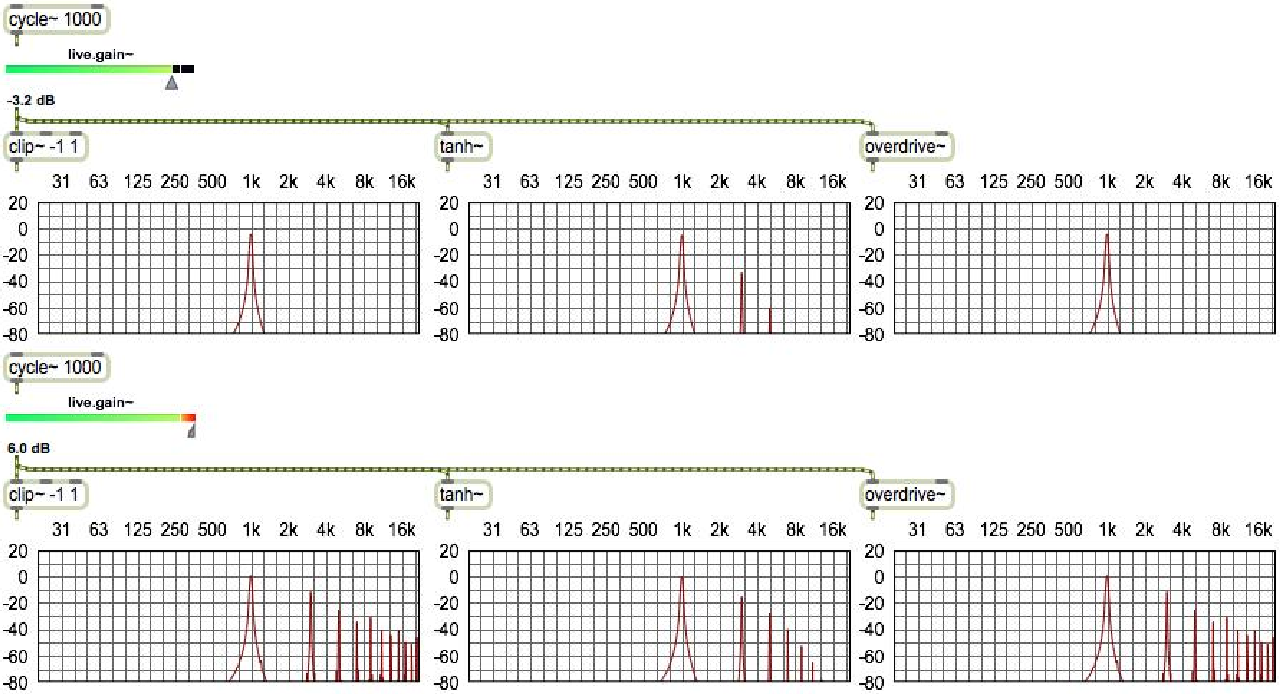


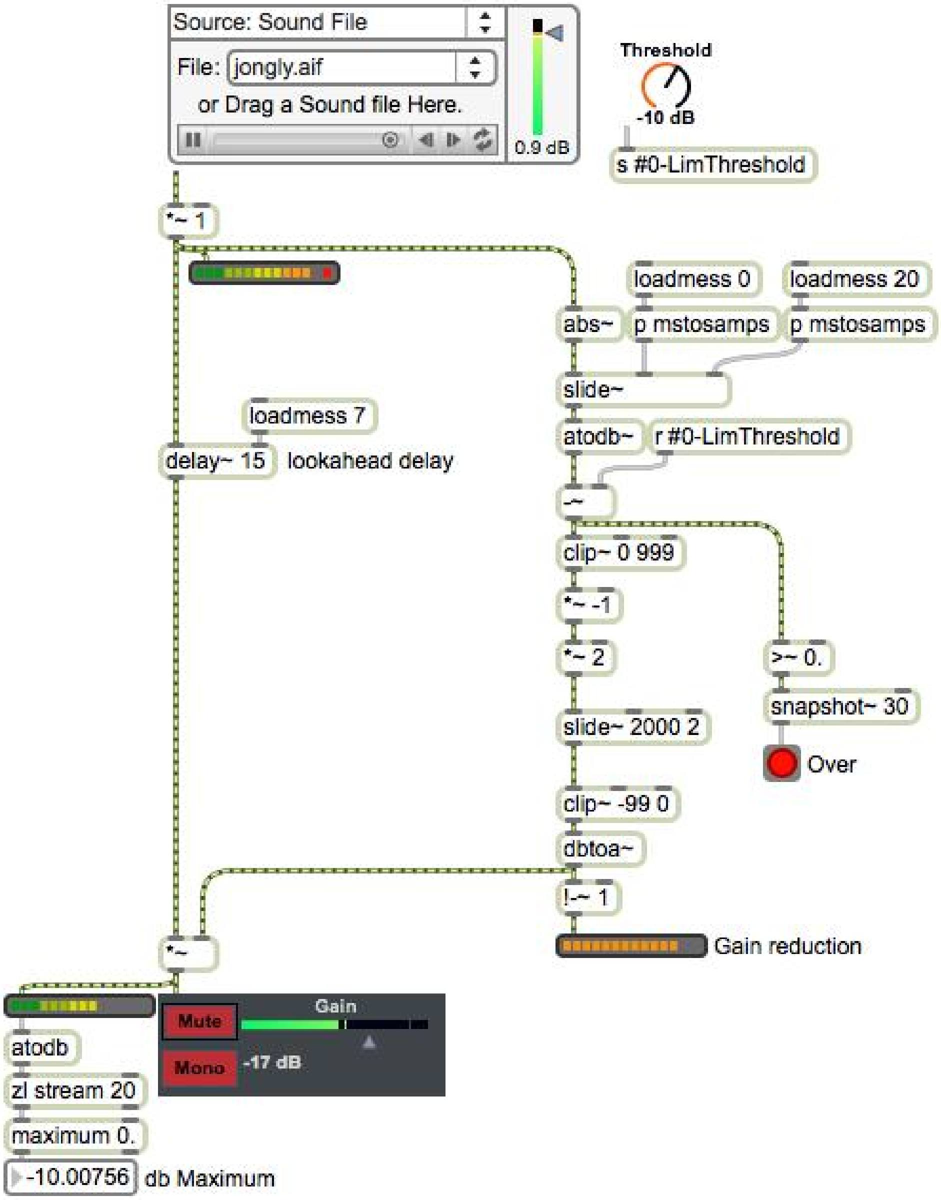

Source: Sound File
File: drumLoop.aif
or Drag a Sound file Here.
-5.8 dB
abs~
slide~ 1 1000
-21.
Threshold (dB)
atodb~
>~
Attack and release of the gain reduction.
20.
Attack(ms)
20.
Release(ms)
p mstosamps
p mstosamps
slide~ 10 1000
snapshot~ 30
*~
!- 1.
Gain Reduction
Mute
Solo
On
Gain
Mono
-14 dB

Working with expanders

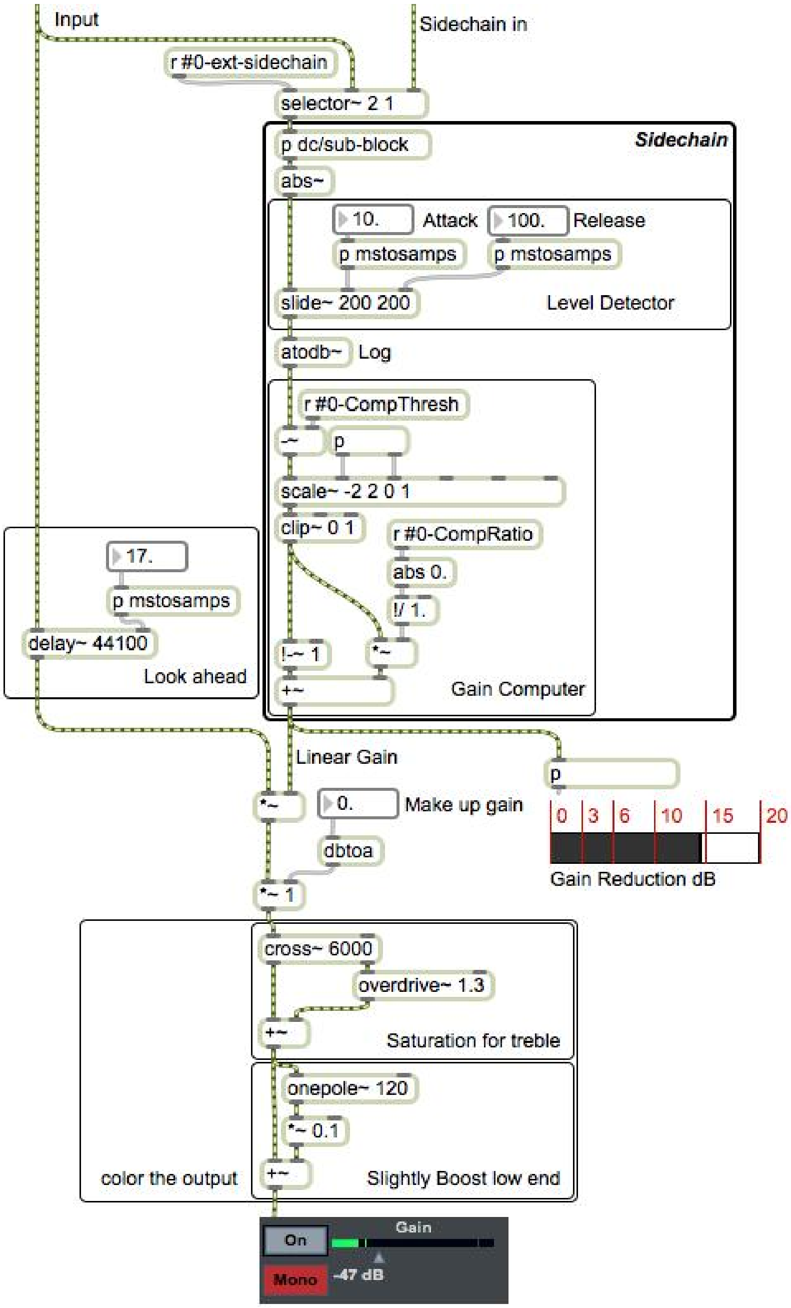


Limiter

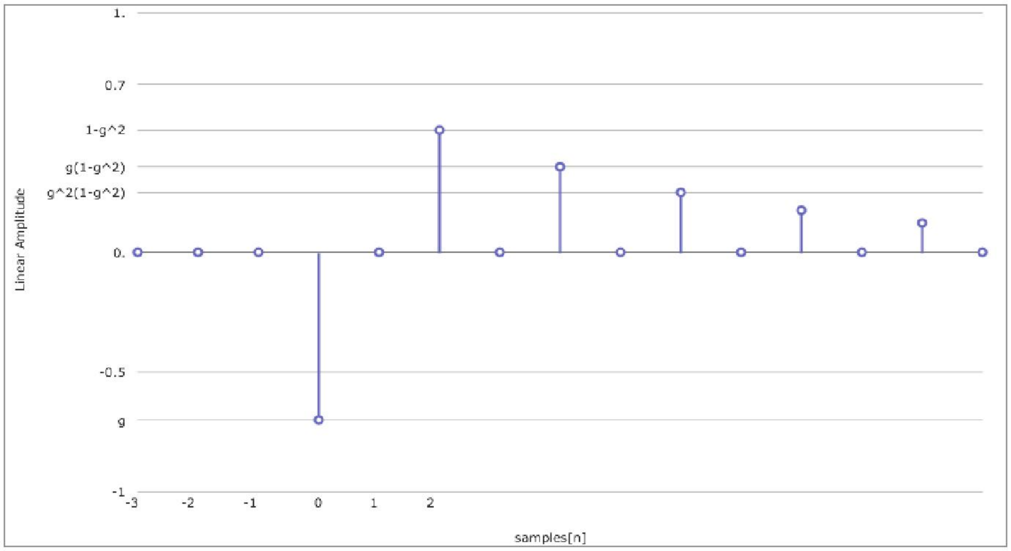

cycle~ 1000
live.gain~
-3.2 dB
clip~ -1 1
tanh~
overdrive~
31 63 125 250 500 1k 2k 4k 8k 16k
20 0 -20 -40 -60 -80
cycle~ 1000
live.gain~
6.0 dB
clip~ -1 1
tanh~
overdrive~
31 63 125 250 500 1k 2k 4k 8k 16k
20 0 -20 -40 -60 -80

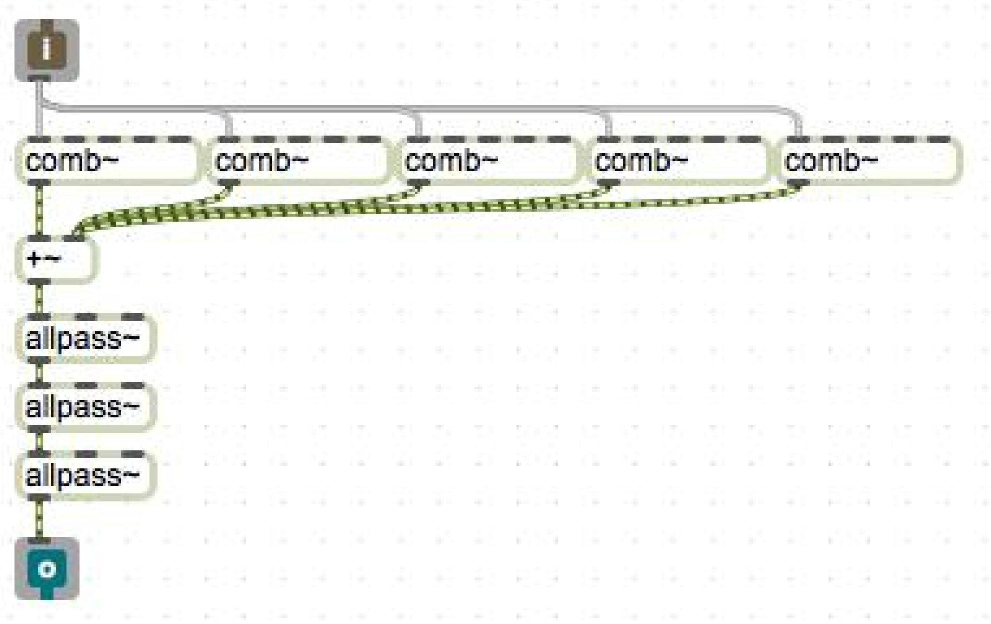

Source: Sound File
File: jongly.aif
or Drag a Sound file Here.
0.9 dB
Threshold
-10 dB
s #0-LimThreshold
*~ 1
loadmess 0
loadmess 20
abs~
p mstosamps
p mstosamps
slide~
loadmess 7
delay~ 15
lookahead delay
atodb~
r #0-LimThreshold
-~
clip~ 0 999
*~ -1
*~ 2
>~ 0.
snapshot~ 30
Over
slide~ 2000 2
clip~ -99 0
dbtoa~
!-~ 1
Gain reduction
*~
Mute
Gain
Mono
-17 dB
atodb
zl stream 20
maximum 0.
-10.00756
db Maximum

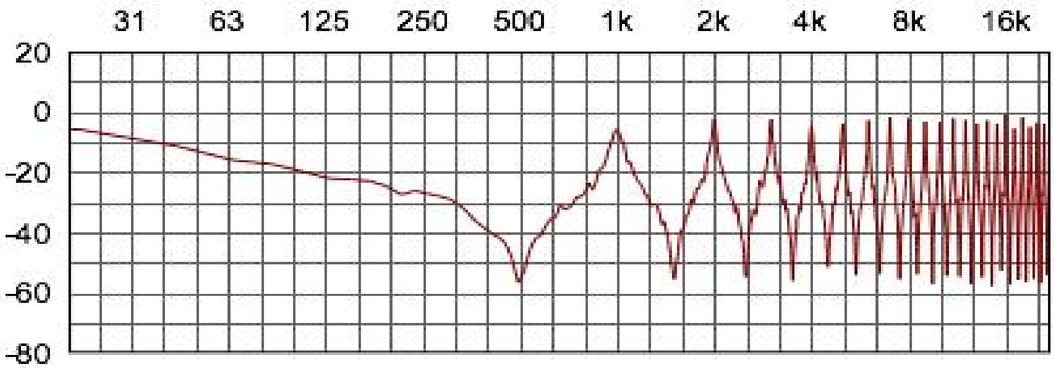
Compressor

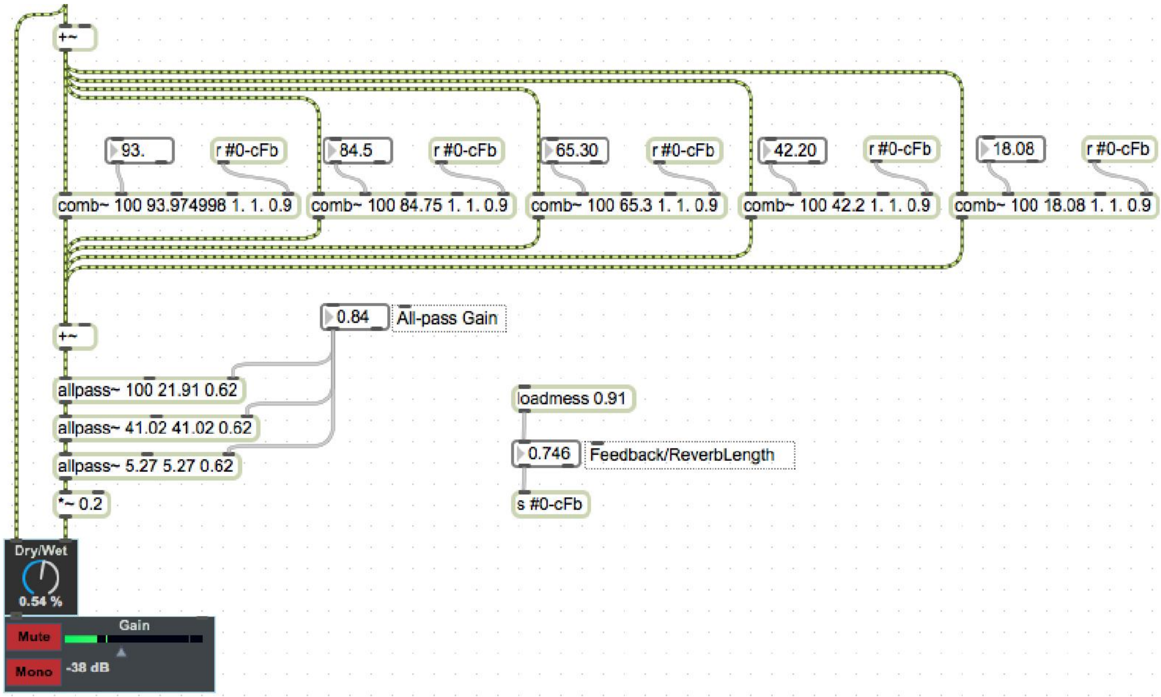

Input
Sidechain in
r #0-ext-sidechain
selector~ 2 1
Sidechain
p dc/sub-block
abs~
10.
Attack
100.
Release
p mstosamps
p mstosamps
slide~ 200 200
Level Detector
atodb~
Log
r #0-CompThresh
-~
p
scale~ -2 2 0 1
clip~ 0 1
r #0-CompRatio
abs 0.
!/ 1.
17.
p mstosamps
delay~ 44100
Look ahead
!-~ 1
*~
+~
Gain Computer
Linear Gain
p
*~
0.
Make up gain
dbtoa
0
3
6
10
15
20
Gain Reduction dB
*~ 1
cross~ 6000
overdrive~ 1.3
+~
Saturation for treble
onepole~ 120
*~ 0.1
+~
color the output
Slightly Boost low end
On
Gain
Mono
-47 dB

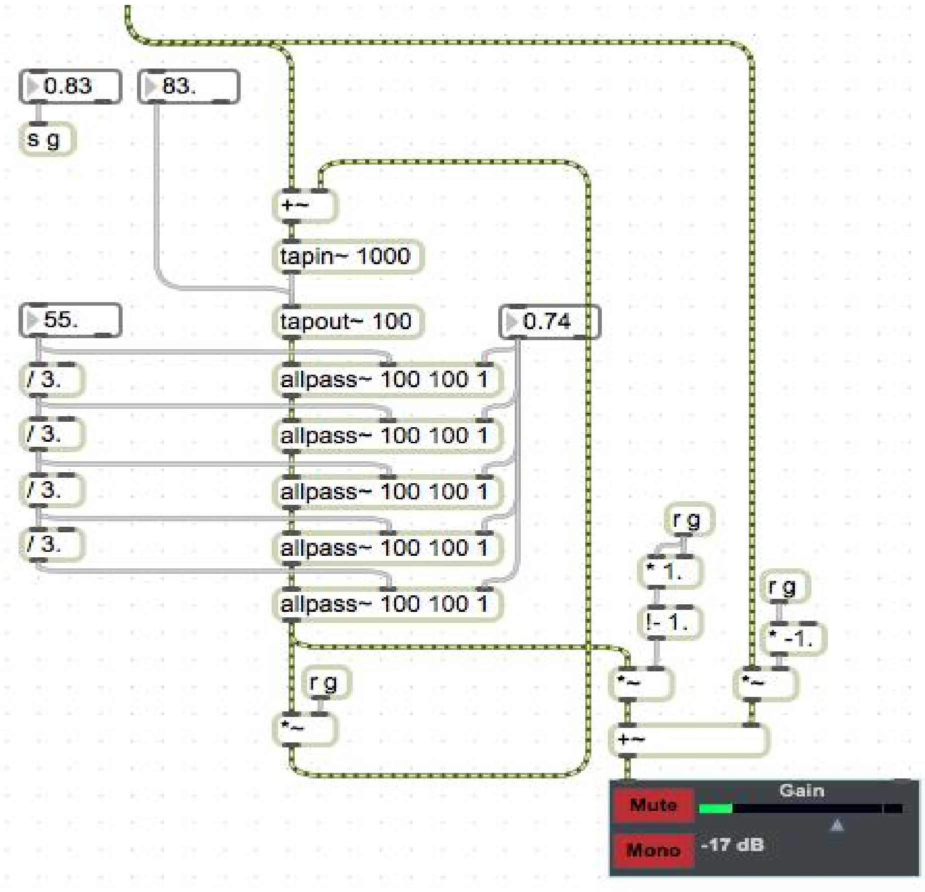
Reverberation

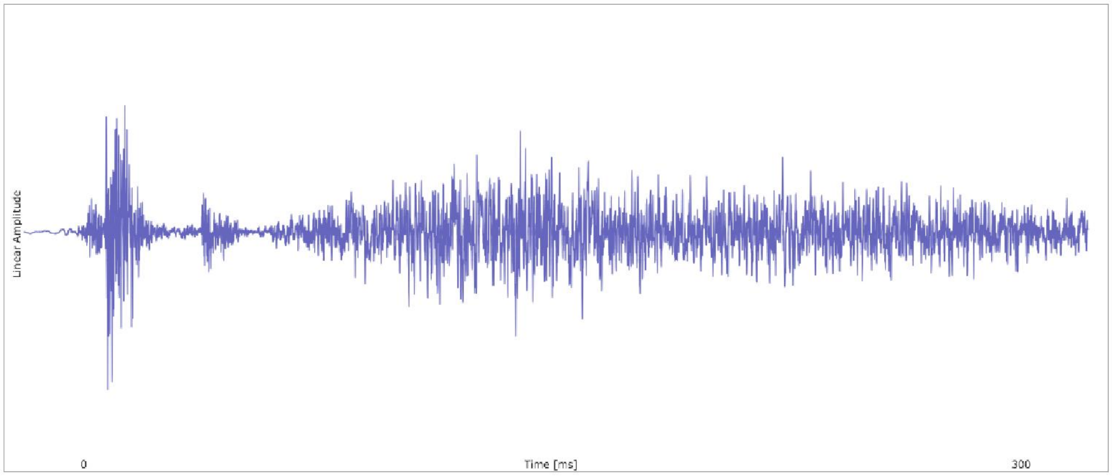




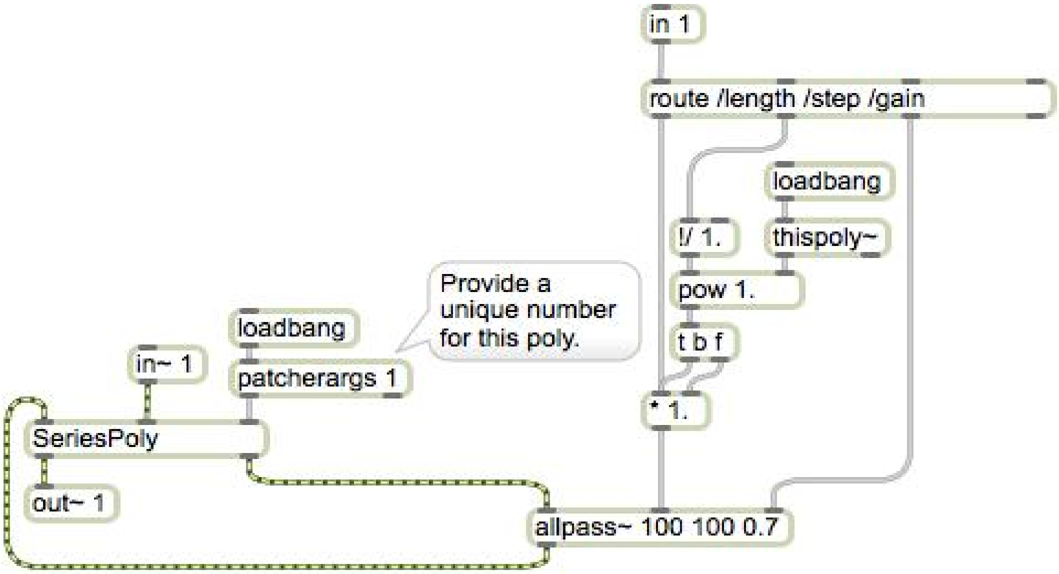

31
63
125
250
500
1k
2k
4k
8k
16k
20
0
-20
-40
-60
-80


+~
93.
r #0-cFb
84.5
r #0-cFb
65.30
r #0-cFb
42.20
r #0-cFb
18.08
r #0-cFb
comb~ 100 93.974998 1. 1. 0.9
comb~ 100 84.75 1. 1. 0.9
comb~ 100 65.3 1. 1. 0.9
comb~ 100 42.2 1. 1. 0.9
comb~ 100 18.08 1. 1. 0.9
+~
0.84
All-pass Gain
allpass~ 100 21.91 0.62
allpass~ 41.02 41.02 0.62
allpass~ 5.27 5.27 0.62
*~ 0.2
loadmess 0.91
0.746
Feedback/ReverbLength
s #0-cFb
Dry/Wet
0.54 %
Mute
Gain
Mono
-38 dB

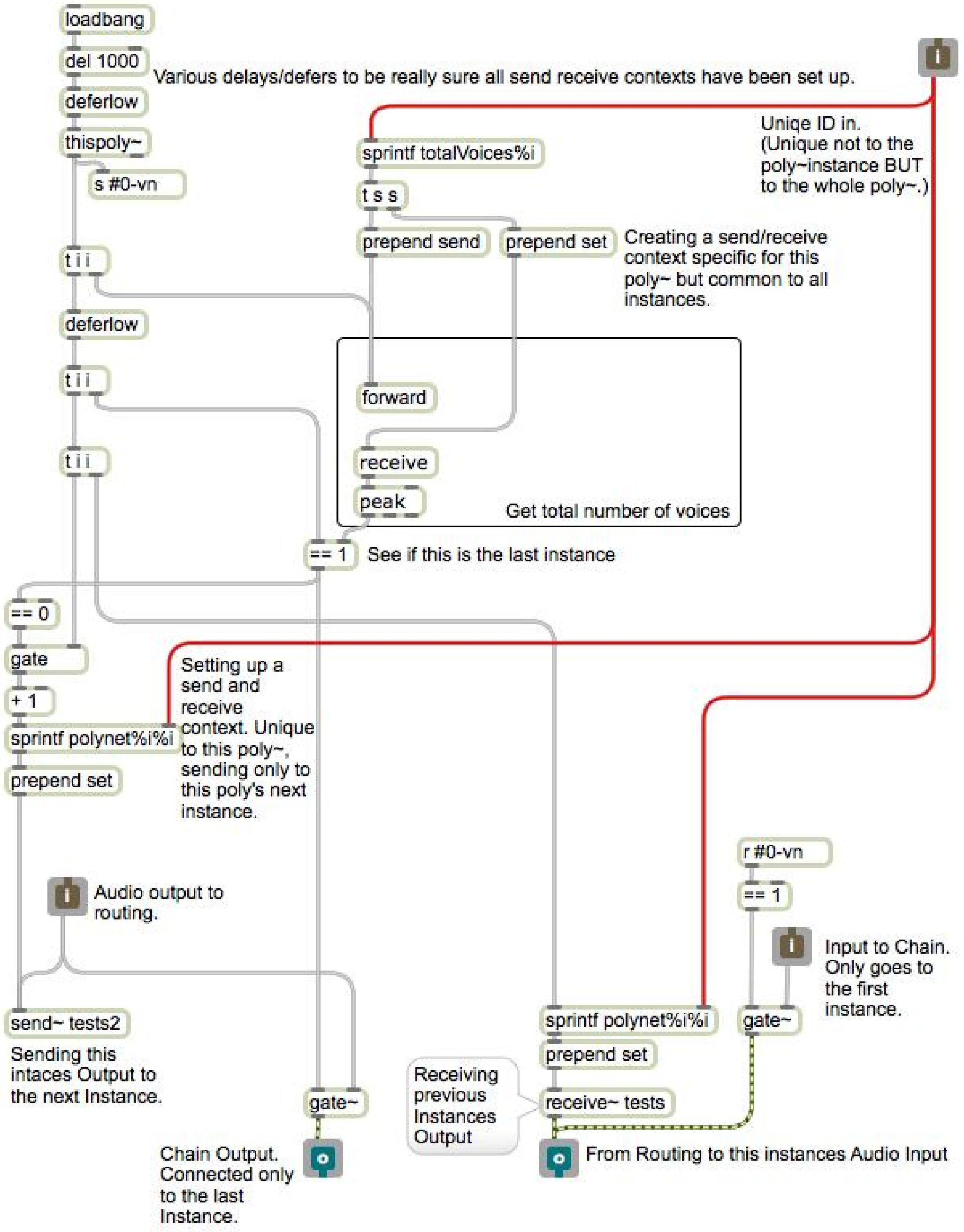

0.83
s g
83.
+~
tapin~ 1000
tapout~ 100
55.
0.74
/ 3.
allpass~ 100 100 1
/ 3.
allpass~ 100 100 1
/ 3.
allpass~ 100 100 1
/ 3.
allpass~ 100 100 1
allpass~ 100 100 1
r g
* 1.
!- 1.
r g
* -1.
r g
*~
*~
*~
+~
Mute
Gain
Mono
-17 dB


Linear Amplitude
0
Time [ms]
300

Poly as a cascade



Provide a unique number for this poly.



Various delays/defers to be really sure all send receive contexts have been set up.

Uniqe ID in.
(Unique not to the poly~instance BUT to the whole poly~.)

Creating a send/receive context specific for this poly~ but common to all instances.

Get total number of voices

See if this is the last instance

Setting up a send and receive context. Unique to this poly~, sending only to this poly's next instance.

Audio output to routing.

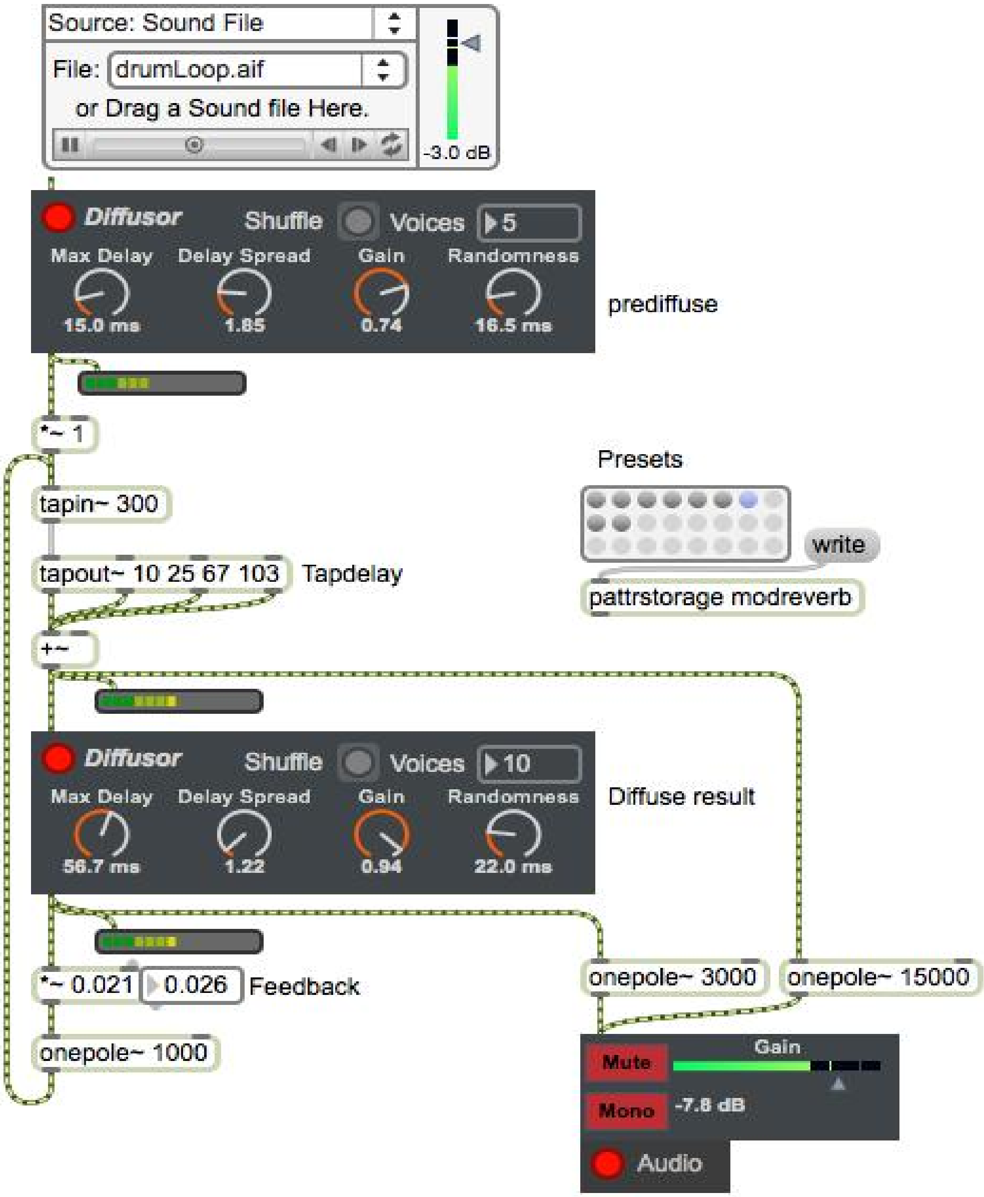
Input to Chain. Only goes to the first instance.

Sending this intaces Output to the next Instance.

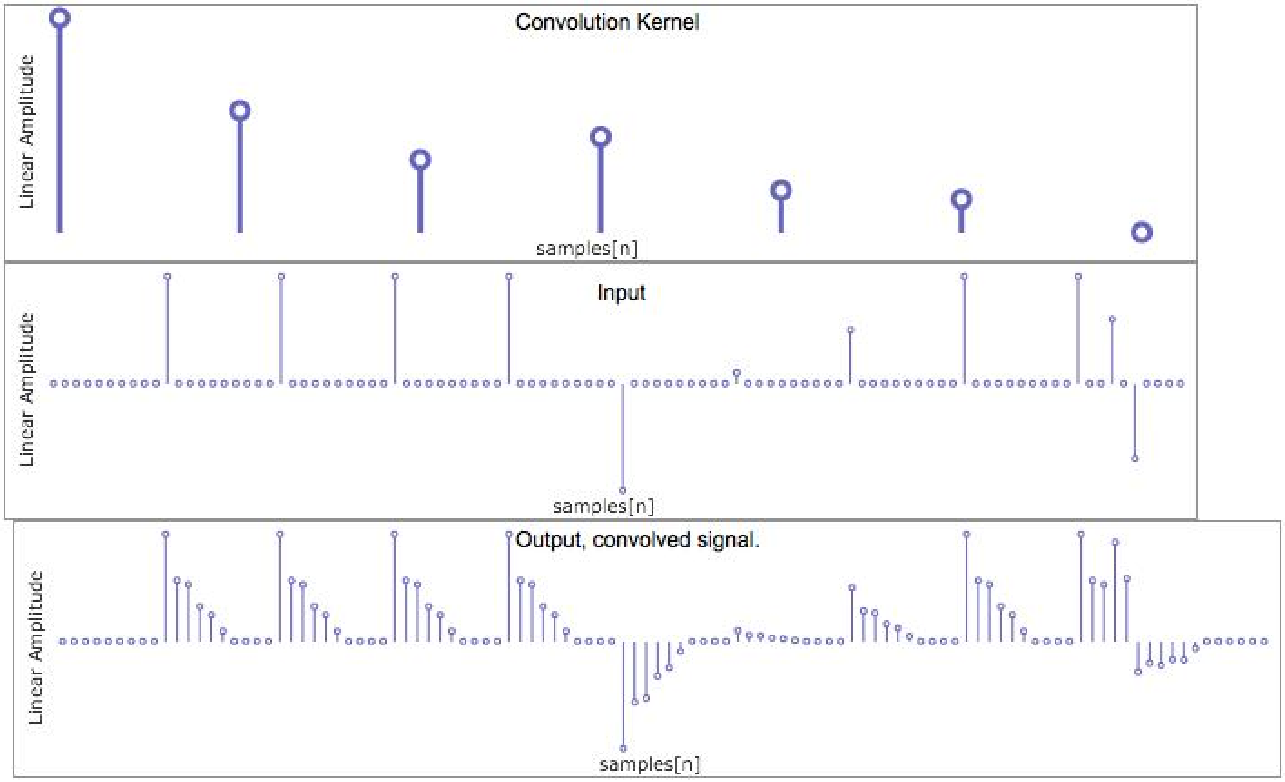
Receiving previous Instances Output

Chain Output. Connected only to the last Instance.

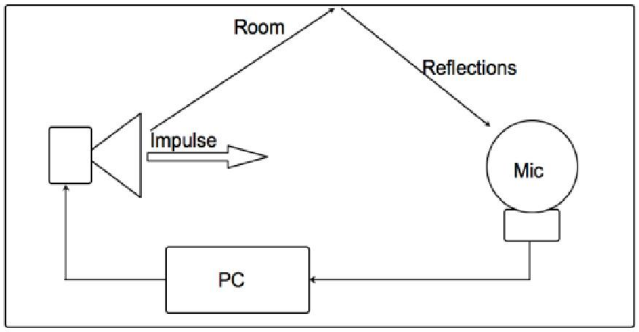
From Routing to this instances Audio Input


Source: Sound File
File: drumLoop.aif
or Drag a Sound file Here.
-3.0 dB
Diffusor
Shuffle
Voices 5
Max Delay 15.0 ms
Delay Spread 1.85
Gain 0.74
Randomness 16.5 ms
prediffuse
*~ 1
Presets
tapin~ 300
write
tapout~ 10 25 67 103
Tapdelay
pattrstorage modreverb
+~
Diffusor
Shuffle
Voices 10
Max Delay 56.7 ms
Delay Spread 1.22
Gain 0.94
Randomness 22.0 ms
Diffuse result
*~ 0.021
0.026
Feedback
onepole~ 3000
onepole~ 15000
onepole~ 1000
Mute
Gain
Mono
-7.8 dB
Audio

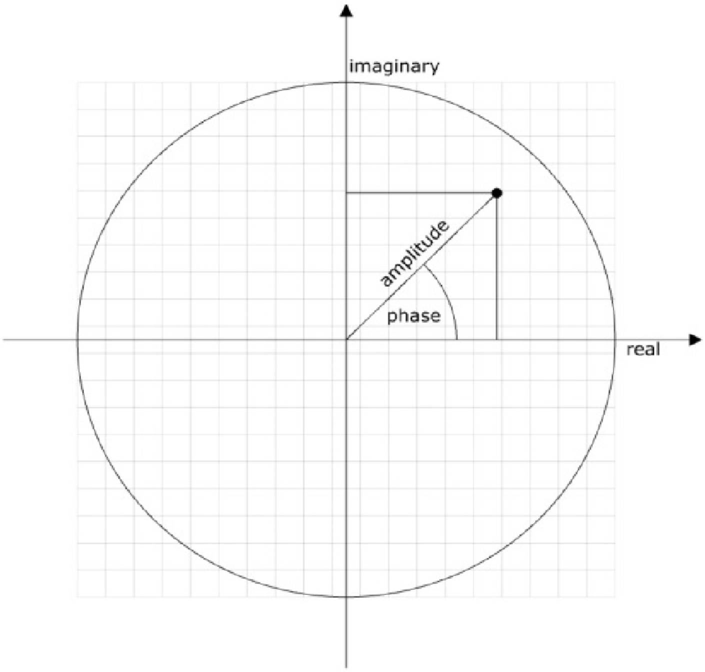
Convolution



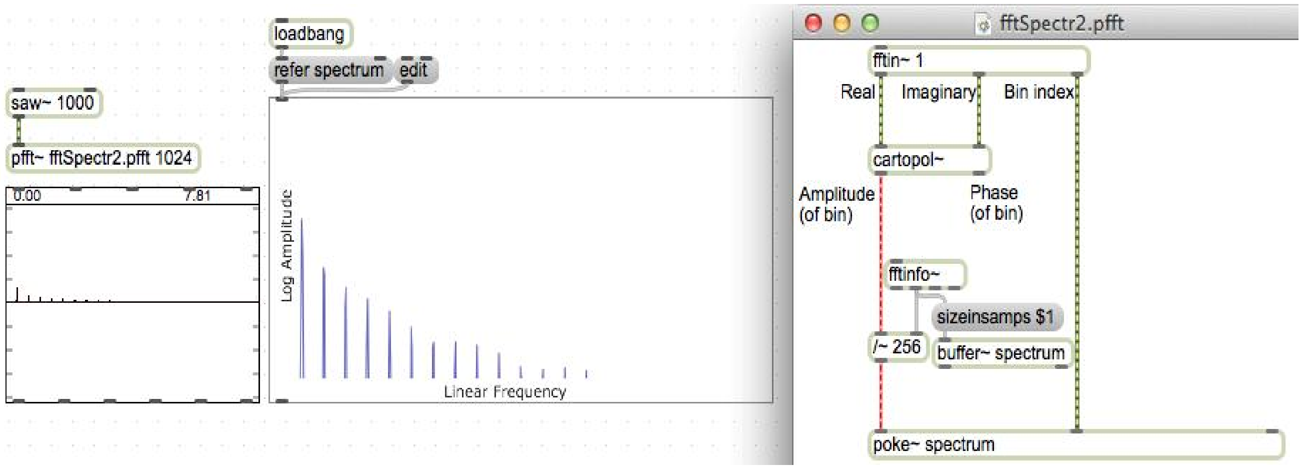
Taking a room's impulse response



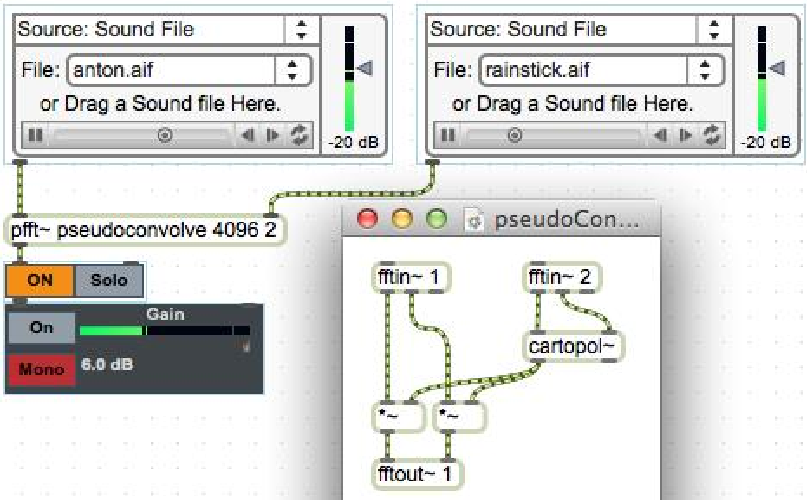
FFT



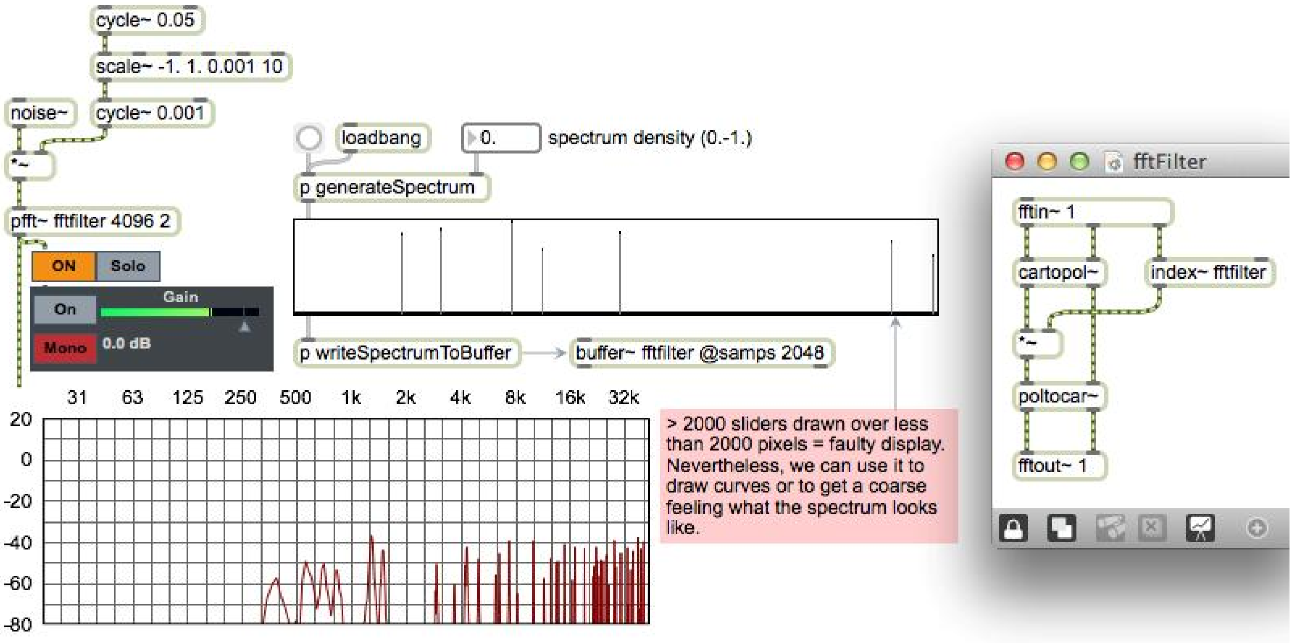
Drawing a signal's spectrum



Simple convolution

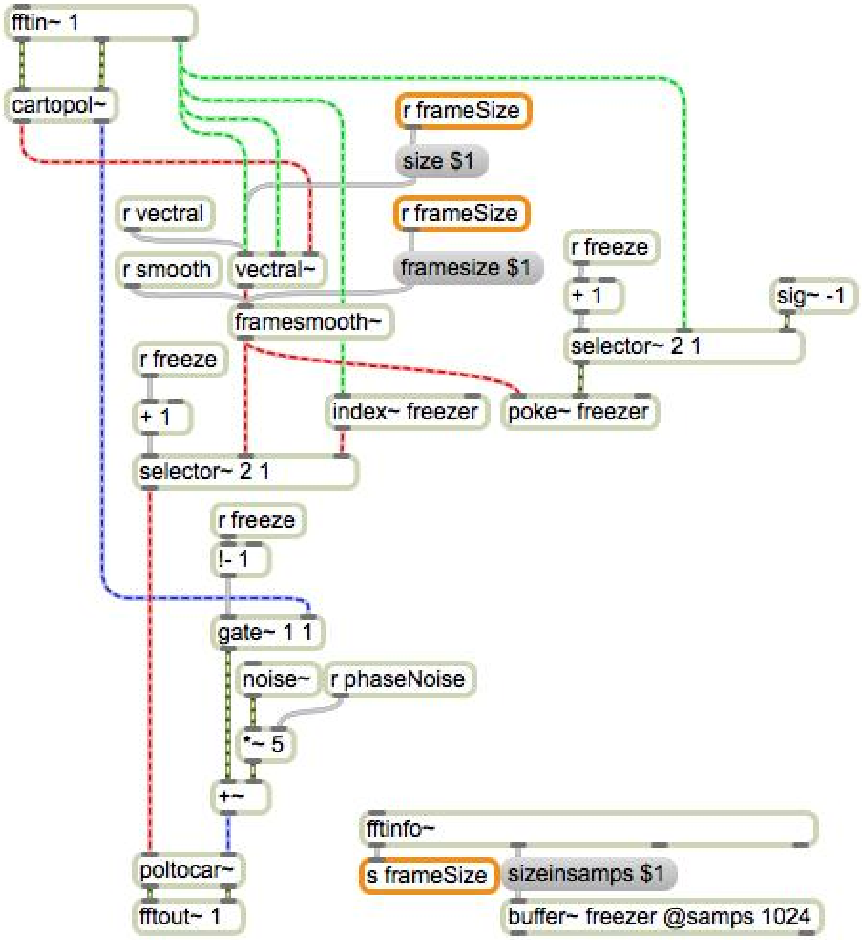


An FFT filter

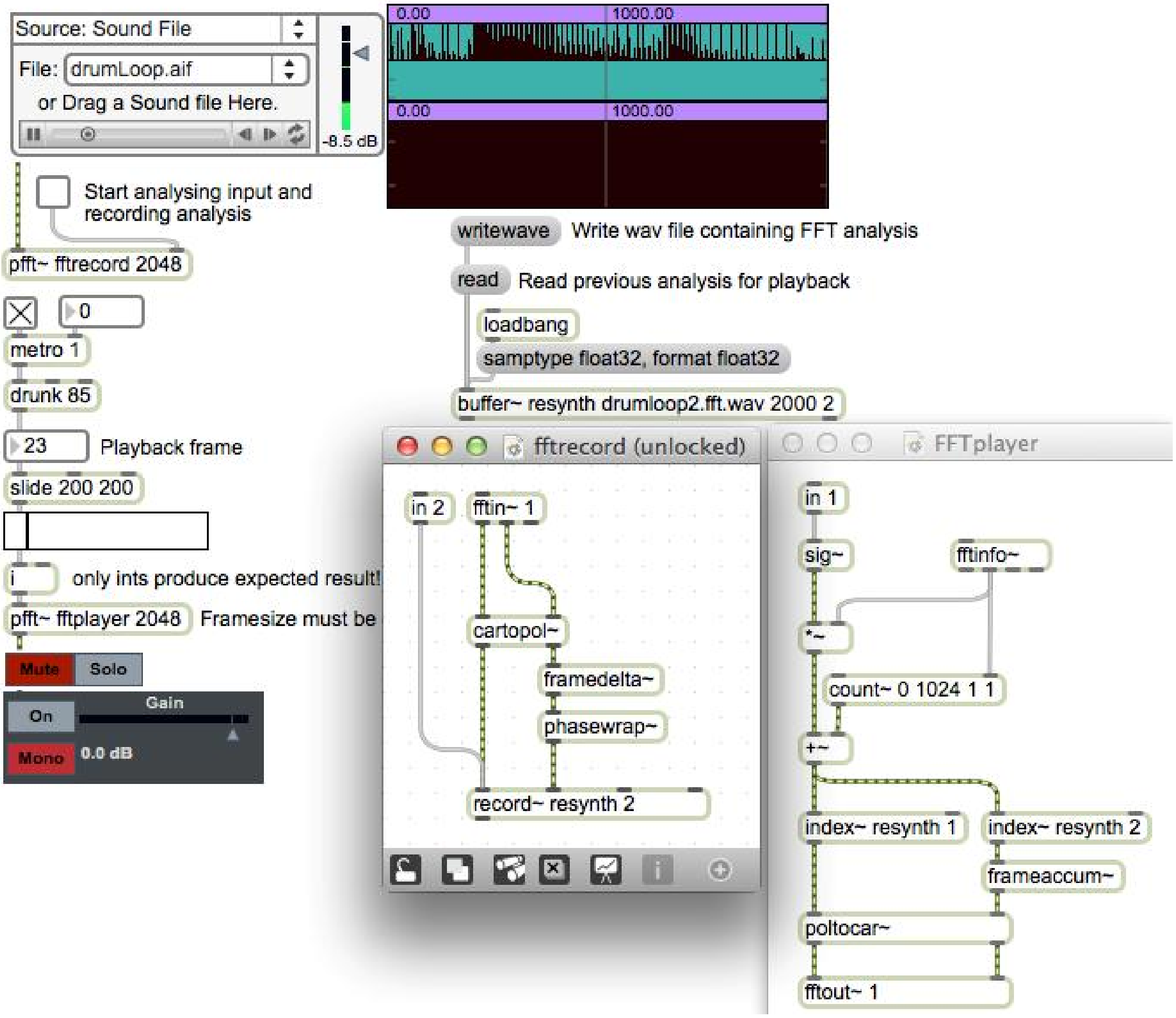


> 2000 sliders drawn over less than 2000 pixels = faulty display. Nevertheless, we can use it to draw curves or to get a coarse feeling what the spectrum looks like.

Spectral reverb and freezing



Recording and playback of FFT data



Start analysing input and recording analysis

Write wav file containing FFT analysis

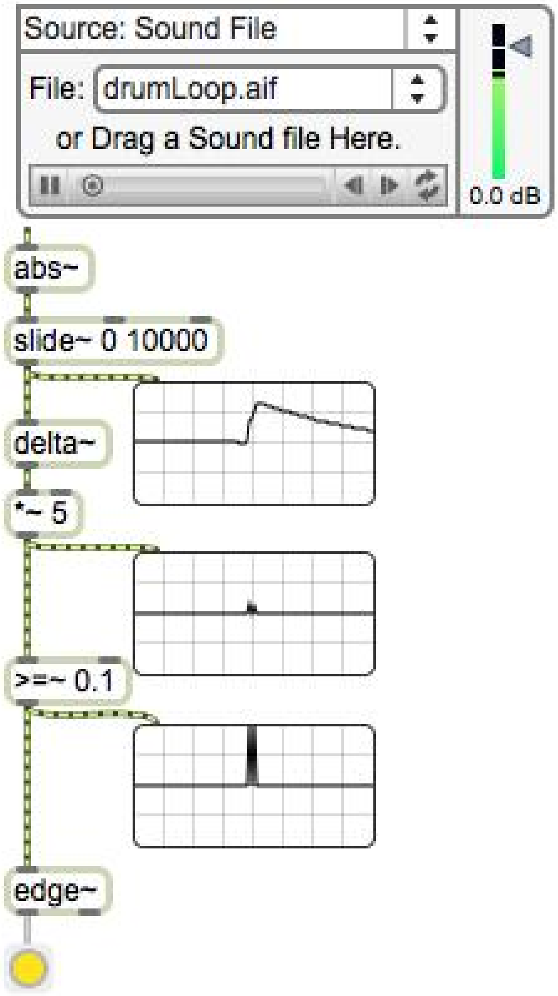
Read previous analysis for playback

Playback frame

only ints produce expected result!

Framesize must be

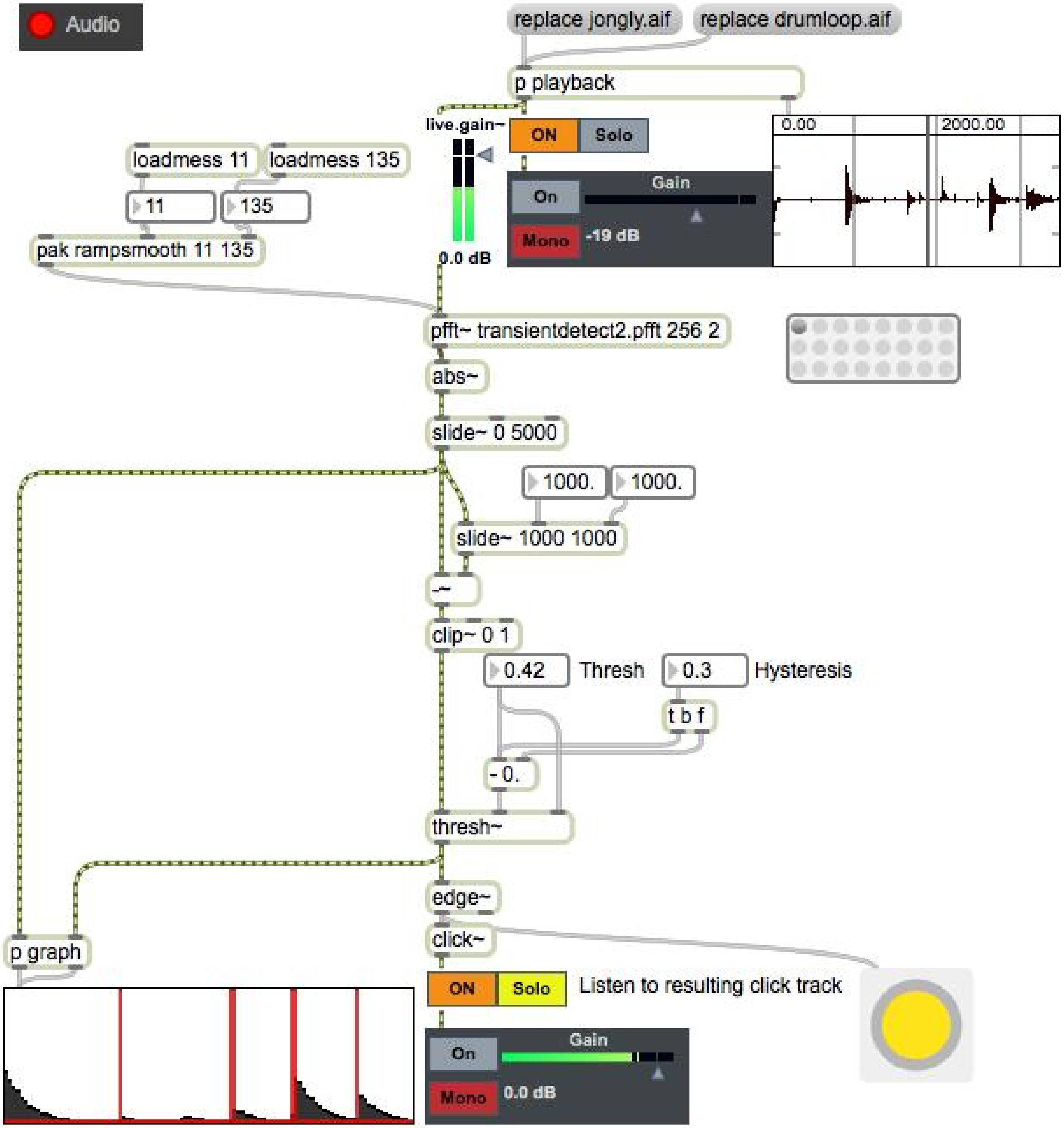
Transient detection

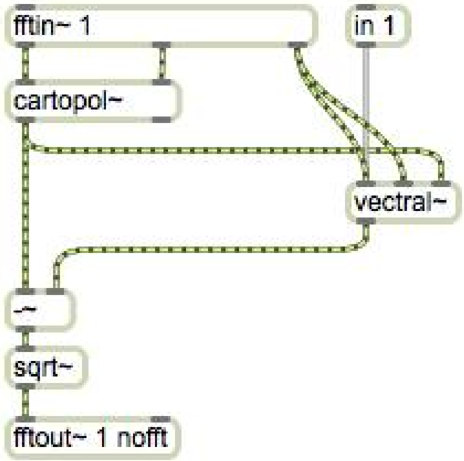


Source: Sound File

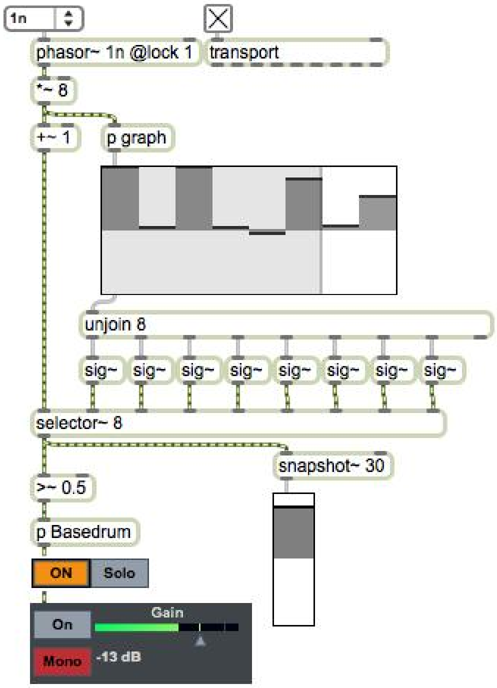
File: drumLoop.aif

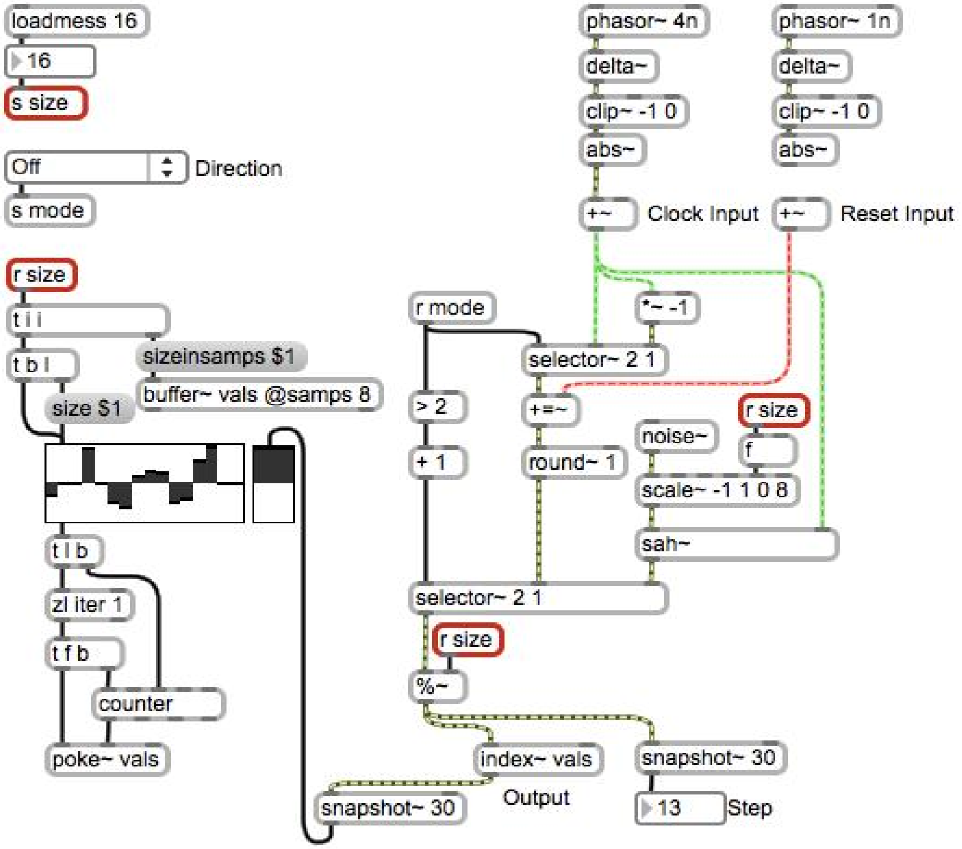
```
abs~
slide~ 0 10000
delta~
*~ 5
>=~ 0.1
edge~
```


Audio
replace jongly.aif
replace drumloop.aif
p playback
live.gain~
ON
Solo
On
Gain
Mono
-19 dB
0.0 dB
0.00
2000.00
loadmess 11
loadmess 135
11
135
pak rampsmooth 11 135
pfft~ transientdetect2.pfft 256 2
abs~
slide~ 0 5000
1000.
1000.
slide~ 1000 1000
-~
clip~ 0 1
0.42
Thresh
0.3
Hysteresis
t b f
- 0.
thresh~
edge~
click~
p graph
ON
Solo
Listen to resulting click track
On
Gain
Mono
0.0 dB



Sample accurate sequencing



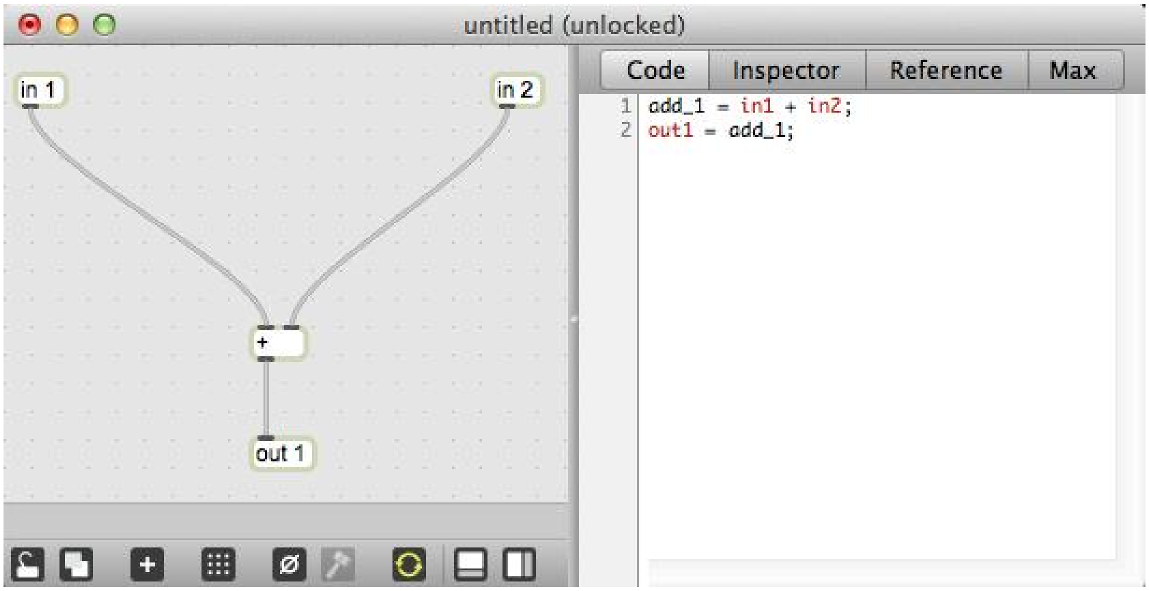

loadmess 16
16
s size
Off
Direction
s mode
r size
t i i
sizeinsamps $1
t b l
buffer~ vals @samps 8
size $1
t l b
zl iter 1
t f b
counter
poke~ vals
phasor~ 4n
delta~
clip~ -1 0
abs~
+~
Clock Input
phasor~ 1n
delta~
clip~ -1 0
abs~
+~
Reset Input
r mode
*~ -1
selector~ 2 1
> 2
+=~
r size
noise~
f
+ 1
round~ 1
scale~ -1 1 0 8
sah~
selector~ 2 1
r size
%~
index~ vals
Output
snapshot~ 30
snapshot~ 30
13
Step

6

Low-level Patching in Gen

Introducing Gen

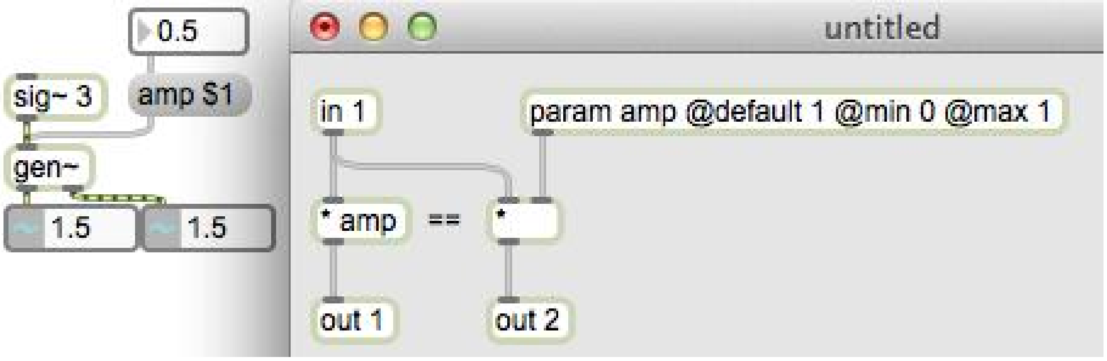
The Gen workspace



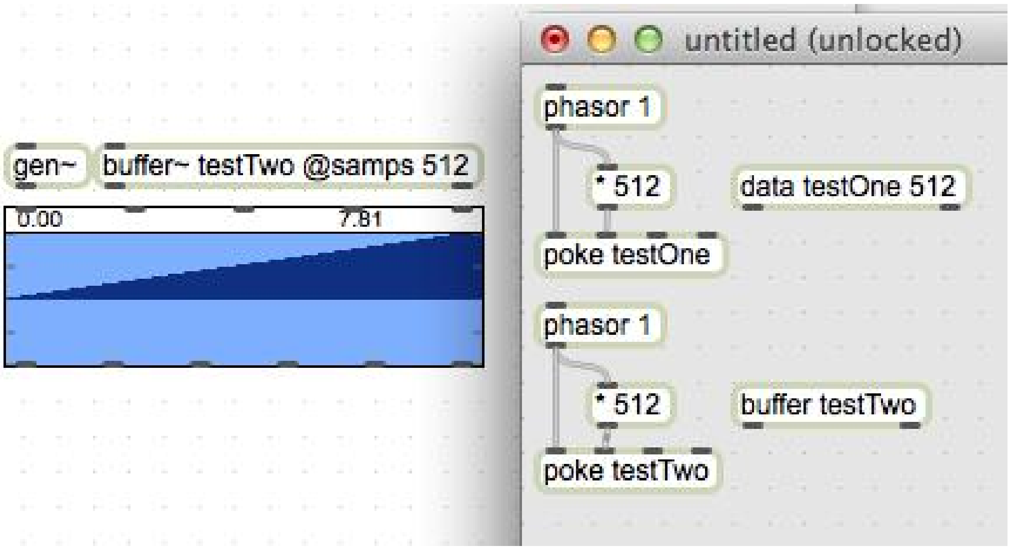
```
add_1 = in1 + in2;
out1 = add_1;
```

Exploring the differences between Max and Gen

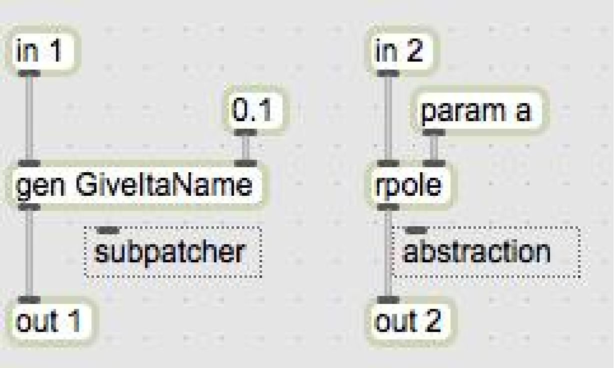
Parameters through param

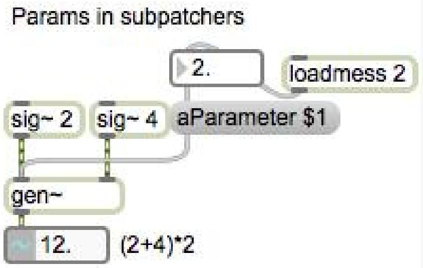


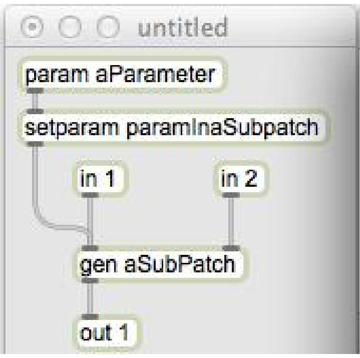
Buffers and data

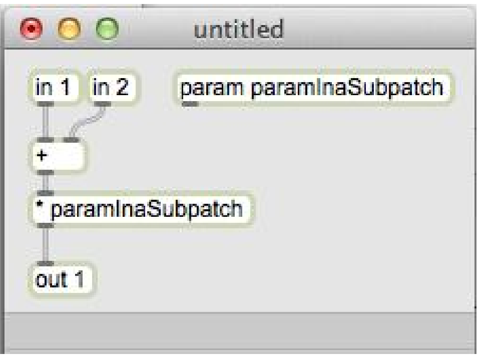


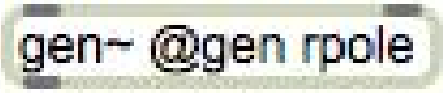
Subpatchers and abstraction inside Gen



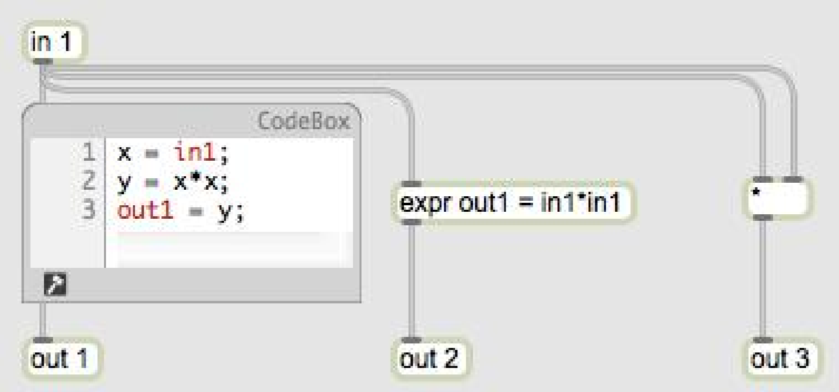




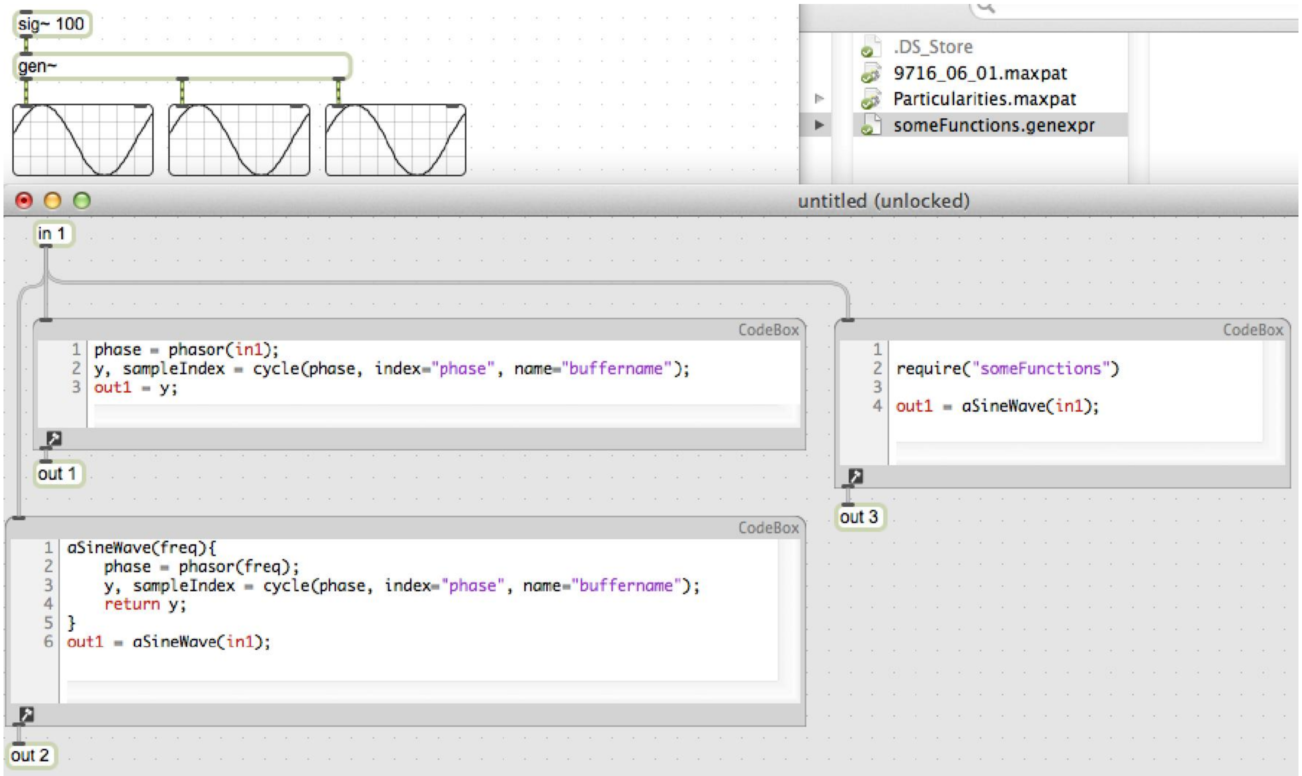




Genexpr and the CodeBox



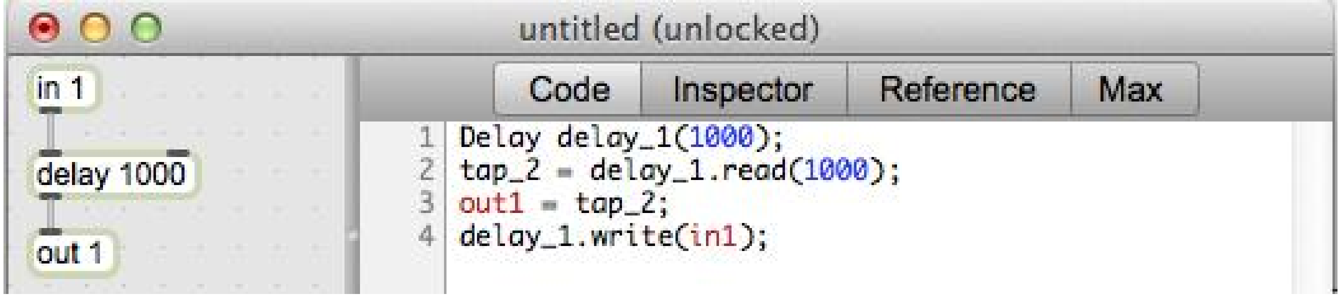
```
x = in1;
y = x*x;
out1 = y;
```



```
phase = phasor(in1);
y, sampleIndex = cycle(phase, index="phase", name="buffername");
out1 = y;
```

```

require("someFunctions")

out1 = aSineWave(in1);
```

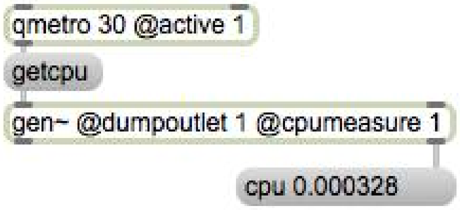
```
aSineWave(freq){
    phase = phasor(freq);
    y, sampleIndex = cycle(phase, index="phase", name="buffername");
    return y;
}
out1 = aSineWave(in1);
```



```
in 1
delay 1000
out 1
```

```
Delay delay_1(1000);
tap_2 = delay_1.read(1000);
out1 = tap_2;
delay_1.write(in1);
```

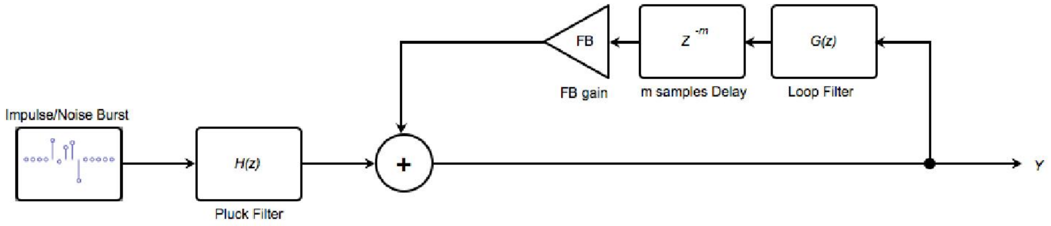
Efficiency

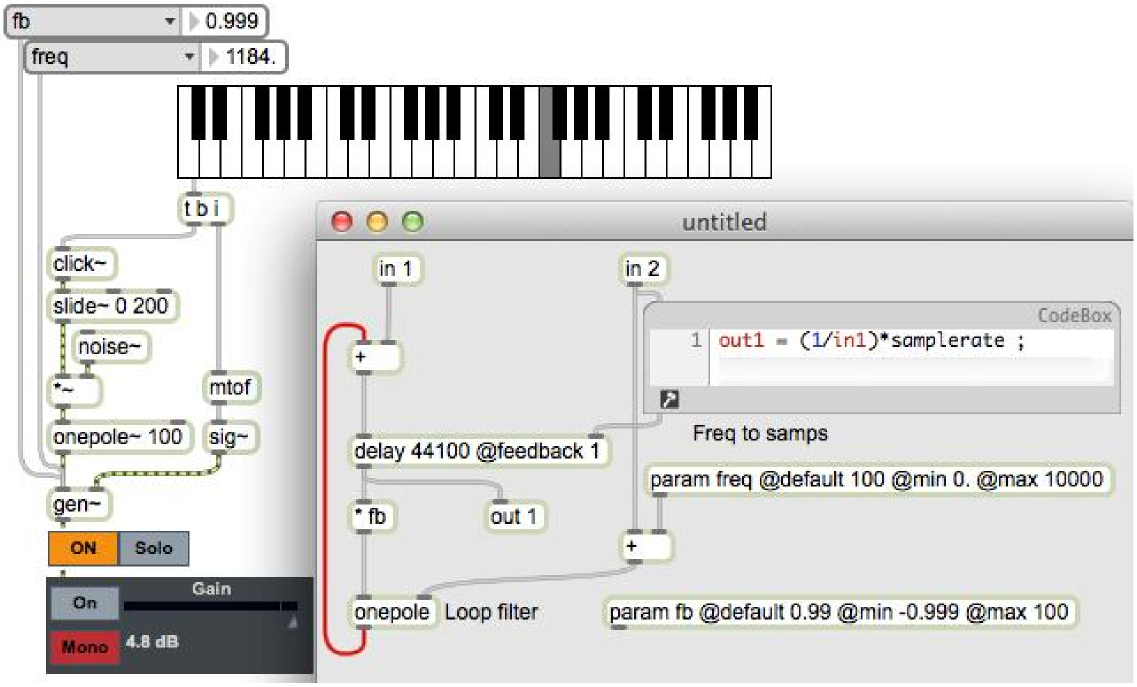


```
qmetro 30 @active 1
getcpu
gen~ @dumpoutlet 1 @cpumeasure 1
cpu 0.000328
```

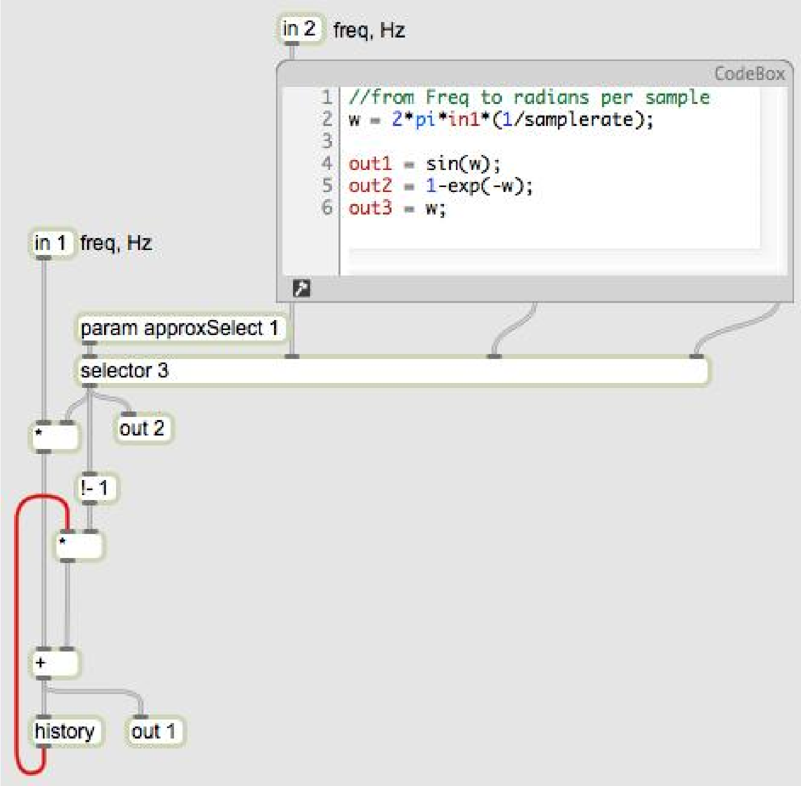
Examples

Karplus-Strong synthesis

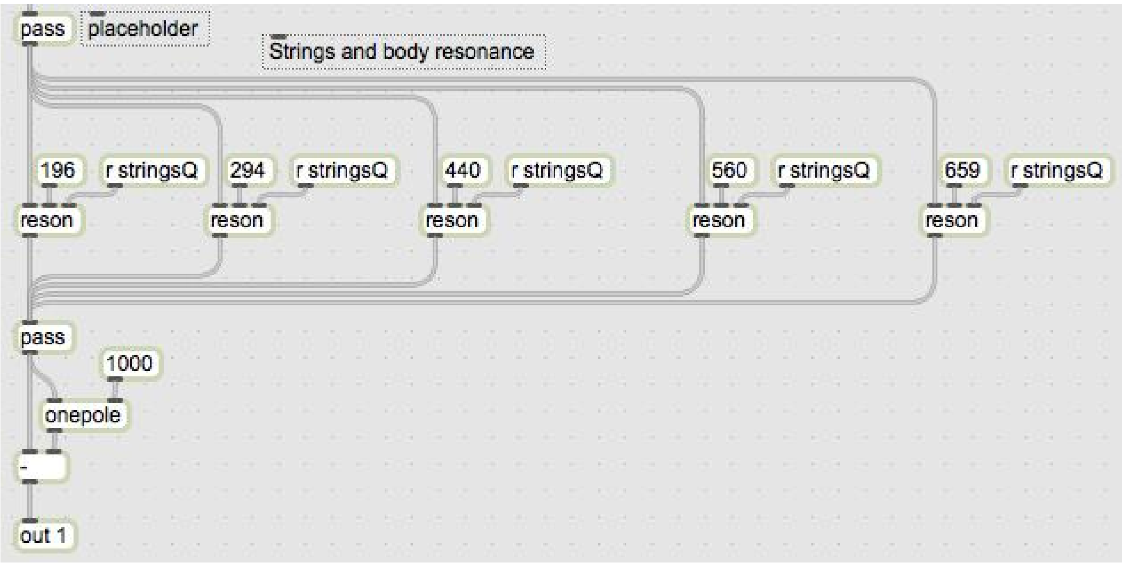




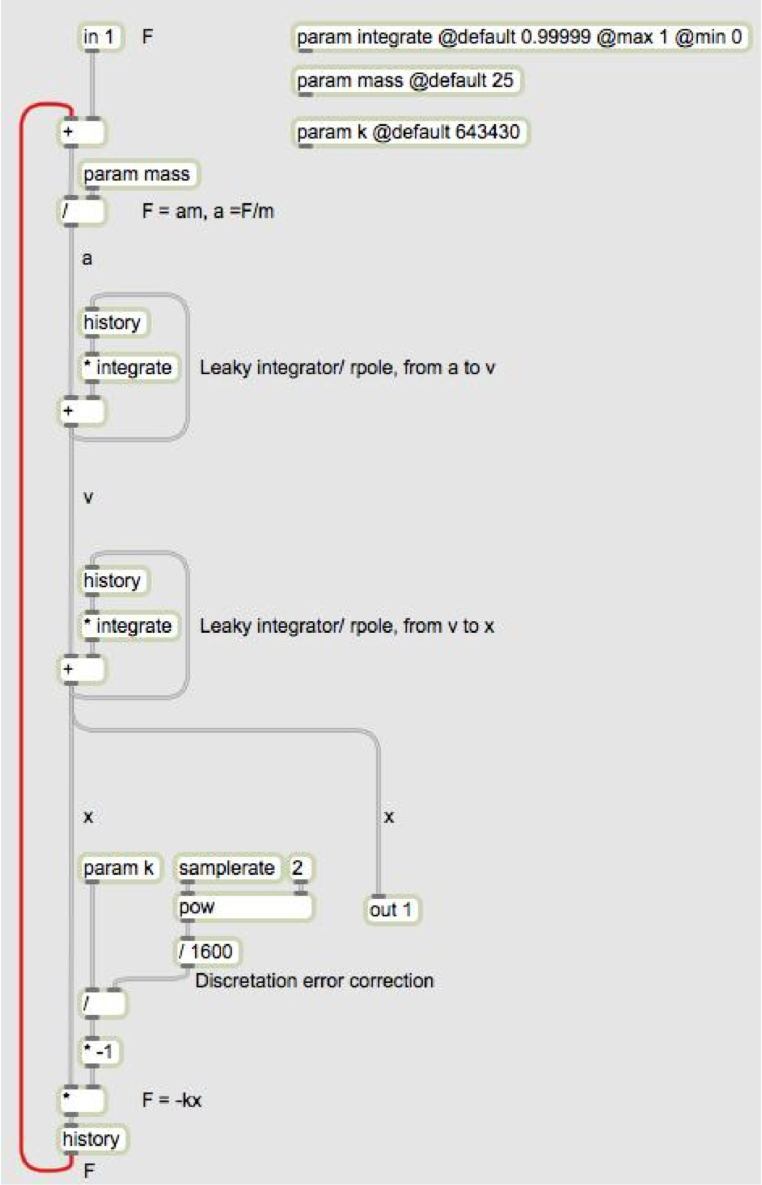
```
out1 = (1/in1)*samplerate ;
```



```
//from Freq to radians per sample
w = 2*pi*in1*(1/samplerate);

out1 = sin(w);
out2 = 1-exp(-w);
out3 = w;
```

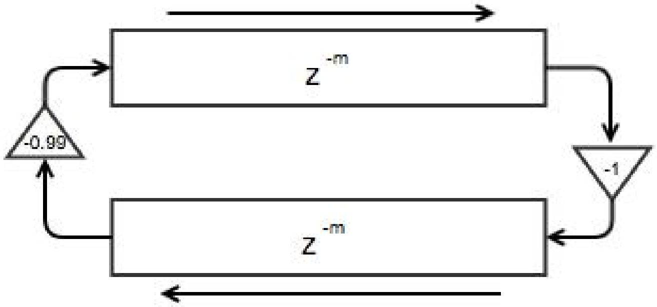


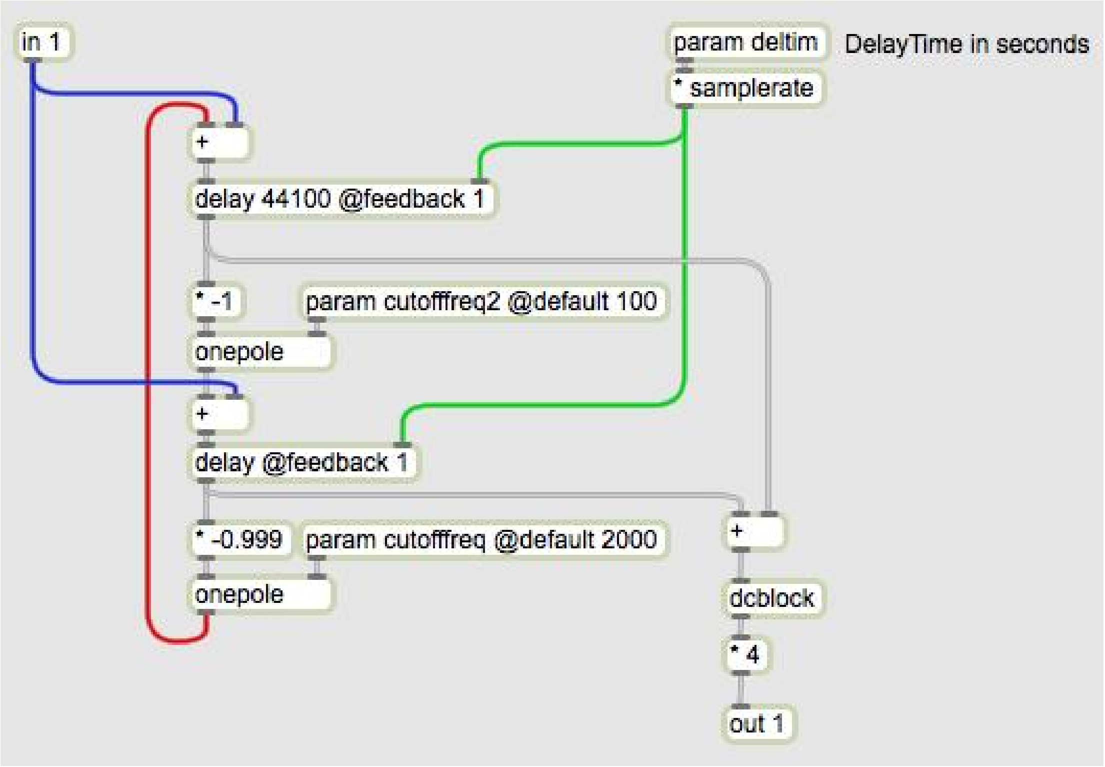
A mass-spring system

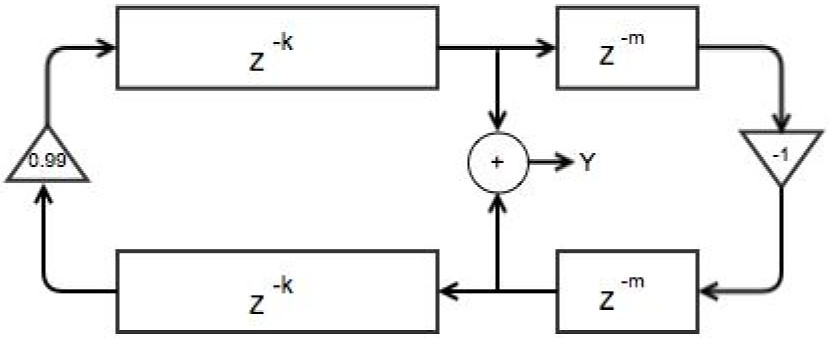


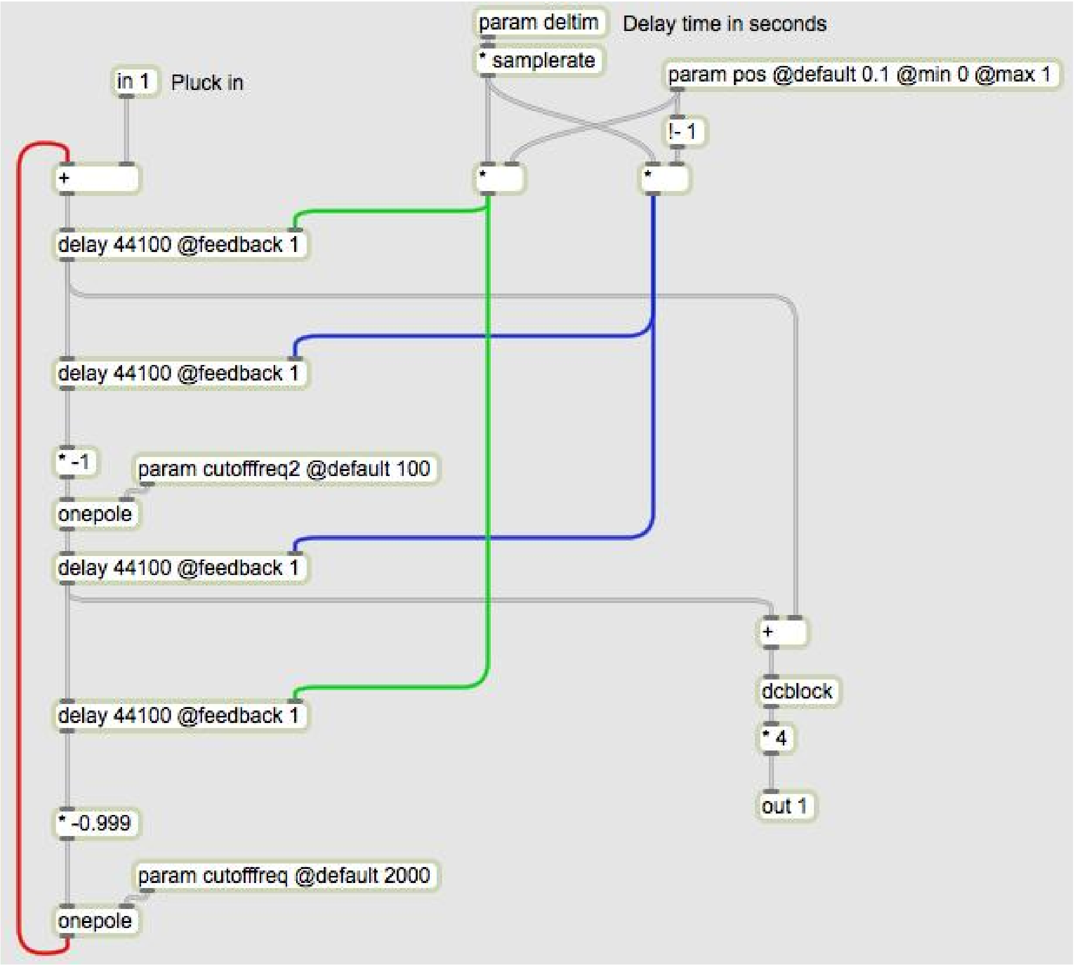
```
in 1   F                          param integrate @default 0.99999 @max 1 @min 0
                                  param mass @default 25
+                                 param k @default 643430
param mass
/      F = am, a =F/m
a
history
* integrate   Leaky integrator/ rpole, from a to v
+
v
history
* integrate   Leaky integrator/ rpole, from v to x
+
x                                        x
param k   samplerate   2
          pow                           out 1
          / 1600
          Discretation error correction
/
* -1
*      F = -kx
history
F
```

Waveguides and scattering junctions

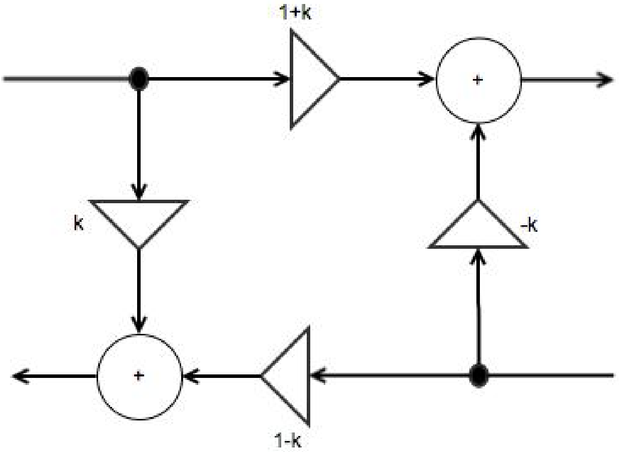


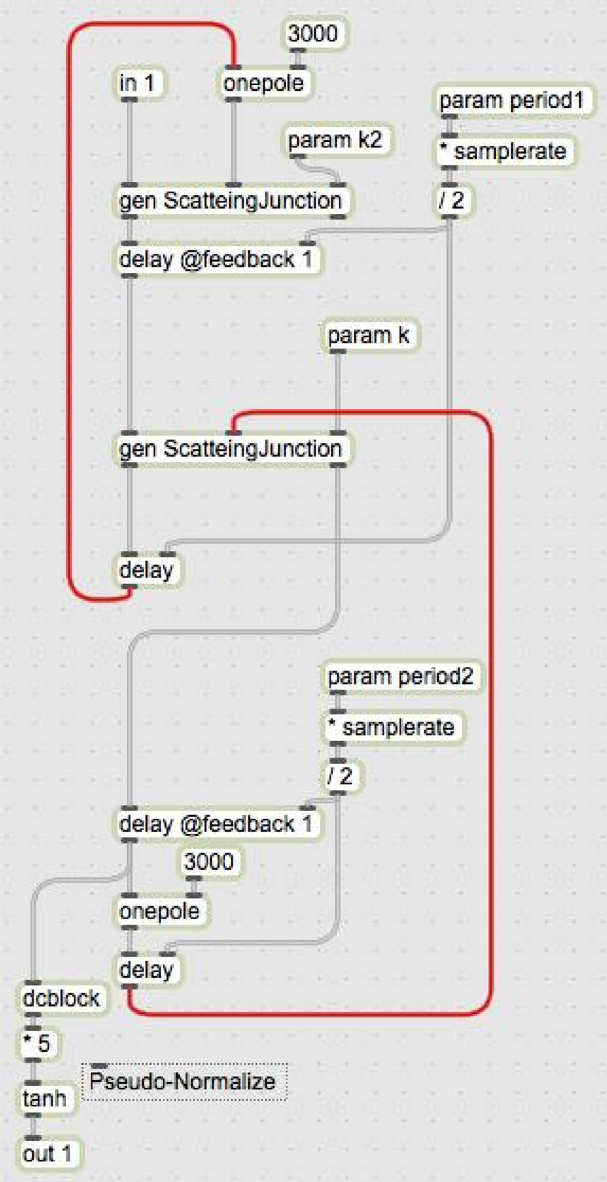






```
param deltim        Delay time in seconds
* samplerate
param pos @default 0.1 @min 0 @max 1
in 1   Pluck in
!- 1
+
*
*
delay 44100 @feedback 1
delay 44100 @feedback 1
* -1
param cutofffreq2 @default 100
onepole
delay 44100 @feedback 1
+
dcblock
delay 44100 @feedback 1
* 4
out 1
* -0.999
param cutofffreq @default 2000
onepole
```

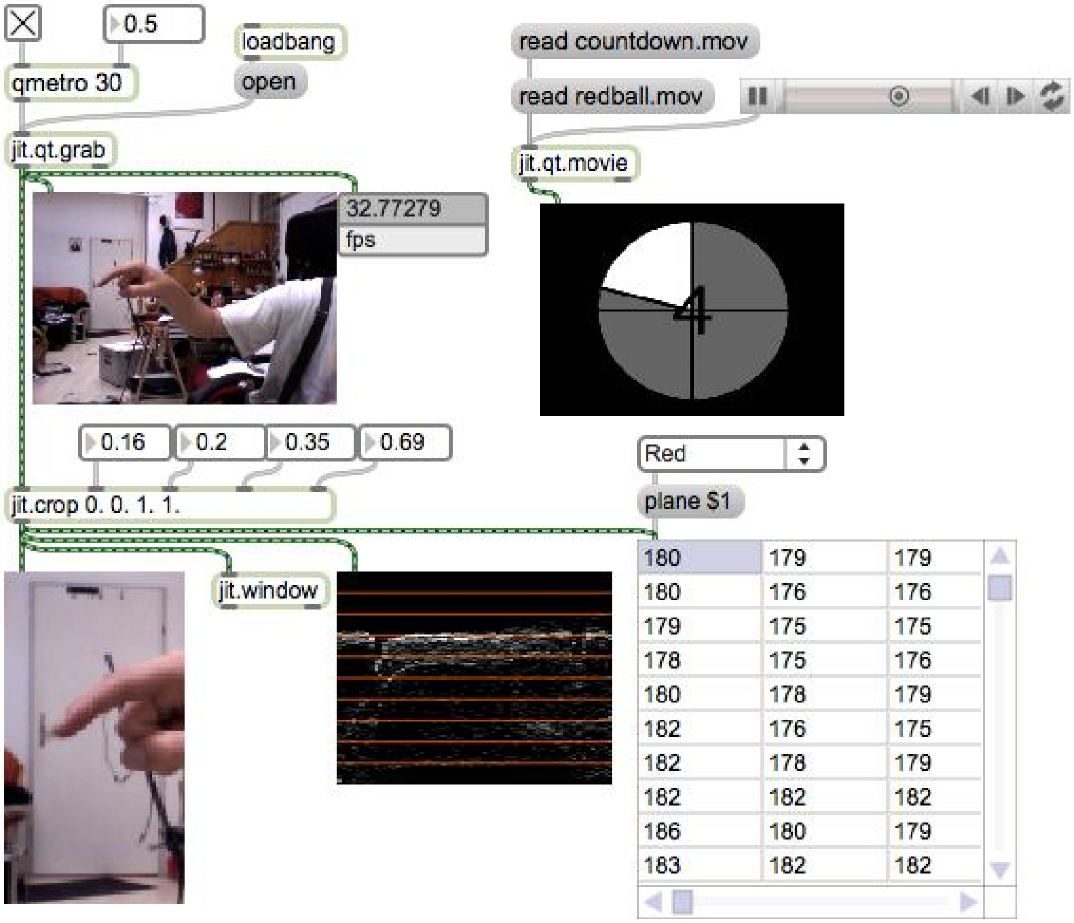

1+k
+
k
-k
+
1-k


3000
in 1
onepole
param period1
param k2
* samplerate
gen ScatteingJunction
/ 2
delay @feedback 1
param k
gen ScatteingJunction
delay
param period2
* samplerate
/ 2
delay @feedback 1
3000
onepole
delay
dcblock
* 5
Pseudo-Normalize
tanh
out 1

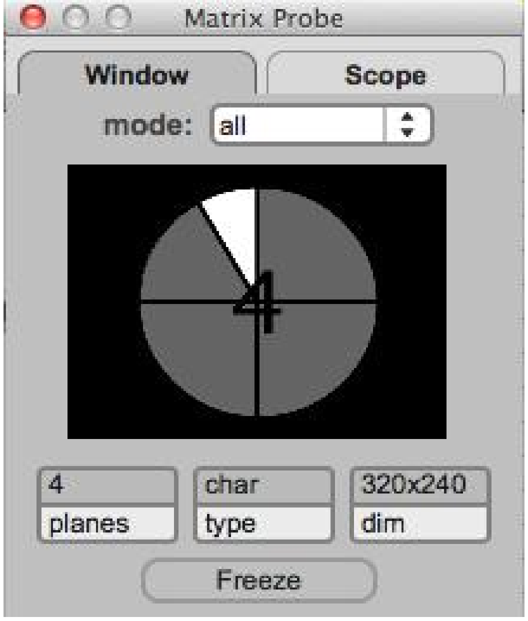
7

Video in Max/Jitter

Inputting and outputting Jitter data



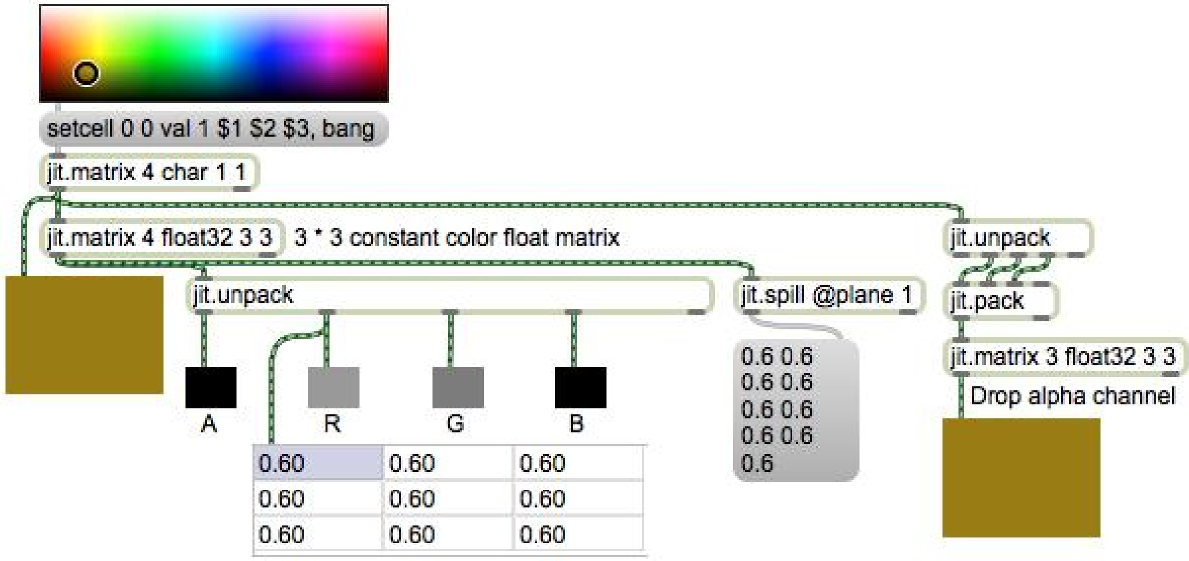
180	179	179
180	176	176
179	175	175
178	175	176
180	178	179
182	176	175
182	178	179
182	182	182
186	180	179
183	182	182



mode: all

4	char	320x240
planes	type	dim

Getting started with the Jitter matrix

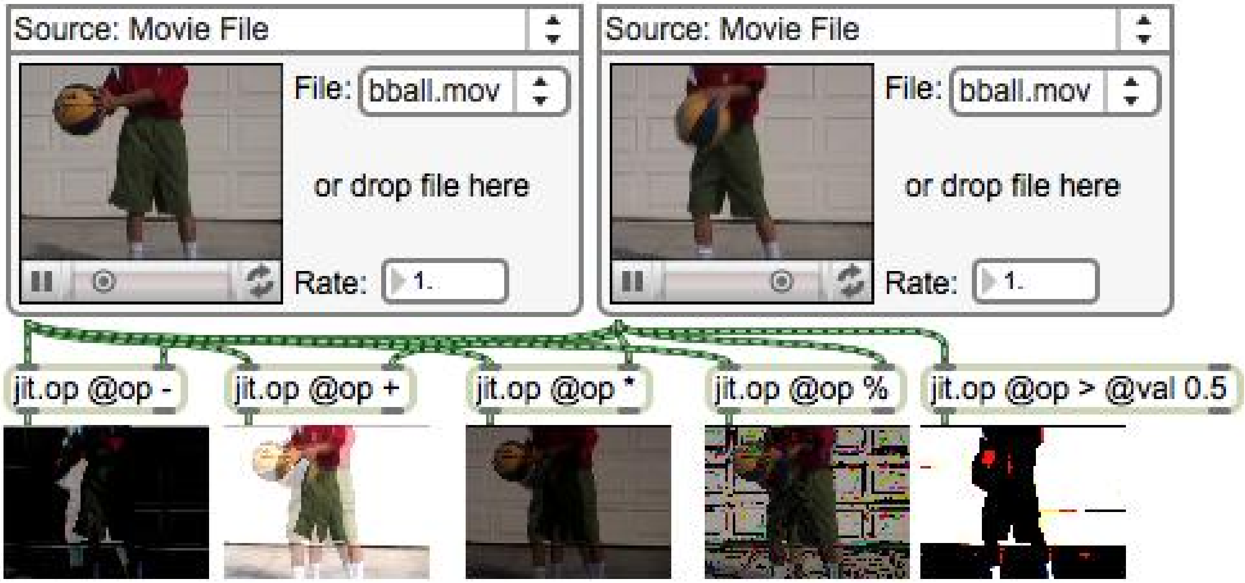


```
setcell 0 0 val 1 $1 $2 $3, bang
jit.matrix 4 char 1 1
jit.matrix 4 float32 3 3    3 * 3 constant color float matrix
jit.unpack
jit.spill @plane 1
jit.unpack
jit.pack
jit.matrix 3 float32 3 3
Drop alpha channel
```

```
0.6 0.6
0.6 0.6
0.6 0.6
0.6 0.6
0.6
```

0.60	0.60	0.60
0.60	0.60	0.60
0.60	0.60	0.60

Matrix processing



Source: Movie File

File: bball.mov

or drop file here

Rate: 1.

Source: Movie File

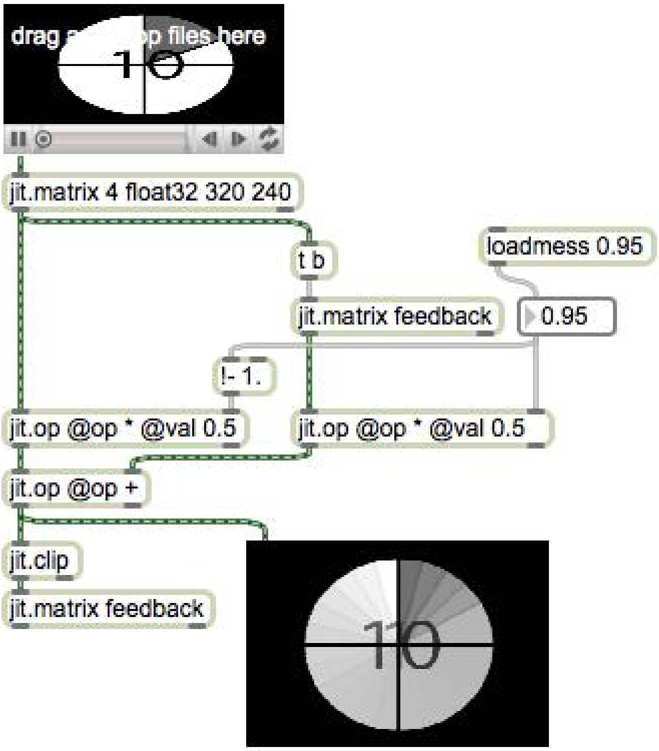
File: bball.mov

or drop file here

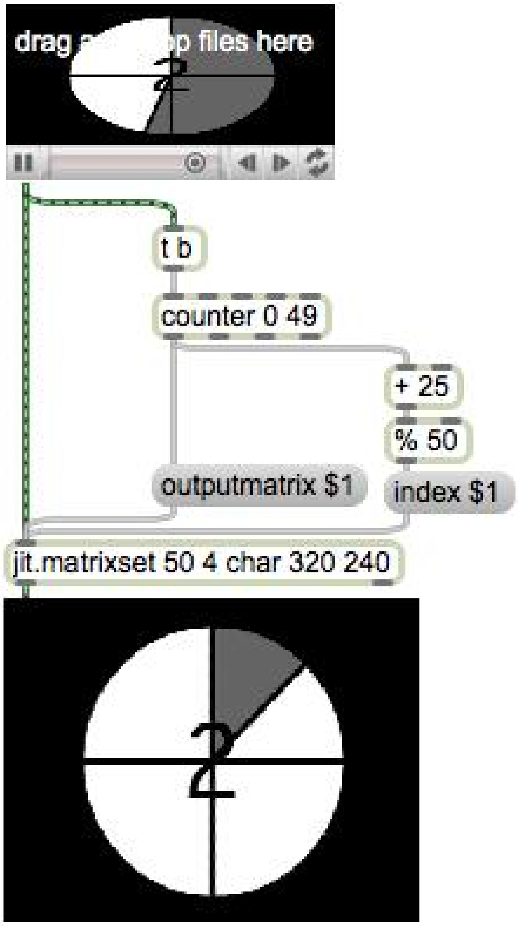
Rate: 1.

```
jit.op @op -
jit.op @op +
jit.op @op *
jit.op @op %
jit.op @op > @val 0.5
```

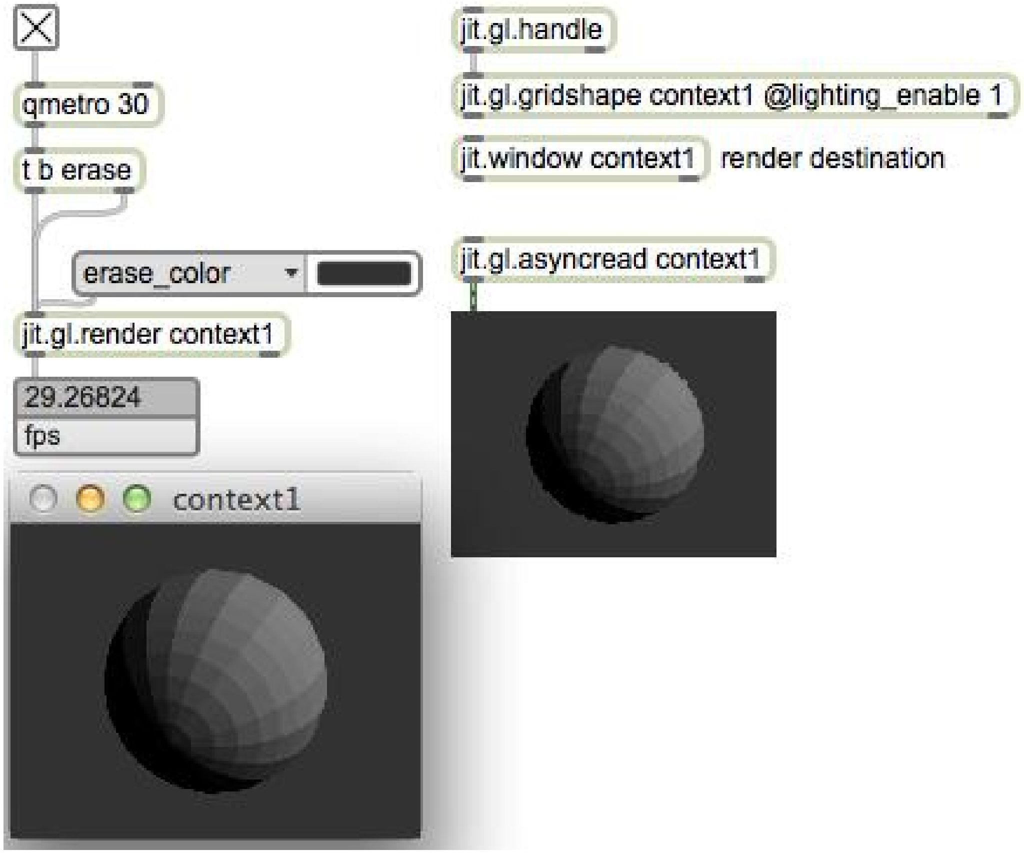
Feedback and delay



```
jit.matrix 4 float32 320 240
t b
loadmess 0.95
jit.matrix feedback
0.95
!- 1.
jit.op @op * @val 0.5
jit.op @op * @val 0.5
jit.op @op +
jit.clip
jit.matrix feedback
```


drag and drop files here
t b
counter 0 49
+ 25
% 50
outputmatrix $1
index $1
jit.matrixset 50 4 char 320 240
2

Using OpenGL in Jitter



qmetro 30

t b erase

erase_color

jit.gl.render context1

29.26824

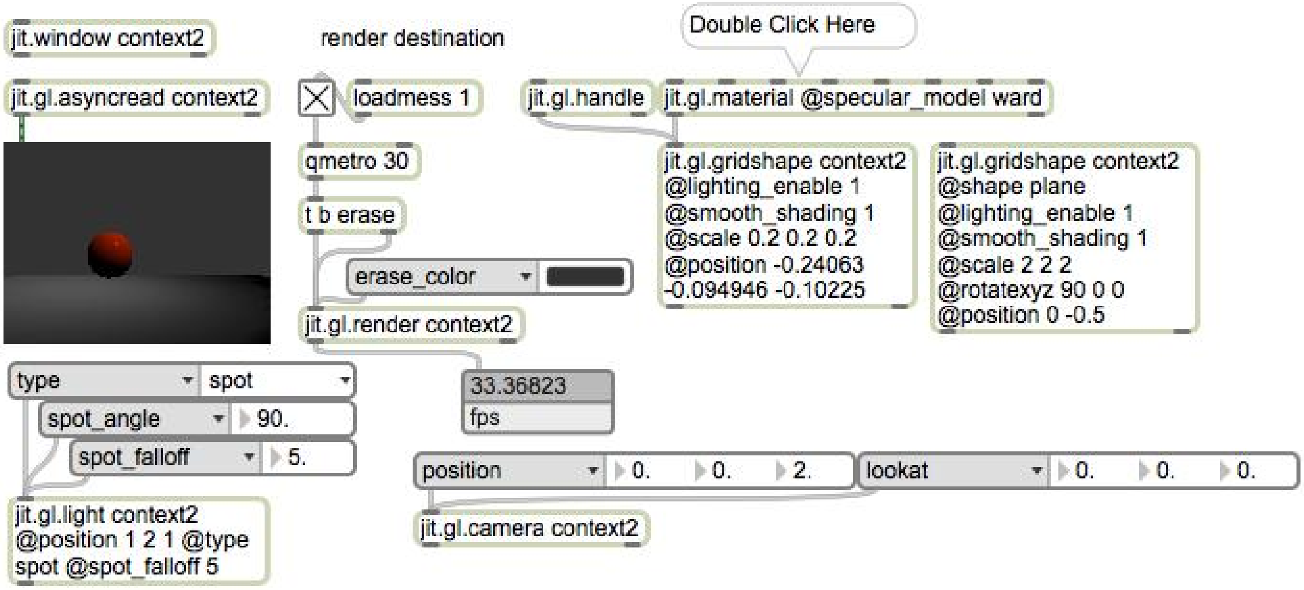
fps

jit.gl.handle

jit.gl.gridshape context1 @lighting_enable 1

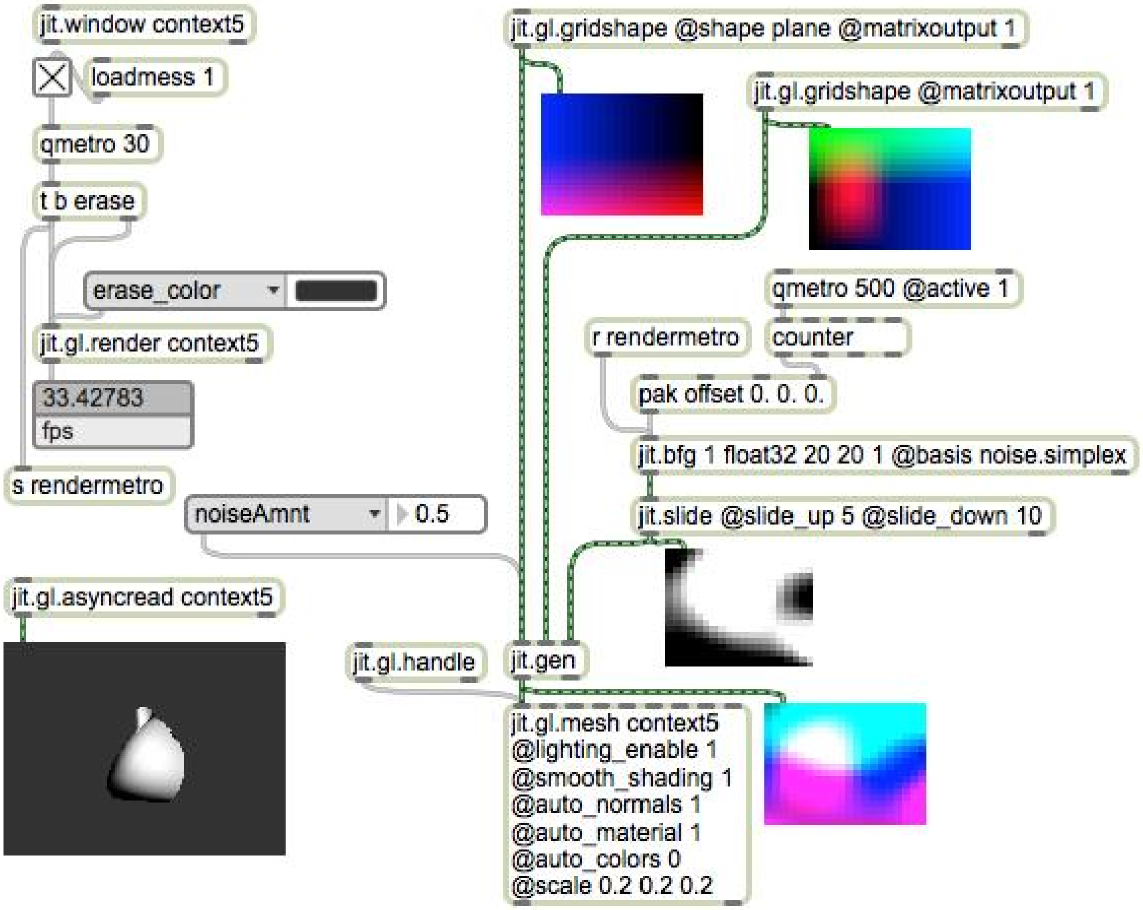
jit.window context1 render destination

jit.gl.asyncread context1



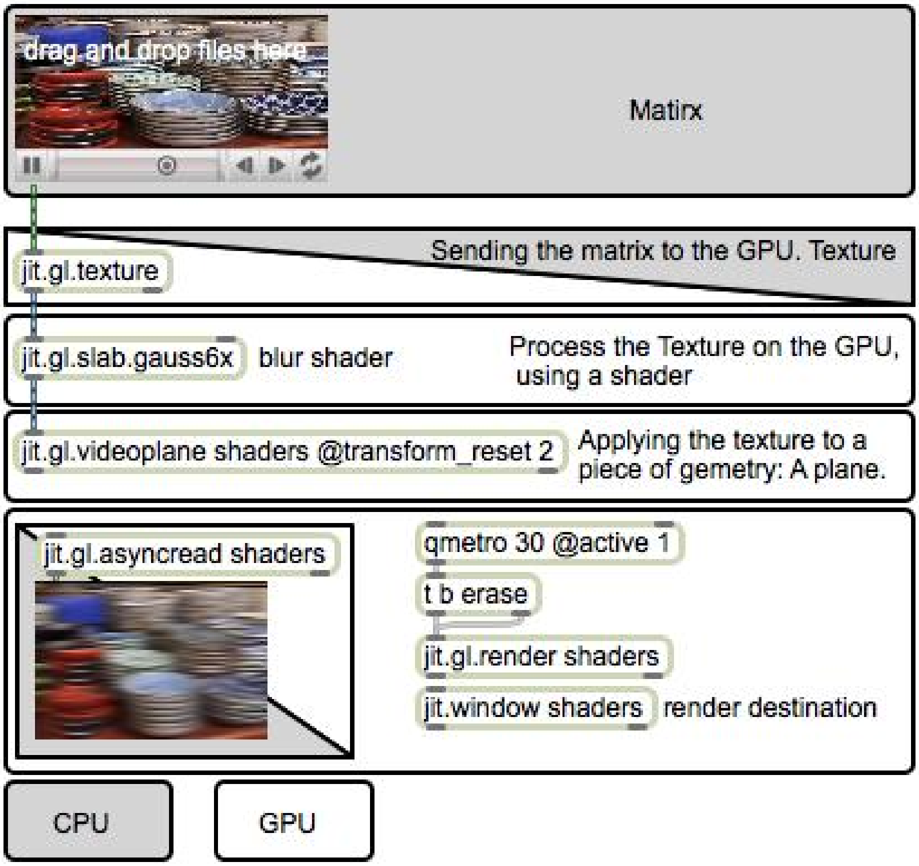
```
jit.window context2
jit.gl.asyncread context2
loadmess 1
qmetro 30
t b erase
erase_color
jit.gl.render context2
jit.gl.handle
jit.gl.material @specular_model ward
jit.gl.gridshape context2
@lighting_enable 1
@smooth_shading 1
@scale 0.2 0.2 0.2
@position -0.24063
-0.094946 -0.10225
jit.gl.gridshape context2
@shape plane
@lighting_enable 1
@smooth_shading 1
@scale 2 2 2
@rotatexyz 90 0 0
@position 0 -0.5
type spot
spot_angle 90.
spot_falloff 5.
jit.gl.light context2
@position 1 2 1 @type
spot @spot_falloff 5
position 0. 0. 2.
lookat 0. 0. 0.
jit.gl.camera context2
```

Geometry manipulation



```
jit.window context5
loadmess 1
qmetro 30
t b erase
erase_color
jit.gl.render context5
33.42783
fps
s rendermetro
noiseAmnt 0.5
jit.gl.asyncread context5
jit.gl.gridshape @shape plane @matrixoutput 1
jit.gl.gridshape @matrixoutput 1
qmetro 500 @active 1
r rendermetro
counter
pak offset 0. 0. 0.
jit.bfg 1 float32 20 20 1 @basis noise.simplex
jit.slide @slide_up 5 @slide_down 10
jit.gl.handle
jit.gen
jit.gl.mesh context5
@lighting_enable 1
@smooth_shading 1
@auto_normals 1
@auto_material 1
@auto_colors 0
@scale 0.2 0.2 0.2
```

Shaders and FX



Matirx

jit.gl.texture

Sending the matrix to the GPU. Texture

jit.gl.slab.gauss6x

blur shader

Process the Texture on the GPU, using a shader

jit.gl.videoplane shaders @transform_reset 2

Applying the texture to a piece of gemetry: A plane.

jit.gl.asyncread shaders

qmetro 30 @active 1

t b erase

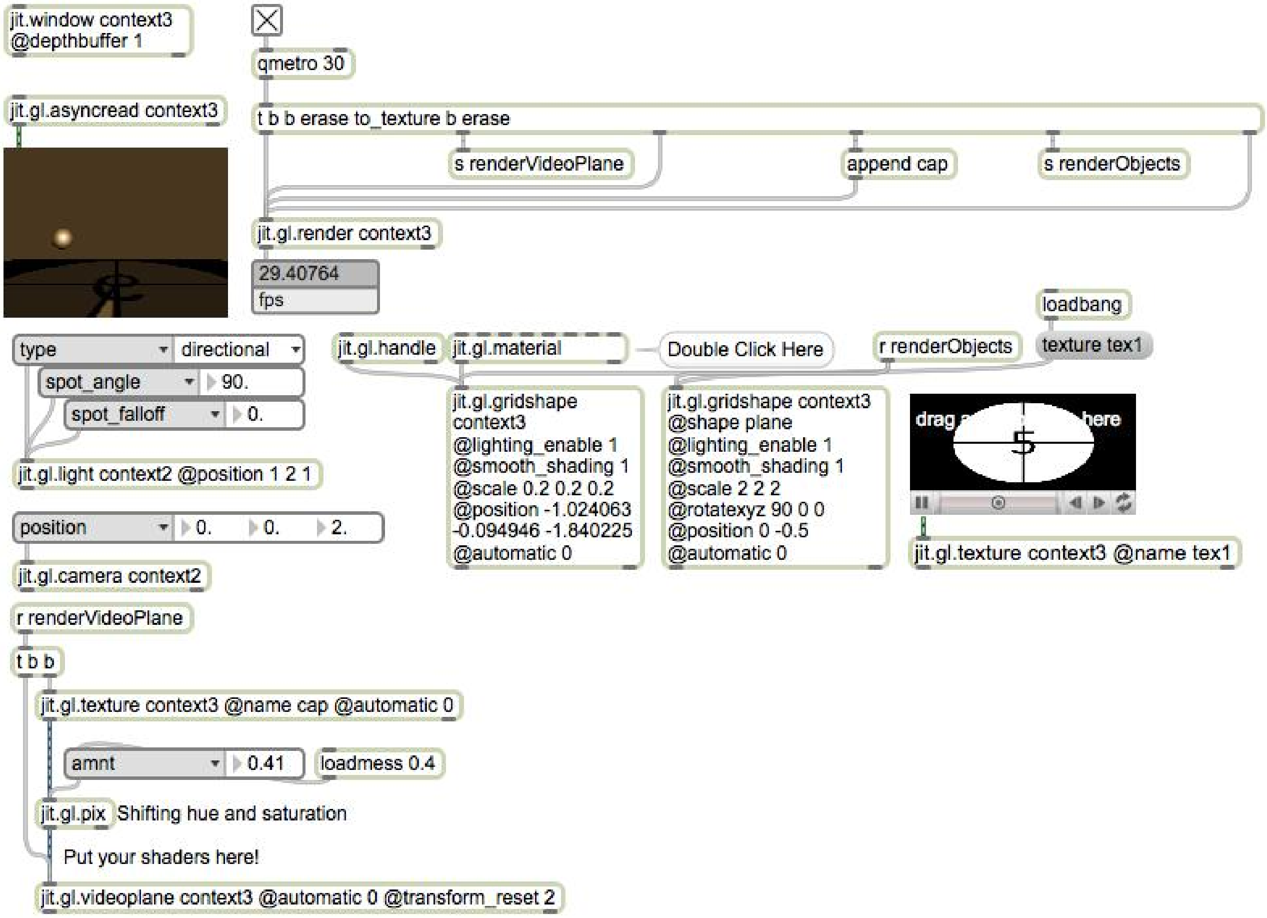
jit.gl.render shaders

jit.window shaders

render destination

CPU

GPU



jit.window context3 @depthbuffer 1

qmetro 30

t b b erase to_texture b erase

s renderVideoPlane

append cap

s renderObjects

jit.gl.asyncread context3

jit.gl.render context3

29.40764

fps

loadbang

type directional

spot_angle 90.

spot_falloff 0.

jit.gl.light context2 @position 1 2 1

jit.gl.handle

jit.gl.material

Double Click Here

r renderObjects

texture tex1

jit.gl.gridshape context3 @lighting_enable 1 @smooth_shading 1 @scale 0.2 0.2 0.2 @position -1.024063 -0.094946 -1.840225 @automatic 0

jit.gl.gridshape context3 @shape plane @lighting_enable 1 @smooth_shading 1 @scale 2 2 2 @rotatexyz 90 0 0 @position 0 -0.5 @automatic 0

jit.gl.texture context3 @name tex1

position 0. 0. 2.

jit.gl.camera context2

r renderVideoPlane

t b b

jit.gl.texture context3 @name cap @automatic 0

amnt 0.41

loadmess 0.4

jit.gl.pix Shifting hue and saturation

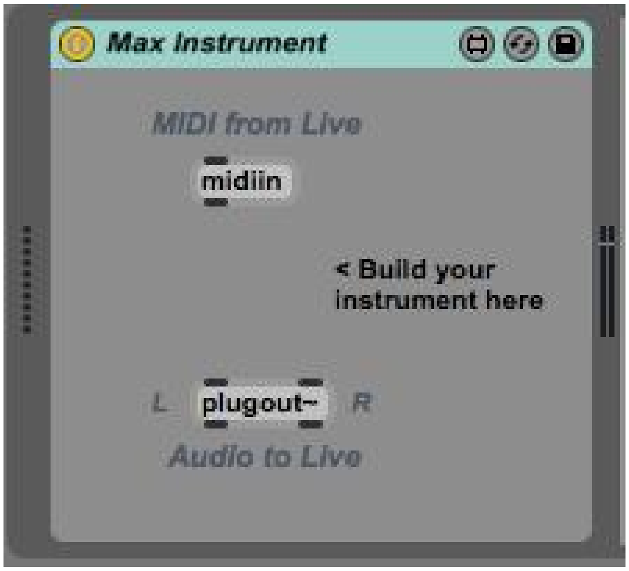
Put your shaders here!

jit.gl.videoplane context3 @automatic 0 @transform_reset 2

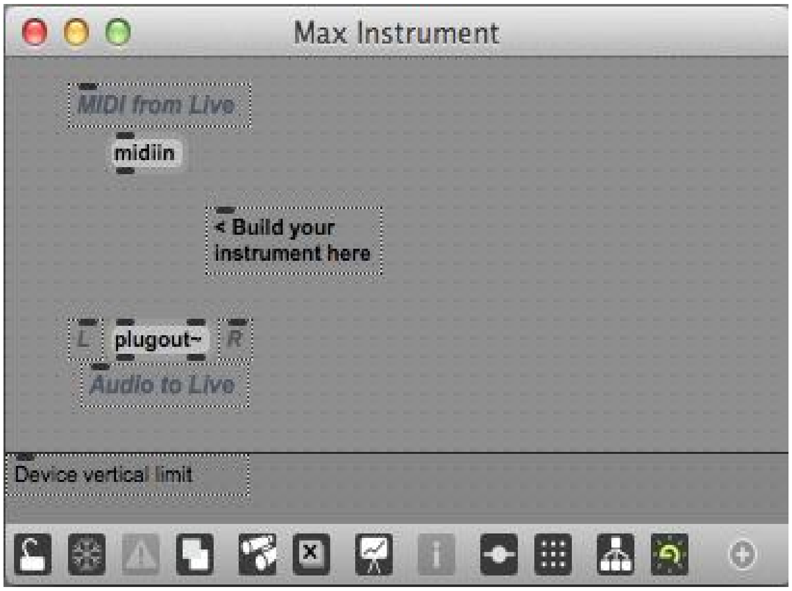
8

Max for Live

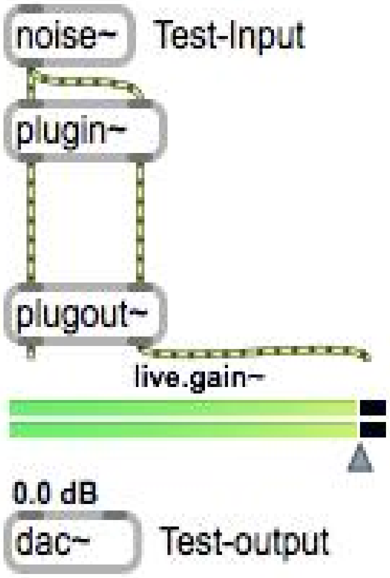
Introducing the fundamentals of Max for Live



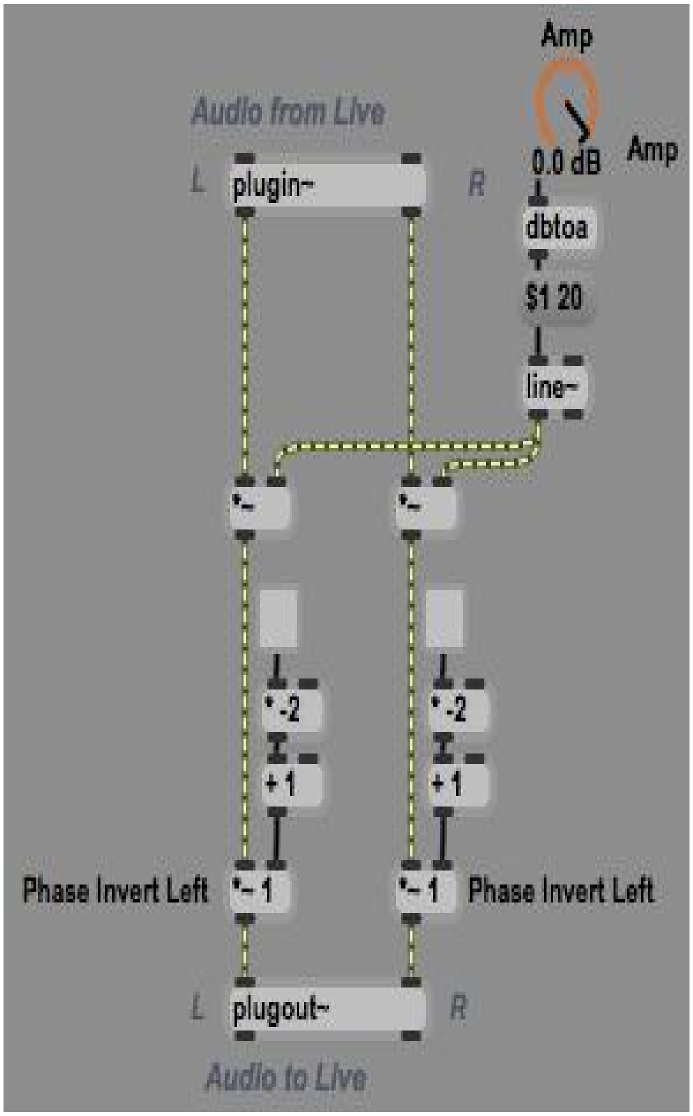
< Build your instrument here

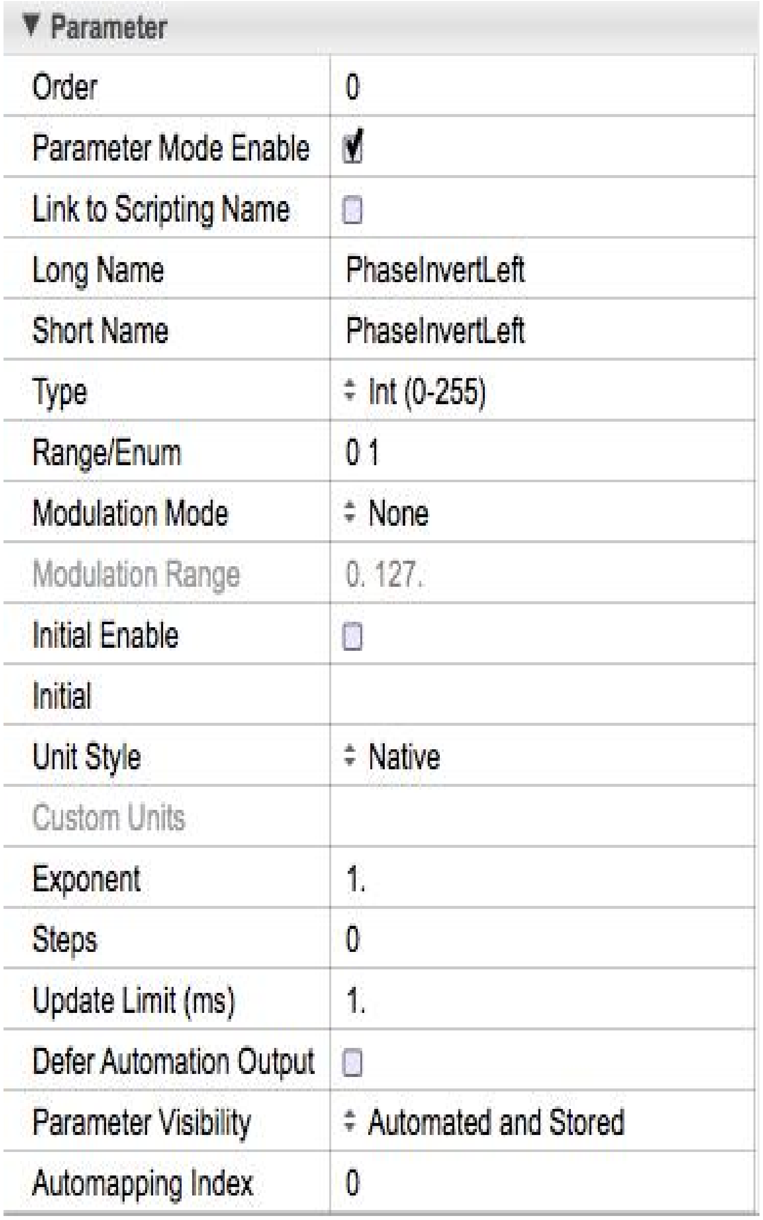

Max Instrument
MIDI from Live
midiin
< Build your instrument here
L
plugout~
R
Audio to Live
Device vertical limit

Audio in/out


noise~
Test-Input
plugin~
plugout~
live.gain~
0.0 dB
dac~
Test-output

Parameters and saving

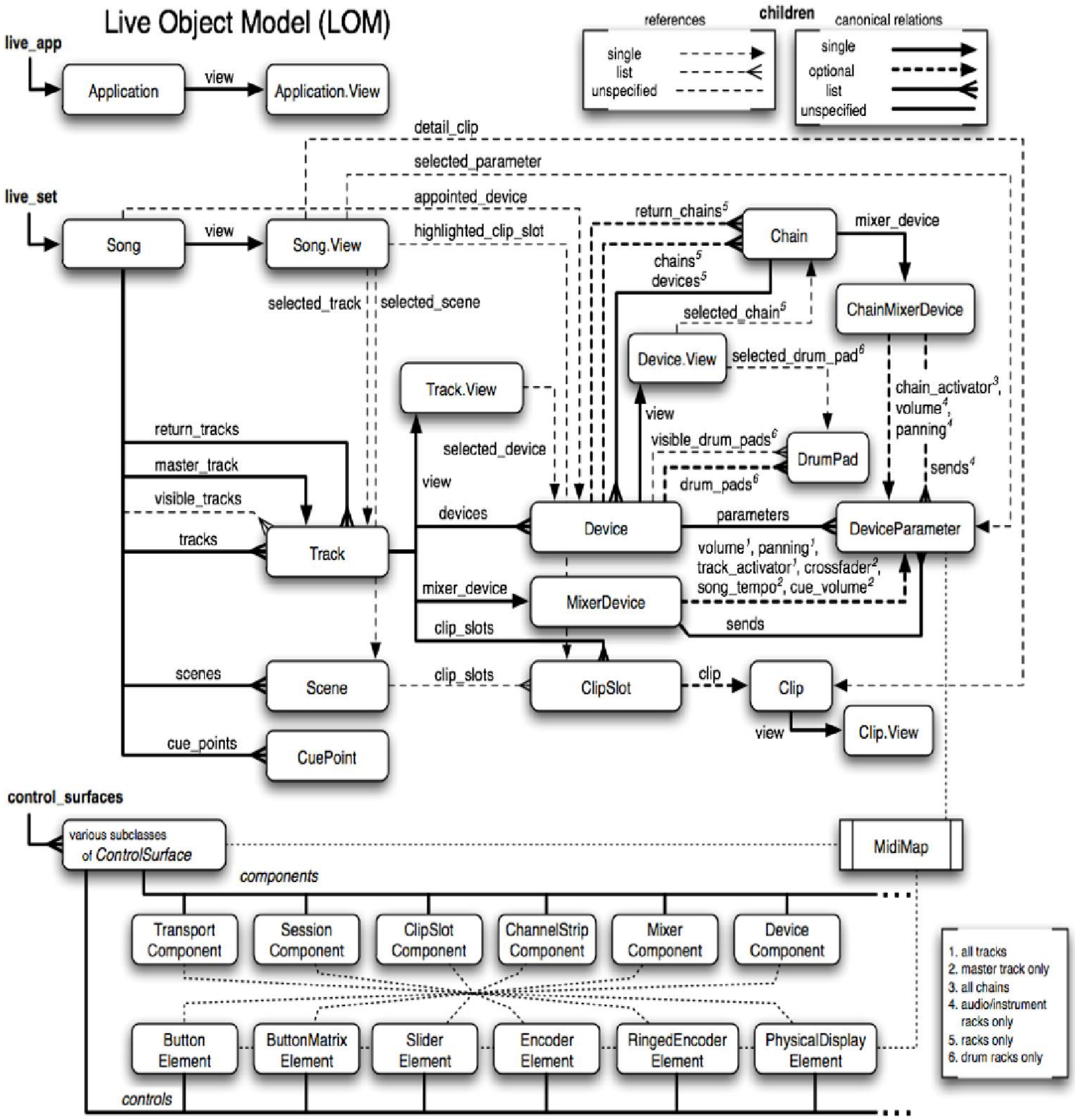


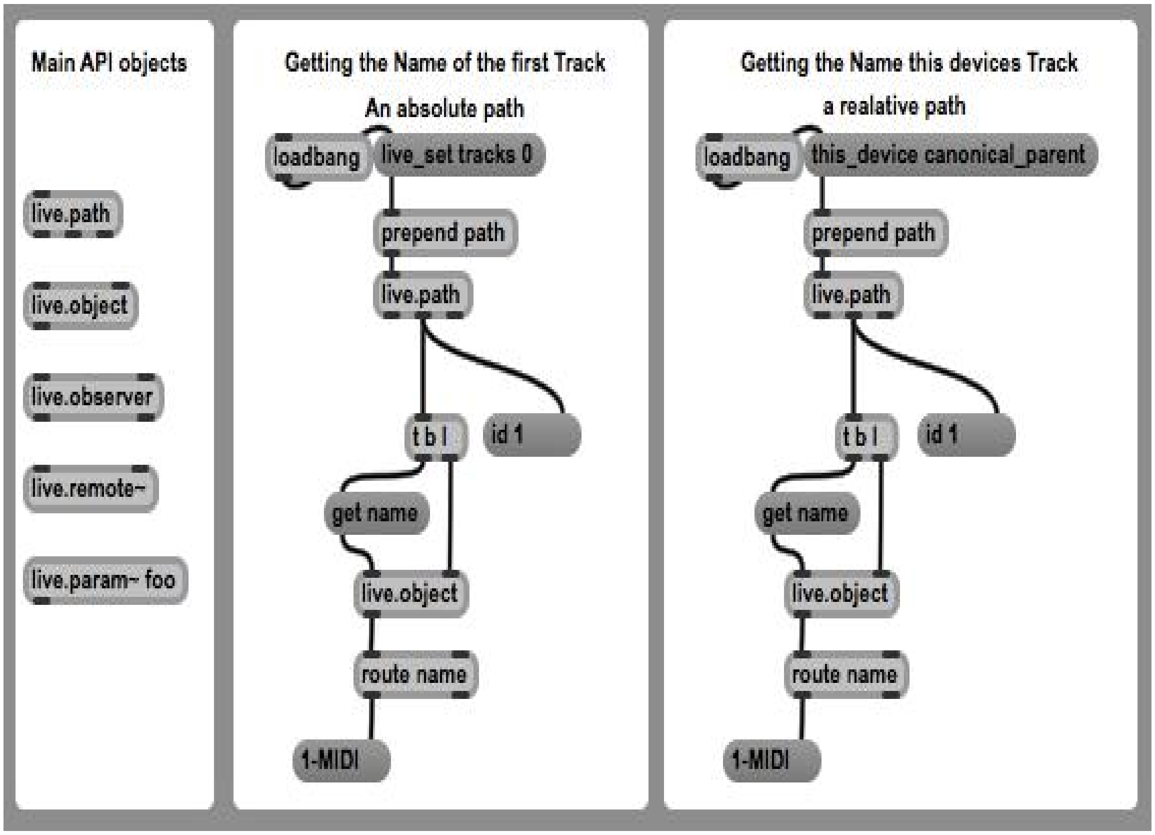


▼ Parameter

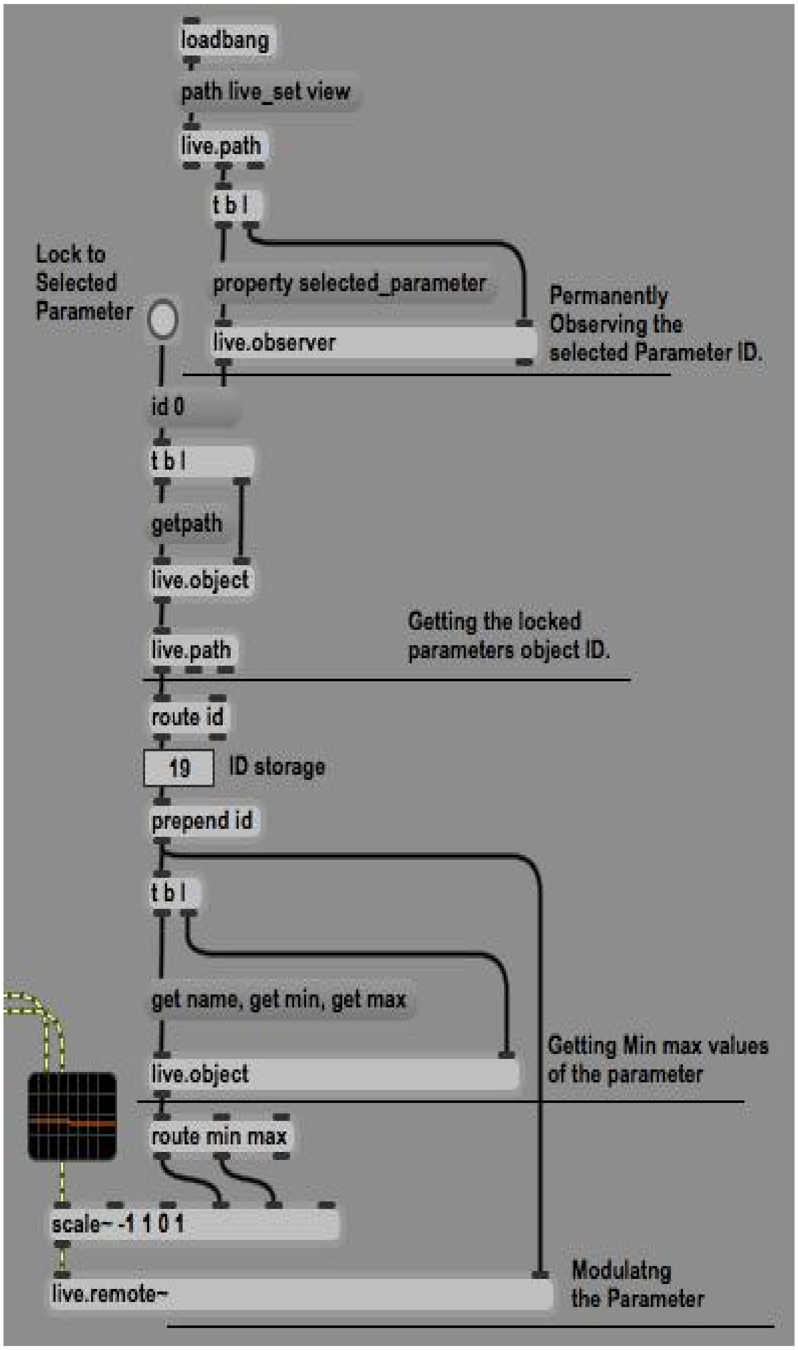
Order	0
Parameter Mode Enable	☑
Link to Scripting Name	□
Long Name	PhaseInvertLeft
Short Name	PhaseInvertLeft
Type	⇕ Int (0-255)
Range/Enum	0 1
Modulation Mode	⇕ None
Modulation Range	0. 127.
Initial Enable	□
Initial	
Unit Style	⇕ Native
Custom Units	
Exponent	1.
Steps	0
Update Limit (ms)	1.
Defer Automation Output	□
Parameter Visibility	⇕ Automated and Stored
Automapping Index	0

The Live API


Live Object Model (LOM)
references
children
canonical relations
single
list
unspecified
single
optional
list
unspecified
live_app
Application
view
Application.View
detail_clip
selected_parameter
appointed_device
live_set
Song
view
Song.View
highlighted_clip_slot
return_chains[5]
Chain
mixer_device
chains[5]
devices[5]
selected_chain[5]
ChainMixerDevice
selected_track
selected_scene
Device.View
selected_drum_pad[6]
Track.View
chain_activator[3],
volume[4],
panning[4]
view
visible_drum_pads[6]
DrumPad
return_tracks
selected_device
sends[4]
master_track
drum_pads[6]
view
visible_tracks
devices
parameters
tracks
Device
DeviceParameter
Track
volume[1], panning[1],
track_activator[1], crossfader[2],
song_tempo[2], cue_volume[2]
mixer_device
MixerDevice
clip_slots
sends
scenes
clip_slots
clip
Scene
ClipSlot
Clip
view
Clip.View
cue_points
CuePoint
control_surfaces
various subclasses
of ControlSurface
MidiMap
components
Transport
Component
Session
Component
ClipSlot
Component
ChannelStrip
Component
Mixer
Component
Device
Component
Button
Element
ButtonMatrix
Element
Slider
Element
Encoder
Element
RingedEncoder
Element
PhysicalDisplay
Element
controls
1. all tracks
2. master track only
3. all chains
4. audio/instrument
racks only
5. racks only
6. drum racks only


Main API objects
live.path
live.object
live.observer
live.remote~
live.param~ foo
Getting the Name of the first Track
An absolute path
loadbang
live_set tracks 0
prepend path
live.path
t b l
id 1
get name
live.object
route name
1-MIDI
Getting the Name this devices Track
a realative path
loadbang
this_device canonical_parent
prepend path
live.path
t b l
id 1
get name
live.object
route name
1-MIDI

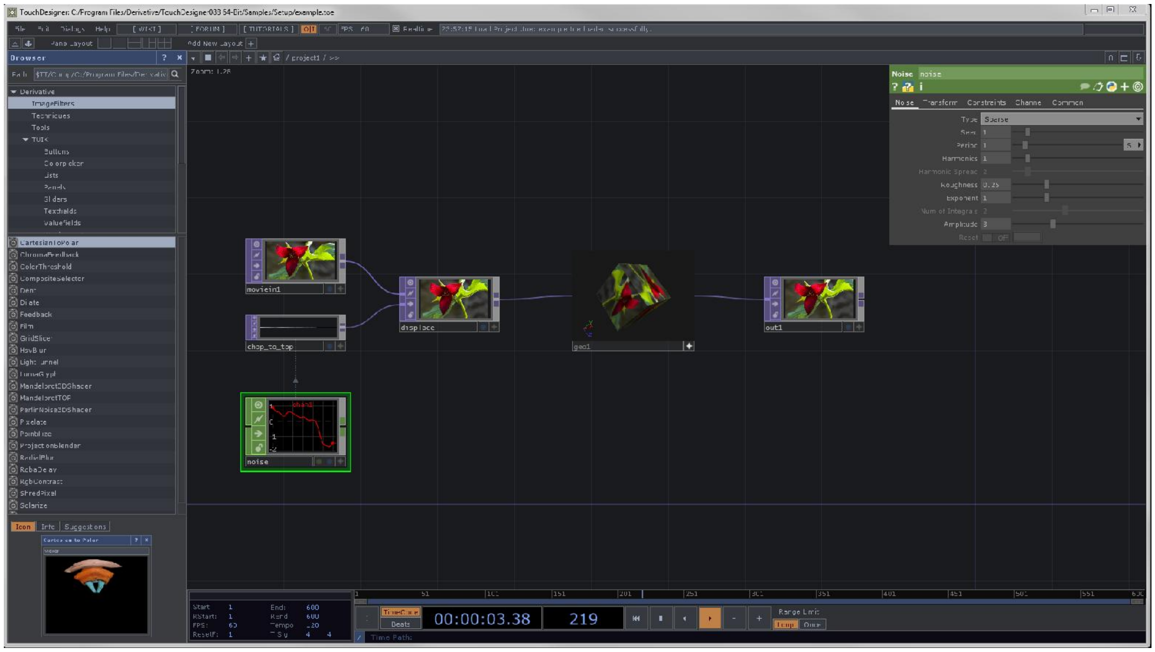
An example device – a parameter modulator


loadbang
path live_set view
live.path
t b l
property selected_parameter
live.observer
Permanently Observing the selected Parameter ID.
Lock to Selected Parameter
id 0
t b l
getpath
live.object
live.path
Getting the locked parameters object ID.
route id
19
ID storage
prepend id
t b l
get name, get min, get max
live.object
Getting Min max values of the parameter
route min max
scale~ -1 1 0 1
live.remote~
Modulatng the Parameter

9

Basic Visualization with TouchDesigner

Basics and UI



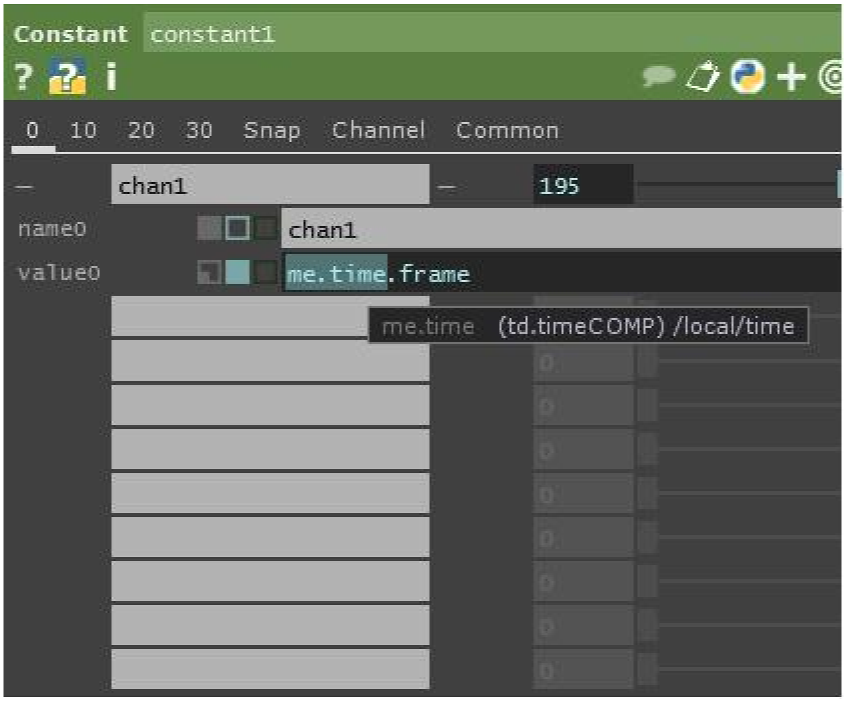
Noise noise

Type Sparse
Seed 1
Period 1
Harmonics 1
Harmonic Spread 2
Roughness 0.25
Exponent 1
Num of Integrals 2
Amplitude 3
Reset OFF

Start: 1 End: 600
RStart: 1 REnd: 600
FPS: 60 Tempo 120
ResetF: 1 T Sig 4 4

00:00:03.38 219

A scripting prologue



Constant constant1

0 10 20 30 Snap Channel Common

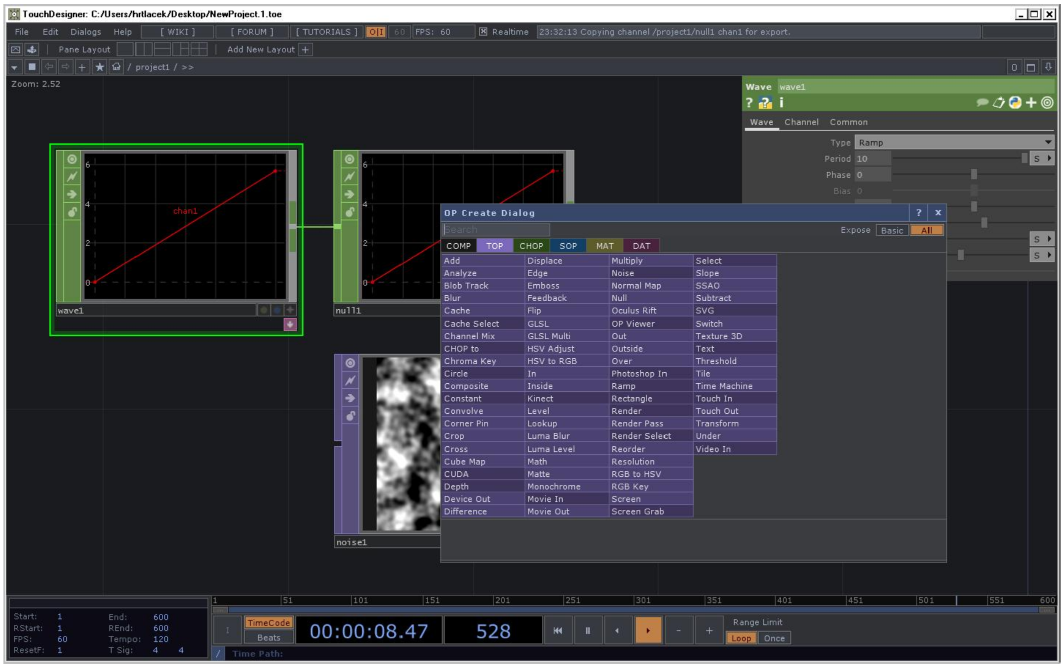
chan1 195

name0 chan1

value0 me.time.frame

me.time (td.timeCOMP) /local/time

Hello World



TouchDesigner: C:/Users/hrtlacek/Desktop/NewProject.1.toe

FPS: 60

23:32:13 Copying channel /project1/null1 chan1 for export.

/ project1 / >>

Zoom: 2.52

Wave wave1

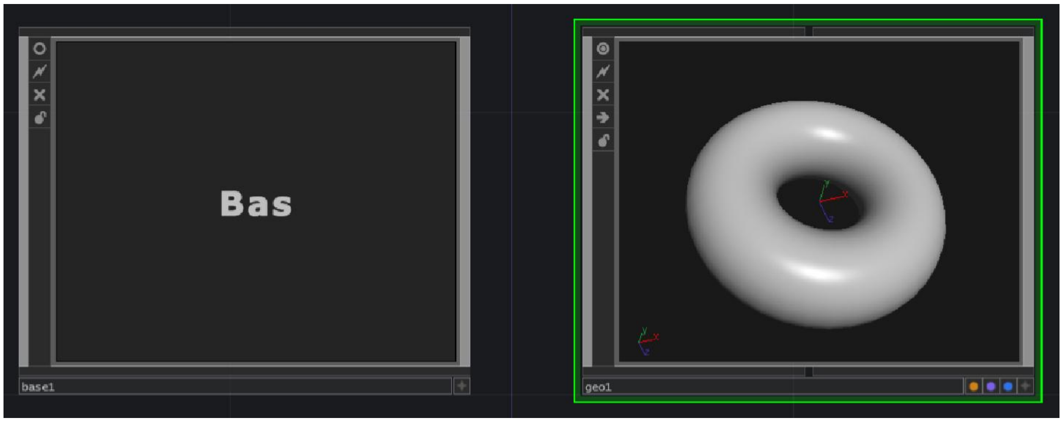
Type Ramp
Period 10
Phase 0
Bias 0

Start: 1 End: 600
RStart: 1 REnd: 600
FPS: 60 Tempo: 120
ResetF: 1 T Sig: 4 4

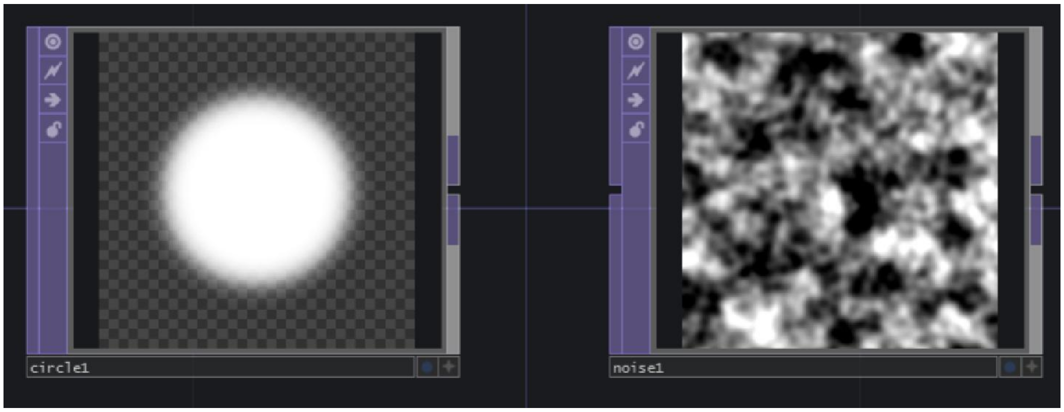
00:00:08.47
528

Time Path:

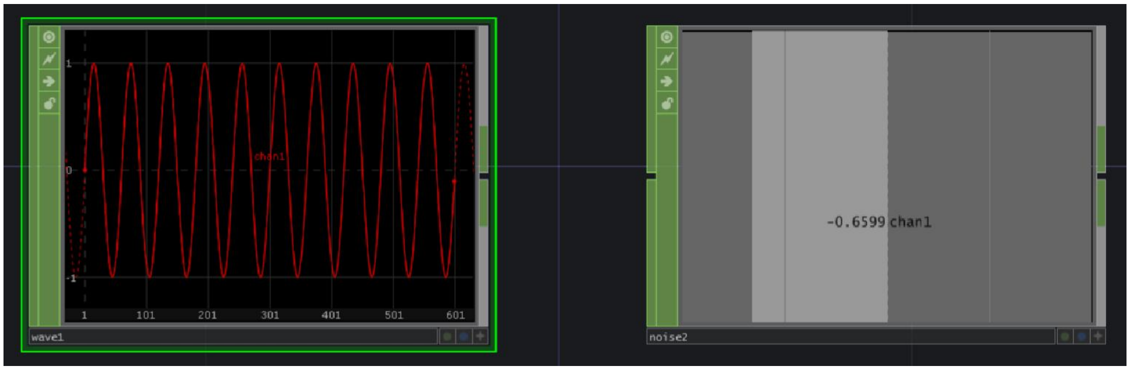
COMPs



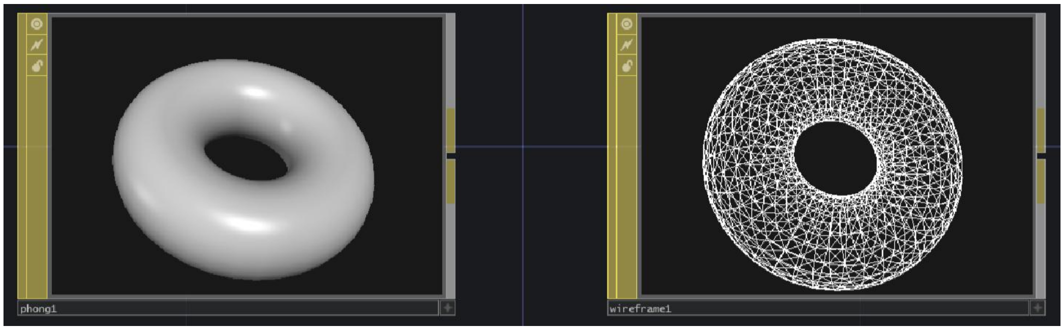
TOPs



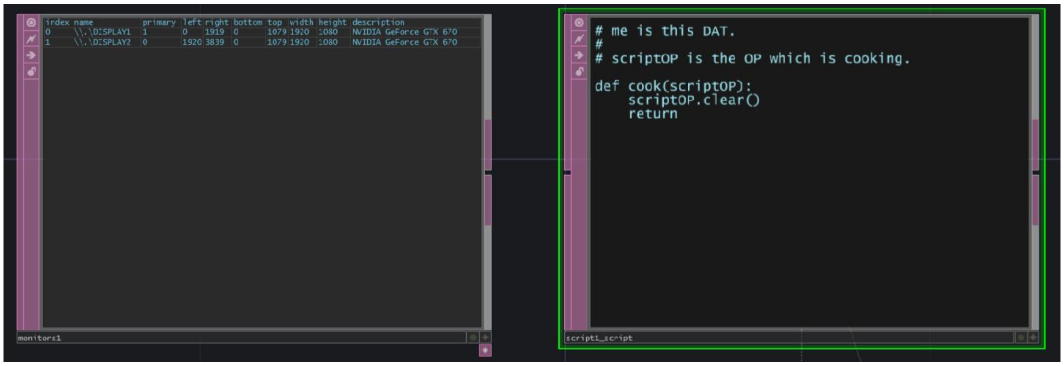
CHOPs



MATs

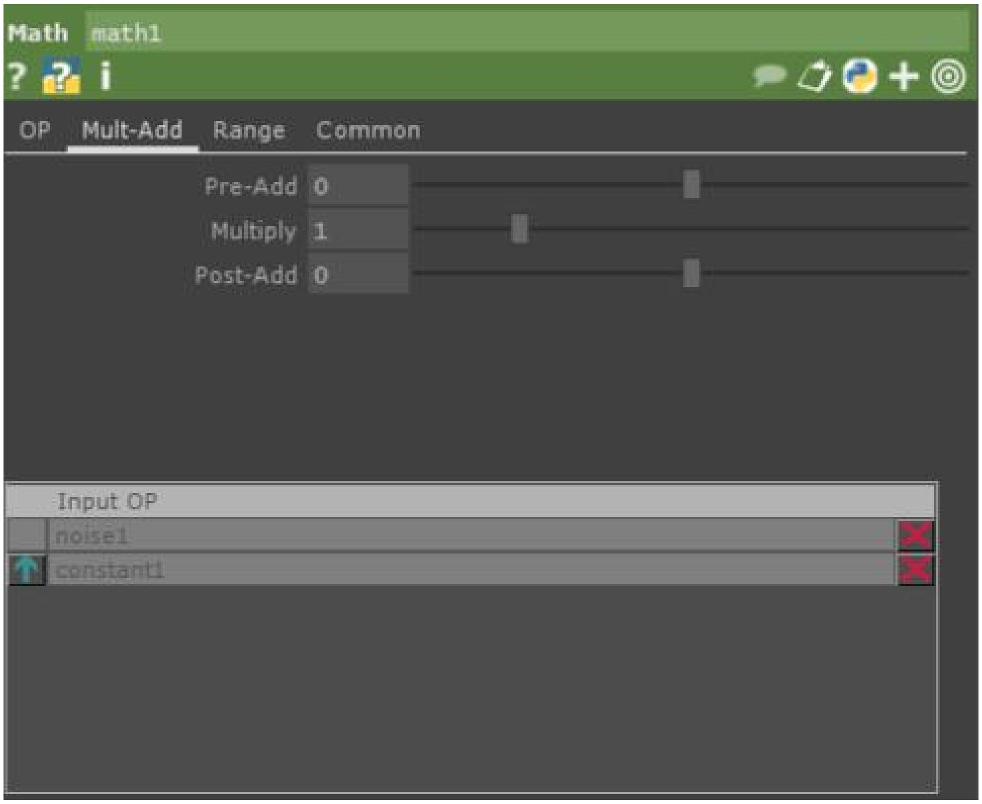


DATs



index	name	primary	left	right	bottom	top	width	height	description
0	\\.\DISPLAY1	1	0	1919	0	1079	1920	1080	NVIDIA GeForce GTX 670
1	\\.\DISPLAY2	0	1920	3839	0	1079	1920	1080	NVIDIA GeForce GTX 670

```
# me is this DAT.
#
# scriptOP is the OP which is cooking.

def cook(scriptOP):
    scriptOP.clear()
    return
```

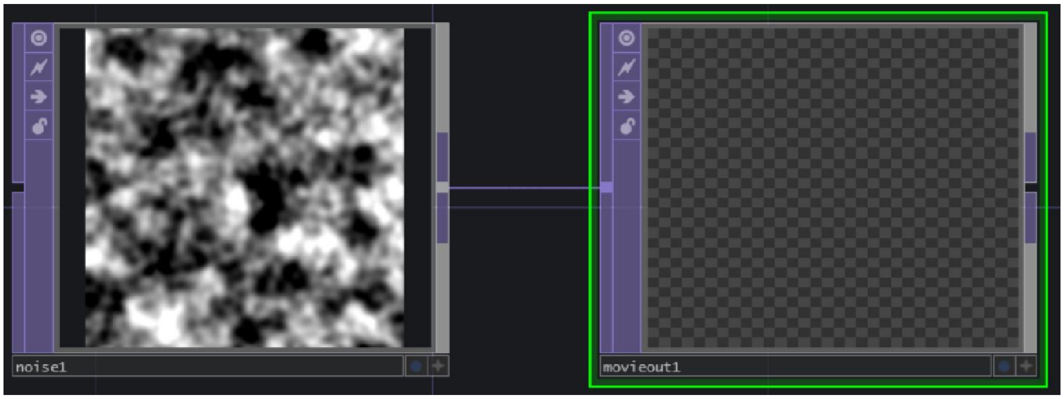


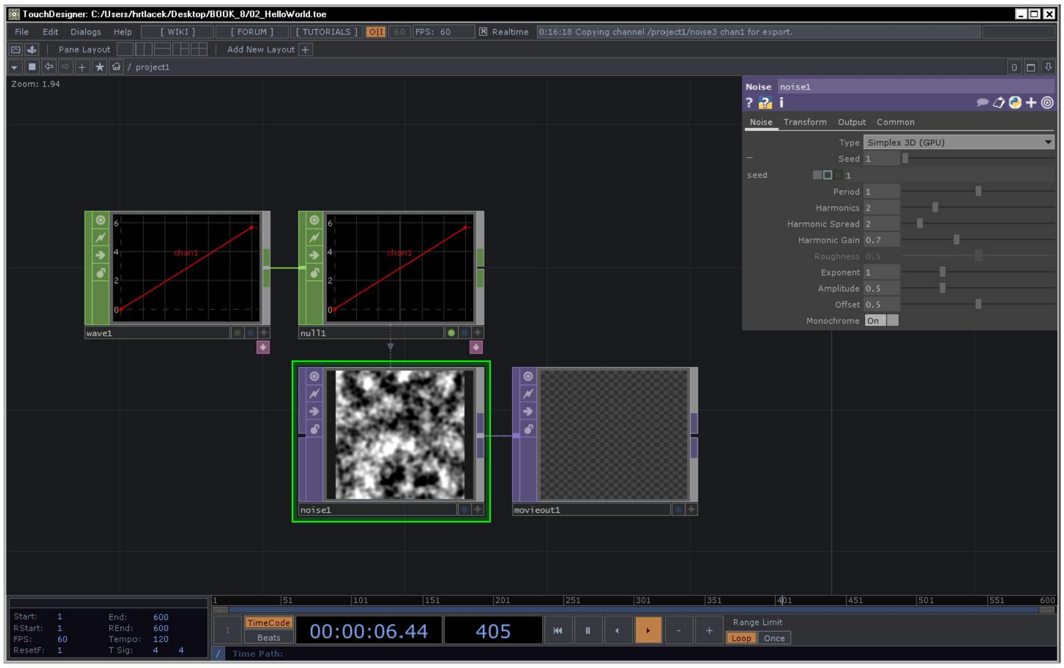
Pre-Add 0

Multiply 1

Post-Add 0

Input OP
noise1
constant1




TouchDesigner: C:/Users/hrtlacek/Desktop/BOOK_8/02_HelloWorld.toe

0:16:18 Copying channel /project1/noise3 chan1 for export.

Zoom: 1.94

Noise noise1

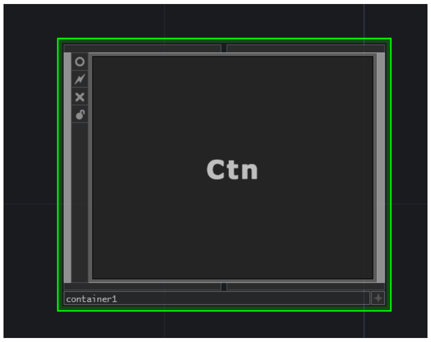
Type Simplex 3D (GPU)
Seed 1
seed 1
Period 1
Harmonics 2
Harmonic Spread 2
Harmonic Gain 0.7
Roughness 0.5
Exponent 1
Amplitude 0.5
Offset 0.5
Monochrome On

Start: 1 End: 600
RStart: 1 REnd: 600
FPS: 60 Tempo: 120
ResetF: 1 T Sig: 4 4

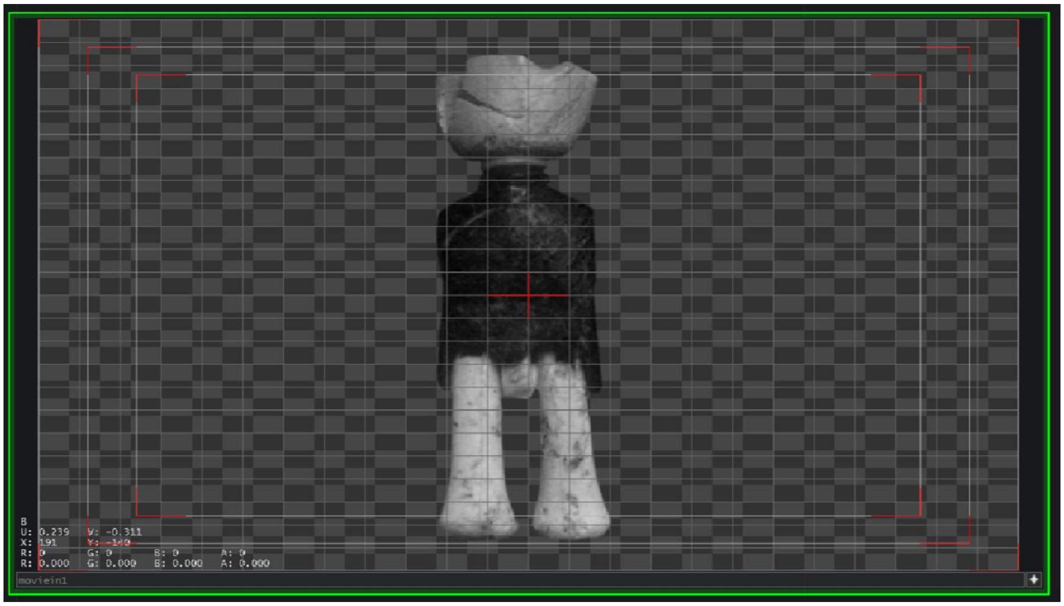
00:00:06.44 405

File Edit Dialogs Help [WIKI] [FORUM] [TUTORIALS] O|I 60 FPS: 60 Realtime
Pane Layout
Add New Layout
/ project1
Noise Transform Output Common
wave1
null1
chan1
noise1
movieout1
TimeCode
Beats
Range Limit
Loop
Once
Time Path:

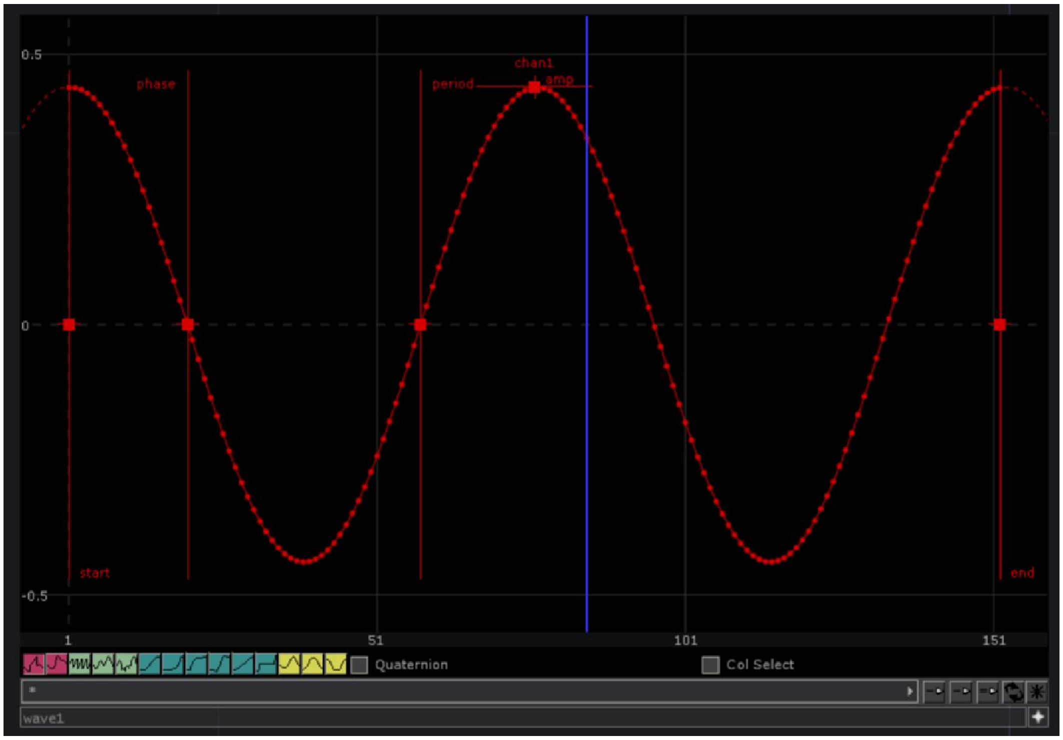
The operators



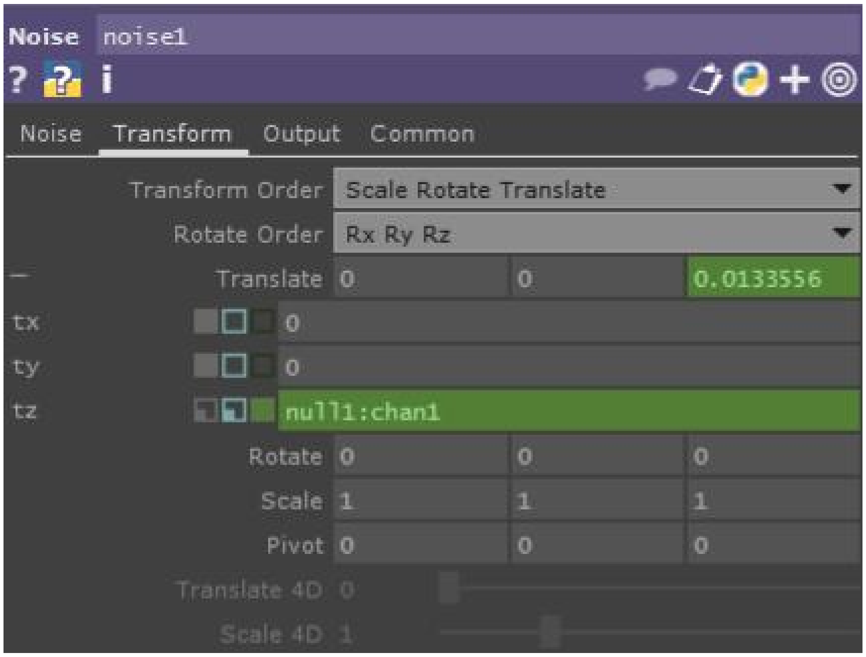
The viewer active flag



```
B
U: 0.239   V: -0.311
X: 191     Y: -140
R: 0       G: 0       B: 0       A: 0
R: 0.000   G: 0.000   B: 0.000   A: 0.000
```

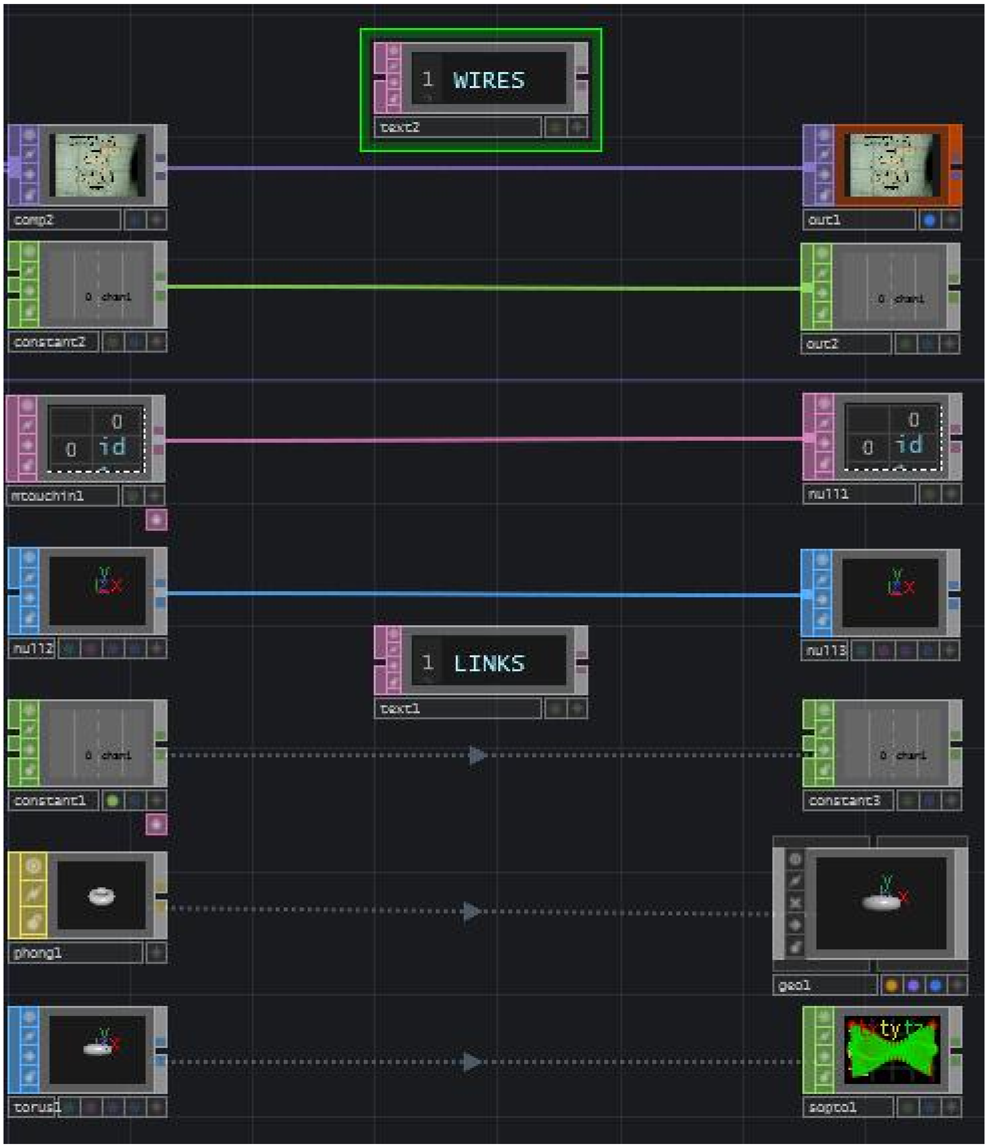

0.5
0
-0.5
phase
period
chan1
amp
start
end
1
51
101
151
Quaternion
Col Select
*
wave1

The parameter dialog

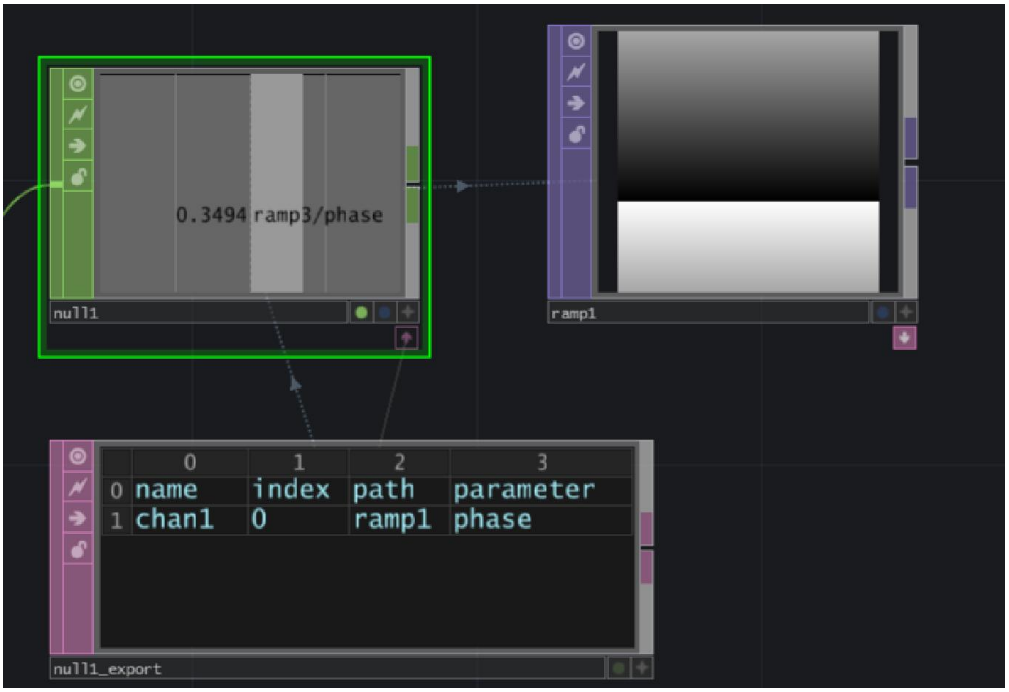


```
Noise  noise1

Transform Order  Scale Rotate Translate
   Rotate Order  Rx Ry Rz
      Translate  0  0  0.0133556
tx               0
ty               0
tz               null1:chan1
         Rotate  0  0  0
          Scale  1  1  1
          Pivot  0  0  0
   Translate 4D  0
       Scale 4D  1
```

Wires and links

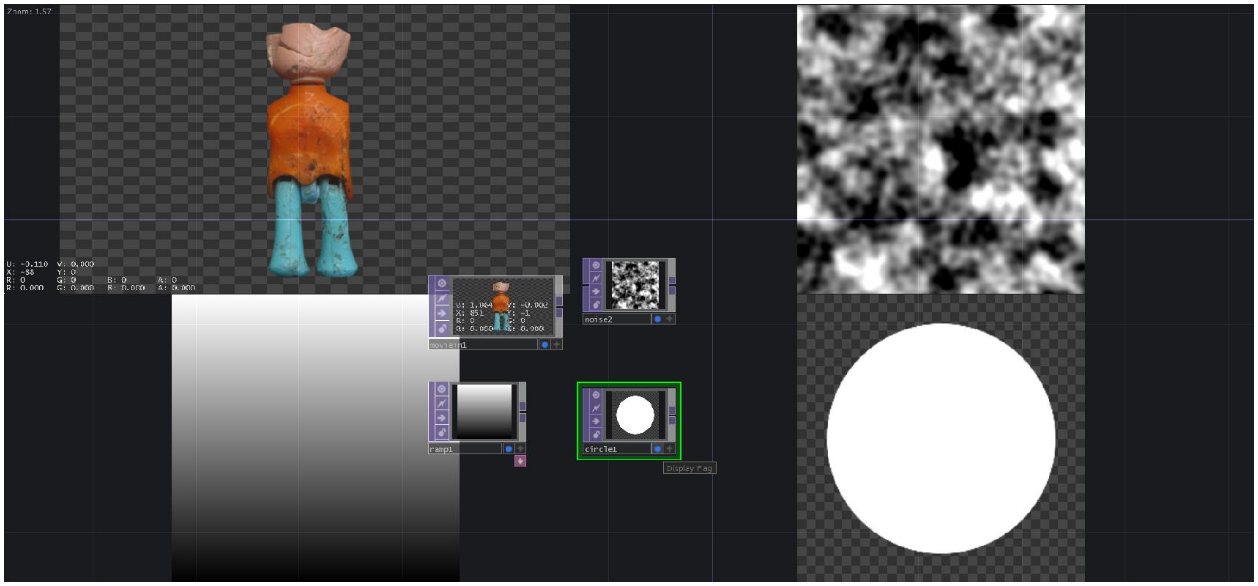


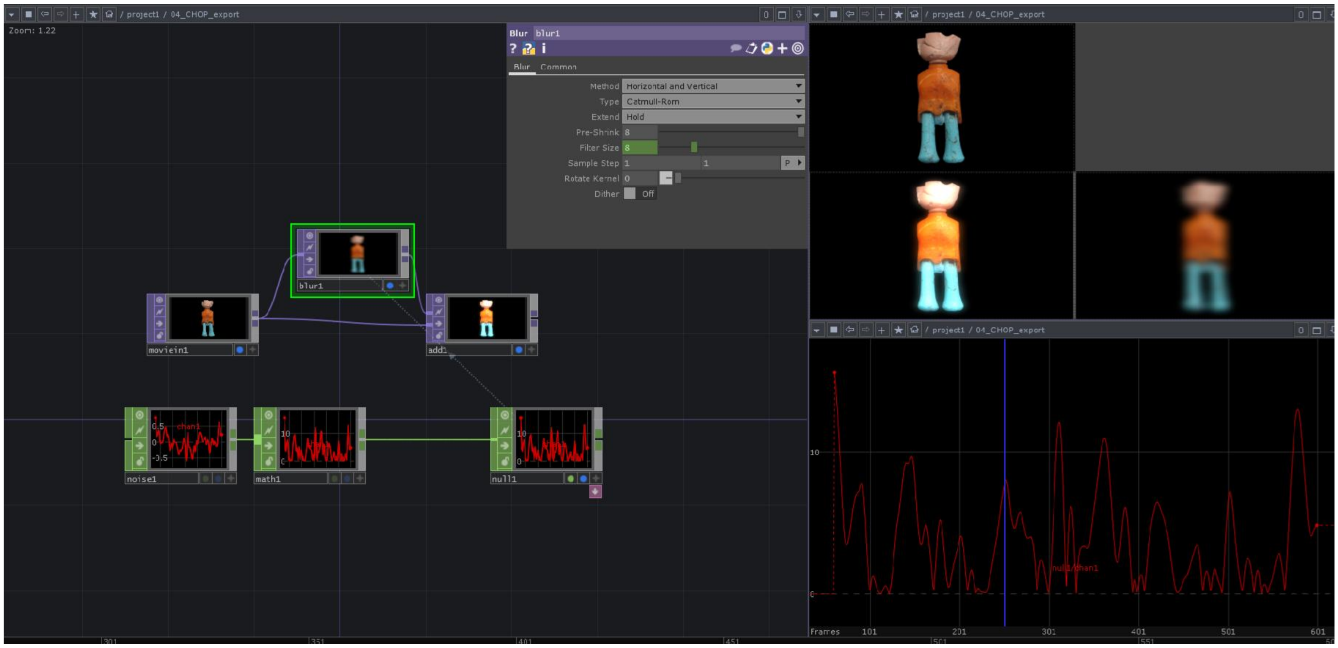
A closer look at timeslicing, CHOPs, and exporting



	0	1	2	3
0	name	index	path	parameter
1	chan1	0	ramp1	phase

Panes





Blur blur1

Blur Common

Method Horizontal and Vertical

Type Catmull-Rom

Extend Hold

Pre-Shrink 8

Filter Size 8

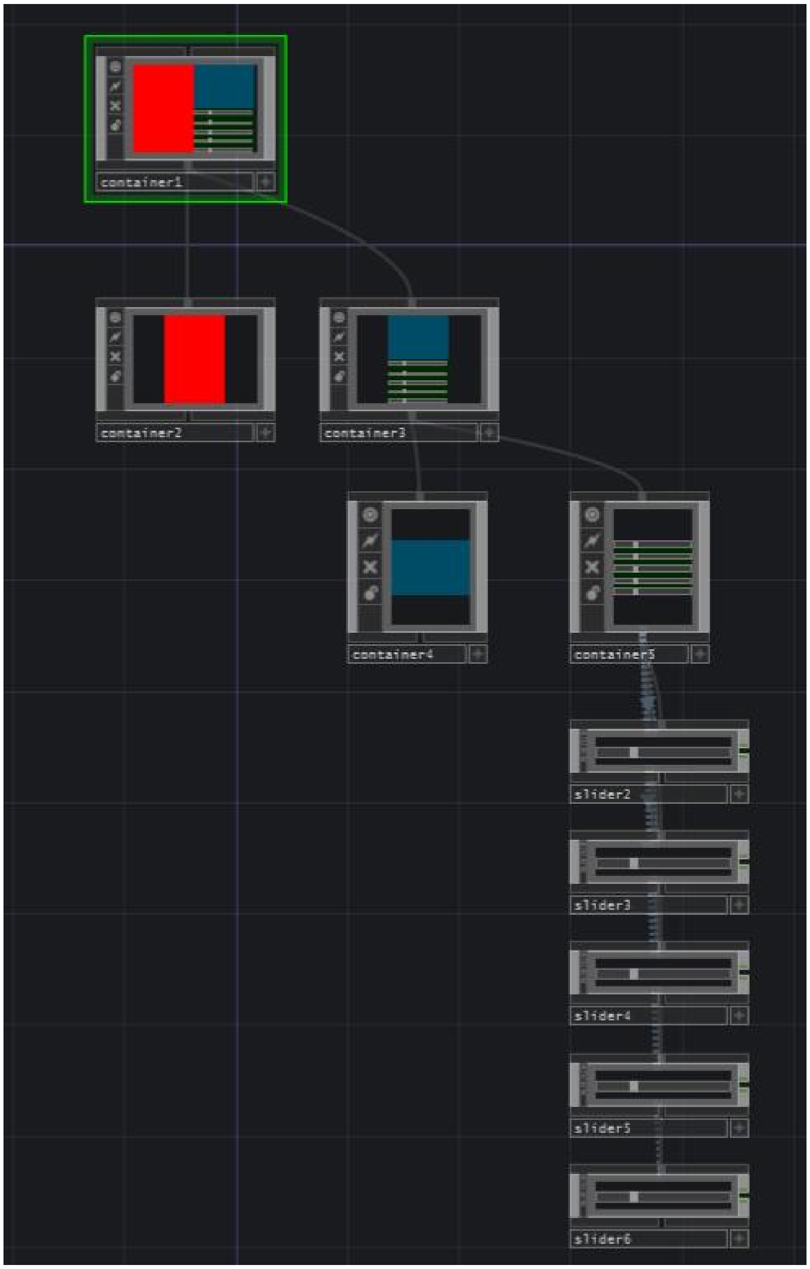
Sample Step 1 1

Rotate Kernel 0

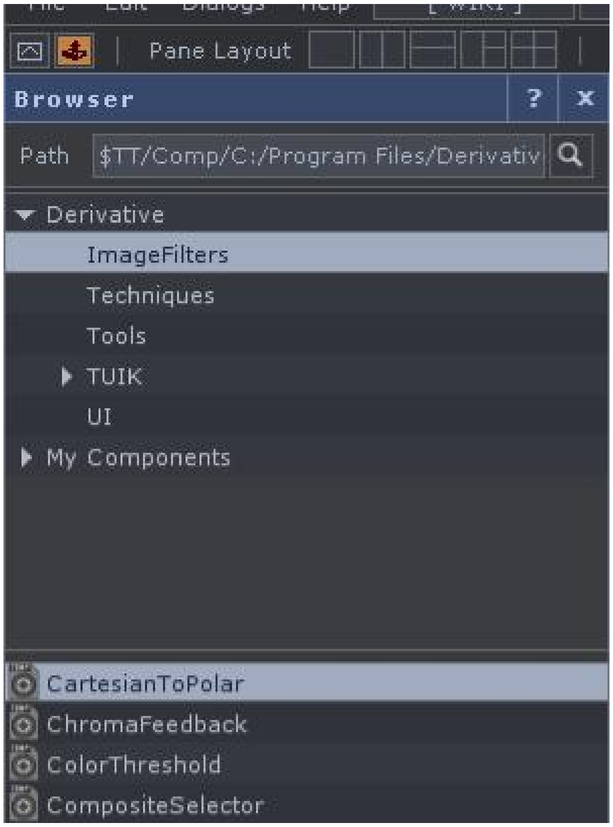
Dither Off

Components – structuring a project

Hierarchy

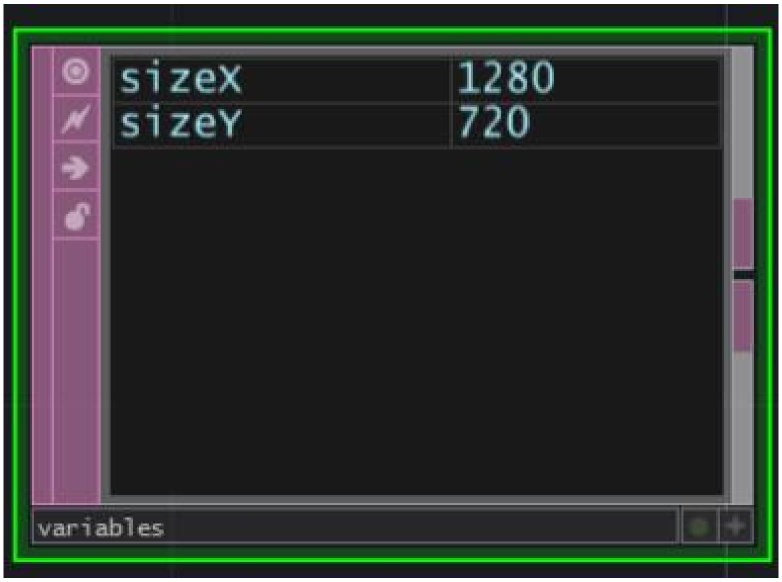


Palette



Path $TT/Comp/C:/Program Files/Derivativ

Local

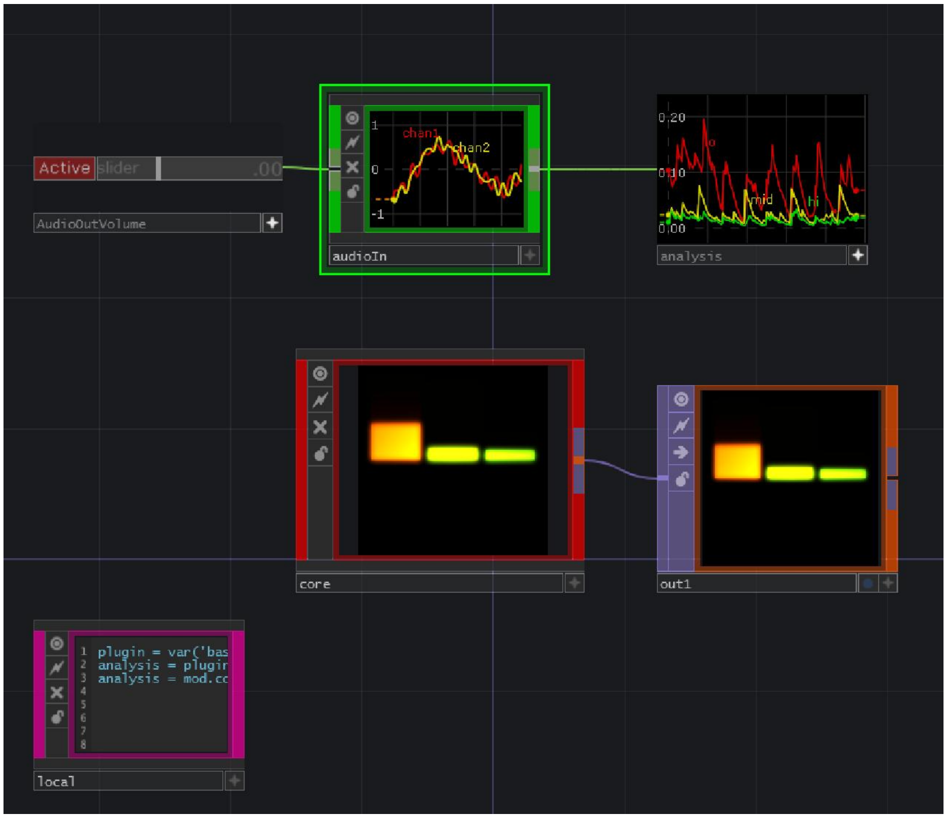


sizeX	1280
sizeY	720

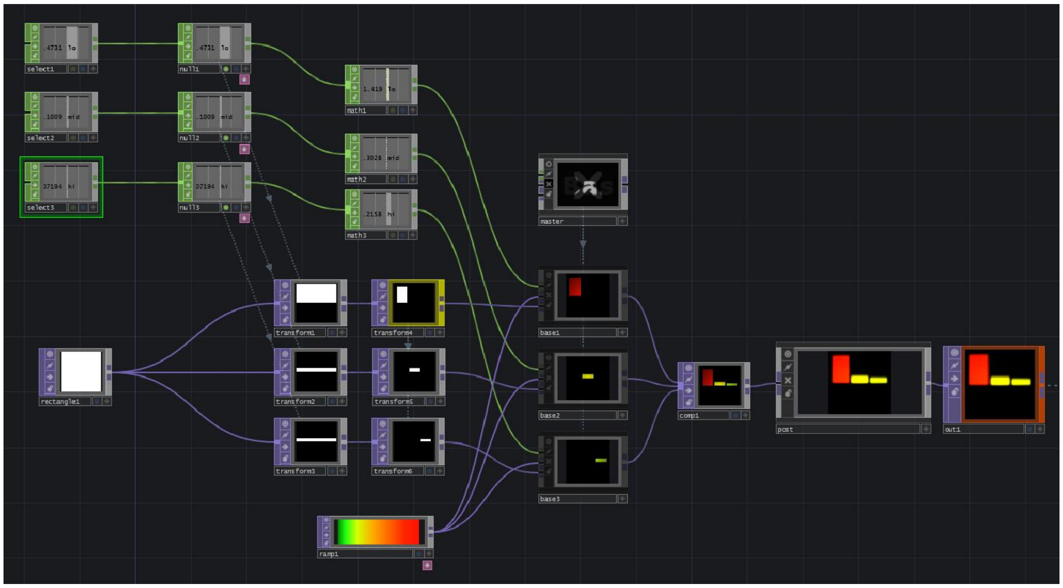
10

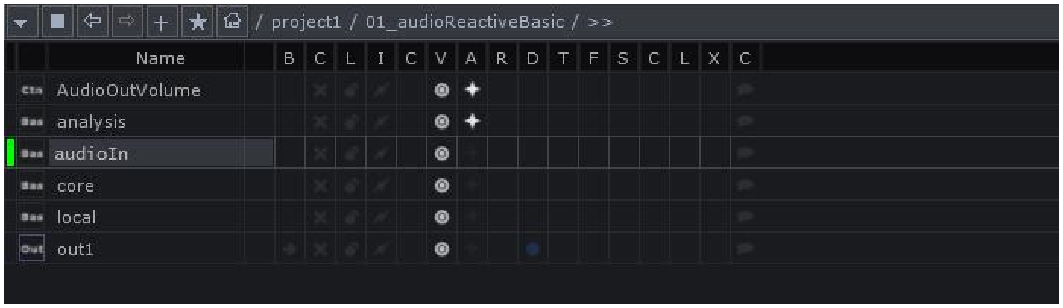
Advanced Visualization with TouchDesigner

Basic audio-reactive video



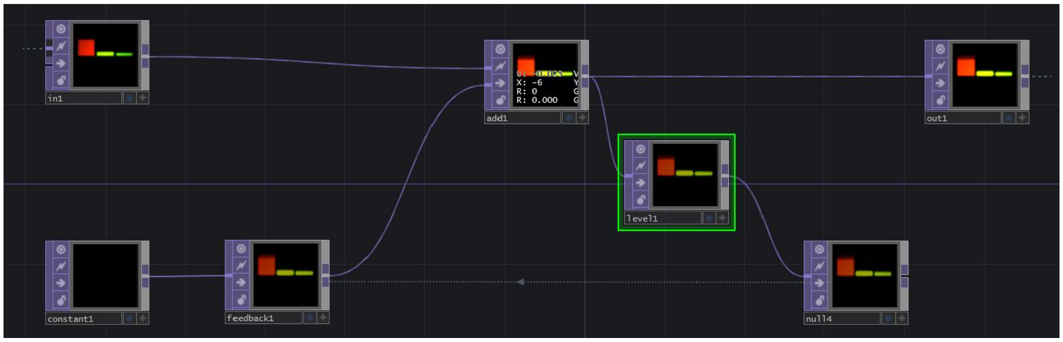
```
plugin = var('bas
analysis = plugir
analysis = mod.cc
```

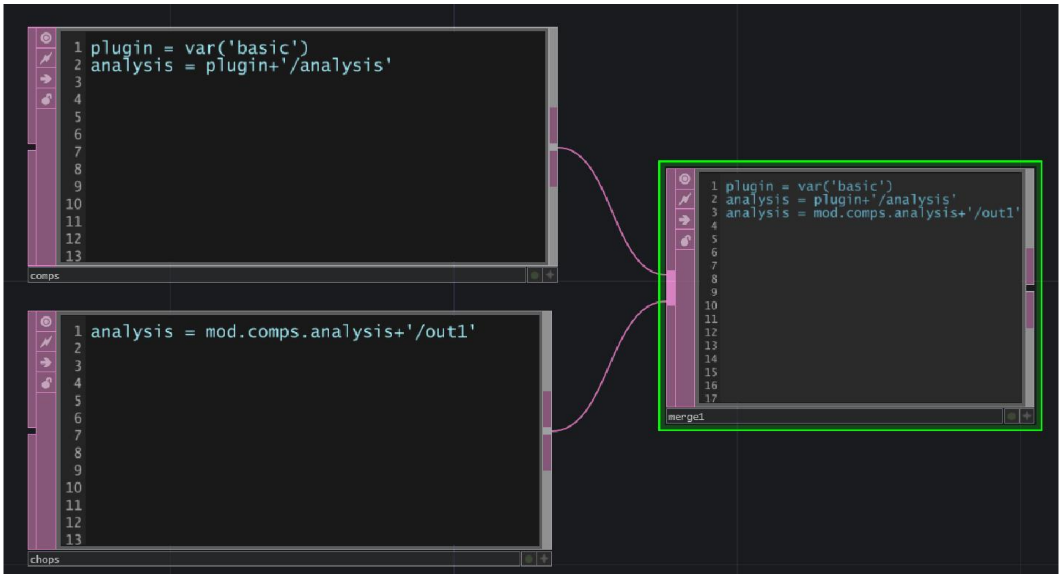




/ project1 / 01_audioReactiveBasic / >>

Name	B	C	L	I	C	V	A	R	D	T	F	S	C	L	X	C
AudioOutVolume						◉	✦									
analysis						◉	✦									
audioIn						◉										
core						◉										
local						◉										
out1						◉			●							



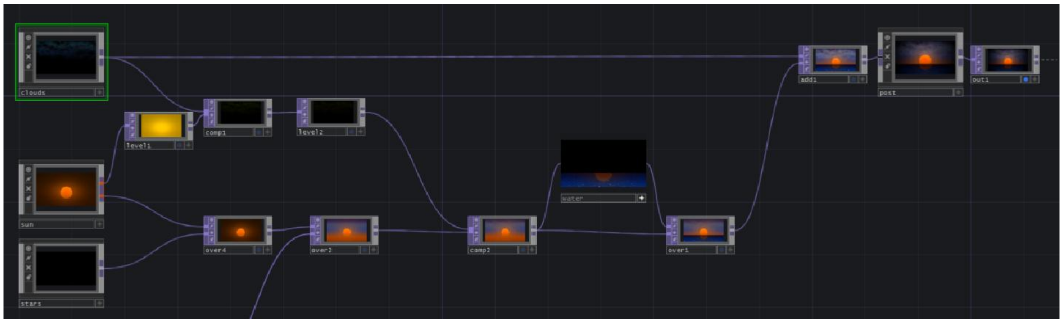


```
plugin = var('basic')
analysis = plugin+'/analysis'
```

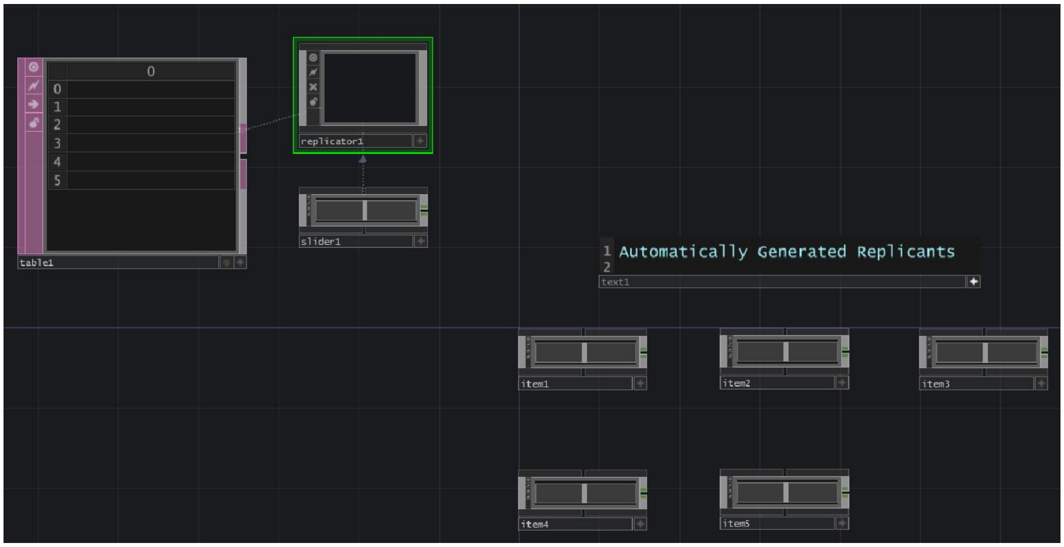
```
analysis = mod.comps.analysis+'/out1'
```

```
plugin = var('basic')
analysis = plugin+'/analysis'
analysis = mod.comps.analysis+'/out1'
```

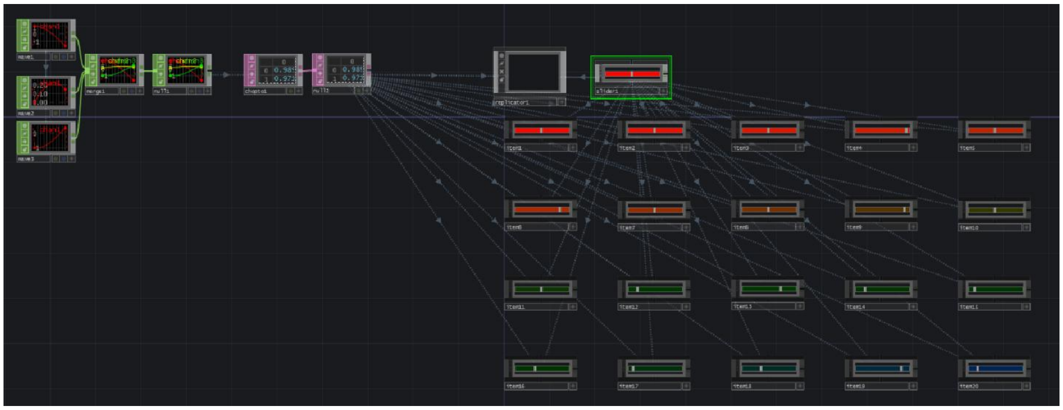
A 2D composting example



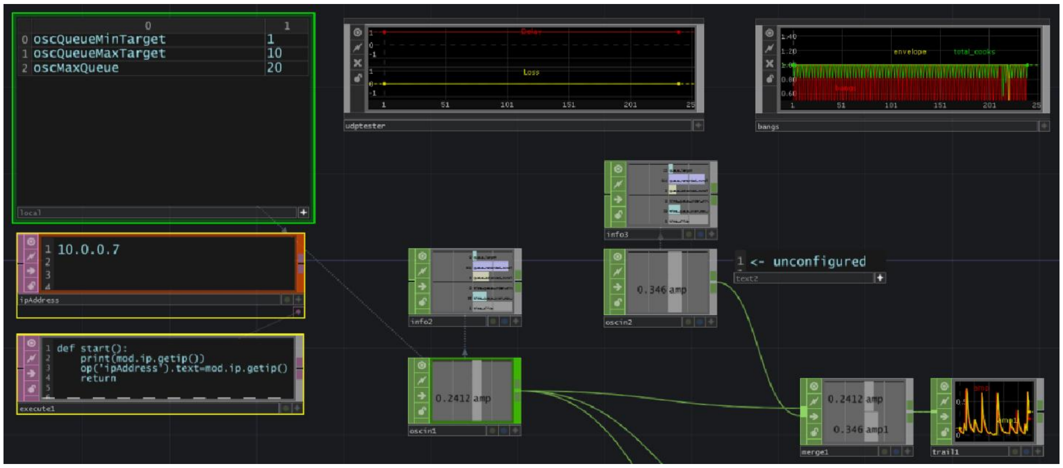
Replicator COMP



The me.digits expression as a way to individualize replicants



Connecting Max and TD

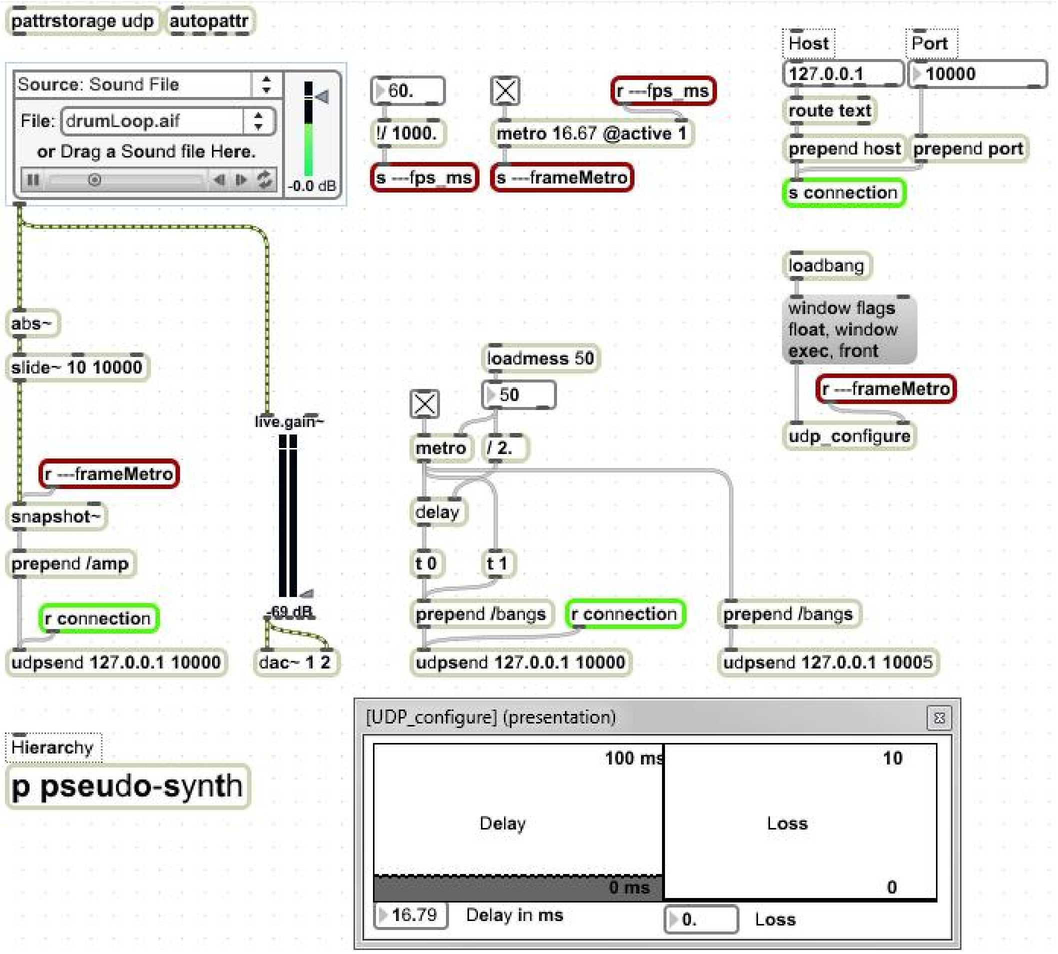


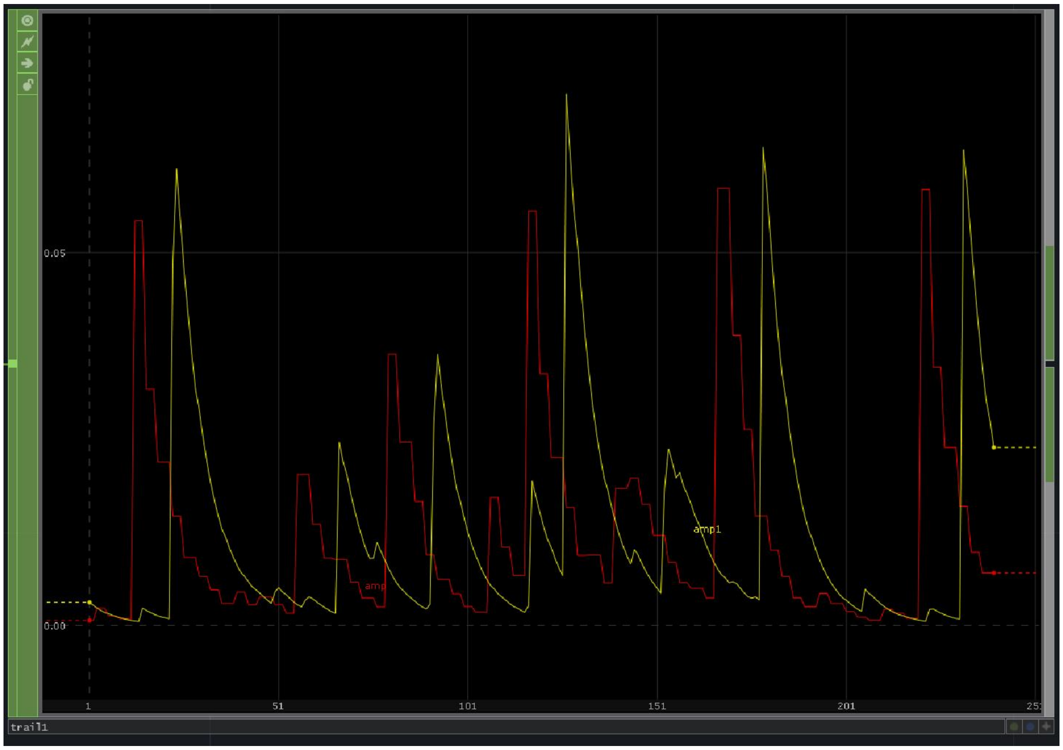
	0	1
0	oscQueueMinTarget	1
1	oscQueueMaxTarget	10
2	oscMaxQueue	20

```
10.0.0.7
```

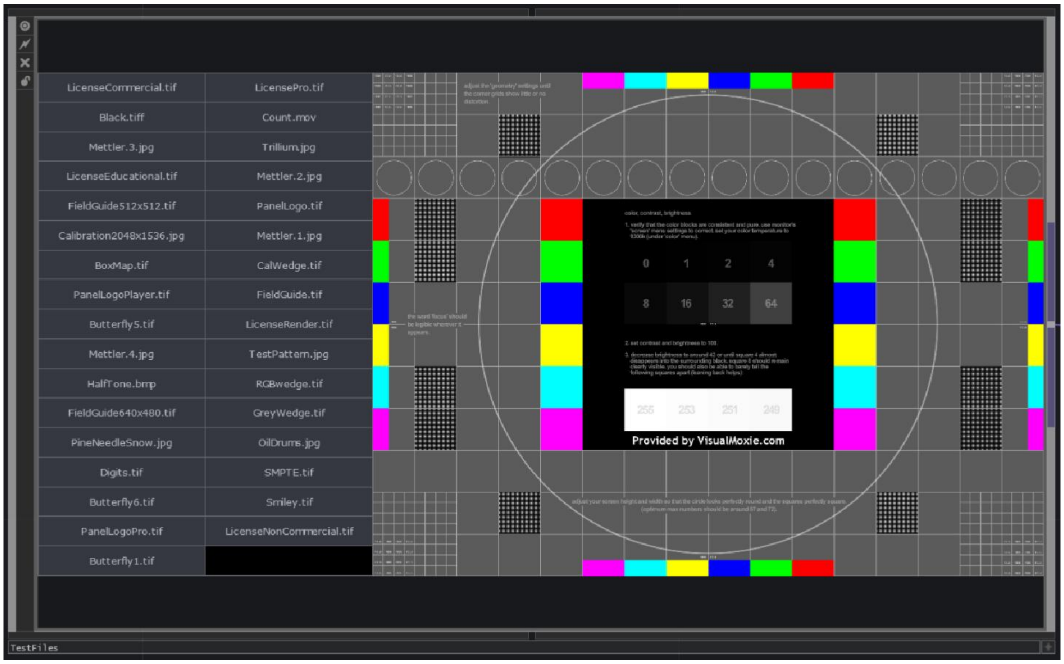
```
def start():
    print(mod.ip.getip())
    op('ipAddress').text=mod.ip.getip()
    return
```

```
1 <- unconfigured
```


pattrstorage udp
autopattr
Source: Sound File
File: drumLoop.aif
or Drag a Sound file Here.
-0.0 dB
60.
!/ 1000.
s ---fps_ms
metro 16.67 @active 1
r ---fps_ms
s ---frameMetro
Host
Port
127.0.0.1
10000
route text
prepend host
prepend port
s connection
loadbang
window flags float, window exec, front
r ---frameMetro
udp_configure
abs~
slide~ 10 10000
live.gain~
r ---frameMetro
snapshot~
prepend /amp
r connection
udpsend 127.0.0.1 10000
-69 dB
dac~ 1 2
loadmess 50
50
metro
/ 2.
delay
t 0
t 1
prepend /bangs
r connection
udpsend 127.0.0.1 10000
prepend /bangs
udpsend 127.0.0.1 10005
Hierarchy
p pseudo-synth
[UDP_configure] (presentation)
100 ms
Delay
0 ms
10
Loss
0
16.79
Delay in ms
0.
Loss


0.05
0.00
amp
amp1
1
51
101
151
201
251
trail1

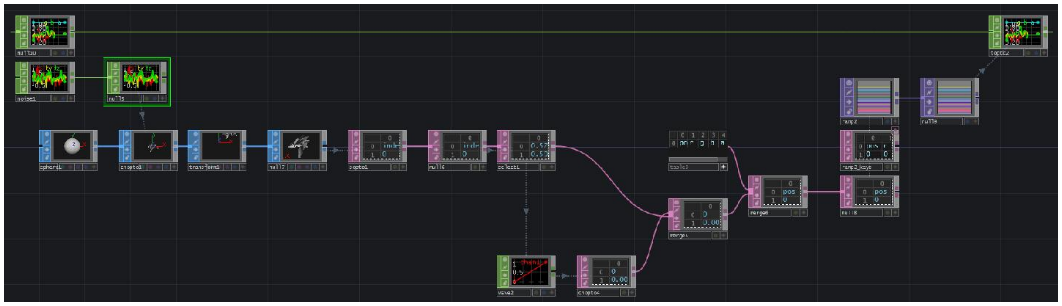
A component for lots of movies

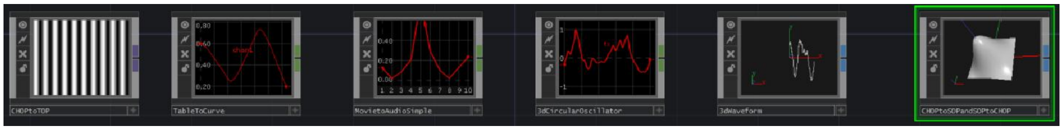


LicenseCommercial.tif	LicensePro.tif
Black.tiff	Count.mov
Mettler.3.jpg	Trillium.jpg
LicenseEducational.tif	Mettler.2.jpg
FieldGuide512x512.tif	PanelLogo.tif
Calibration2048x1536.jpg	Mettler.1.jpg
BoxMap.tif	CalWedge.tif
PanelLogoPlayer.tif	FieldGuide.tif
Butterfly5.tif	LicenseRender.tif
Mettler.4.jpg	TestPattern.jpg
HalfTone.bmp	RGBwedge.tif
FieldGuide640x480.tif	GreyWedge.tif
PineNeedleSnow.jpg	OilDrums.jpg
Digits.tif	SMPTE.tif
Butterfly6.tif	Smiley.tif
PanelLogoPro.tif	LicenseNonCommercial.tif
Butterfly1.tif	

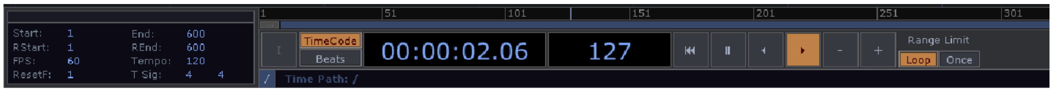
TestFiles

Converting between OP families

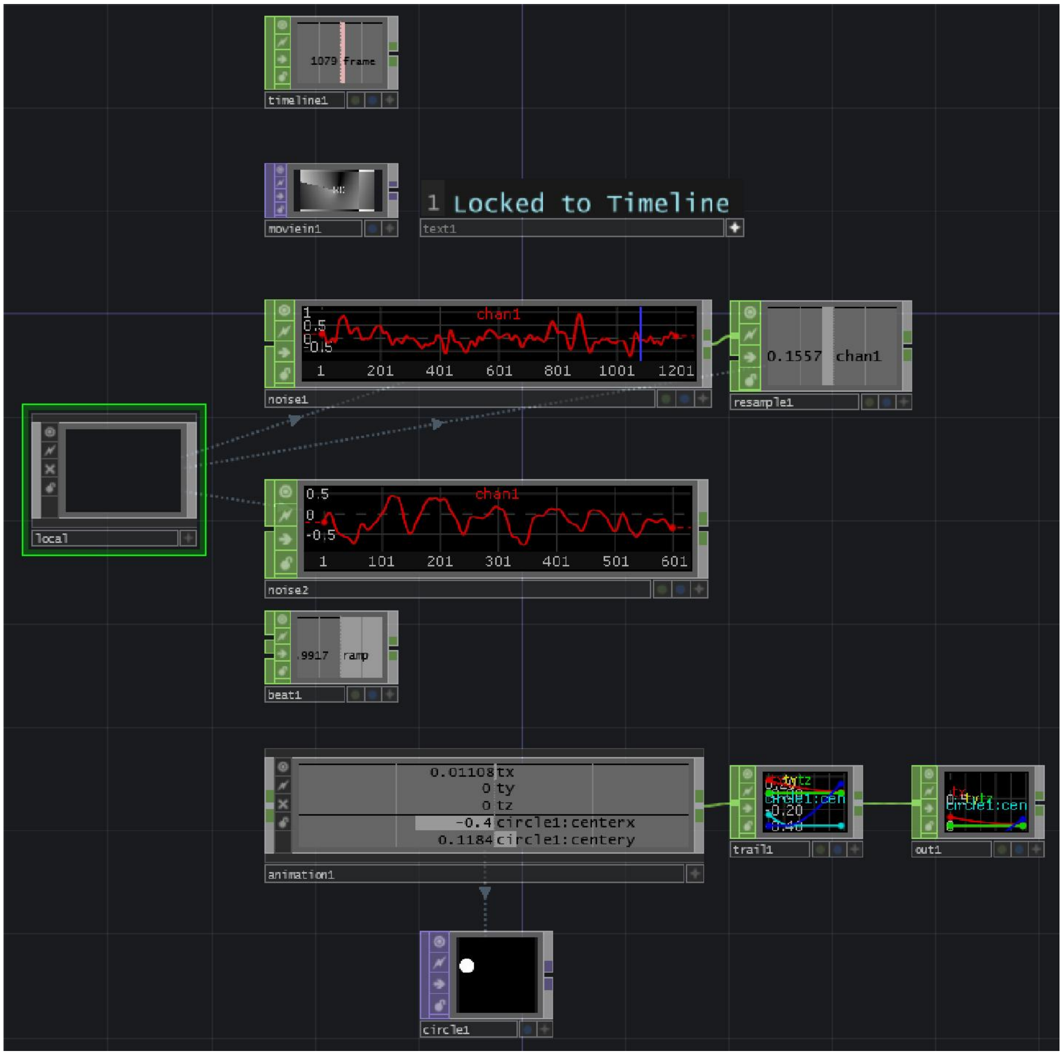


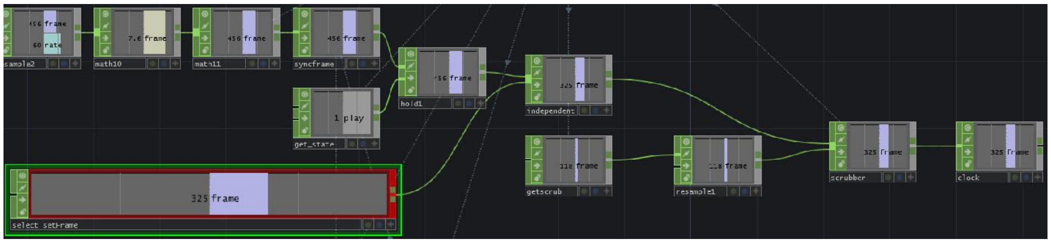


Dealing with time

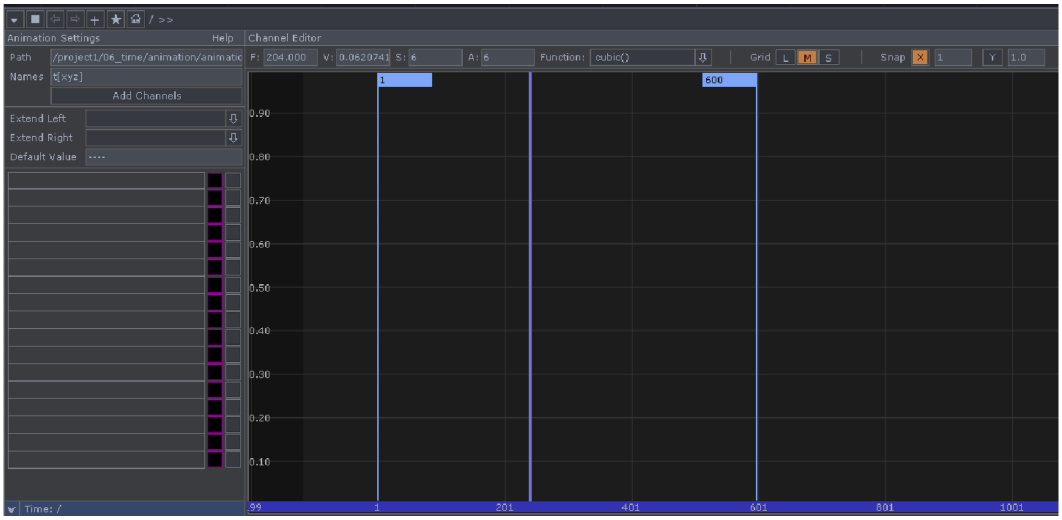


```
Start:   1      End:     600
RStart:  1      REnd:    600
FPS:     60     Tempo:   120
ResetF:  1      T Sig:   4     4
```





The Animation component


Animation Settings

Path /project1/06_time/animation/animatic

Names t[xyz]

Add Channels

Extend Left

Extend Right

Default Value ----

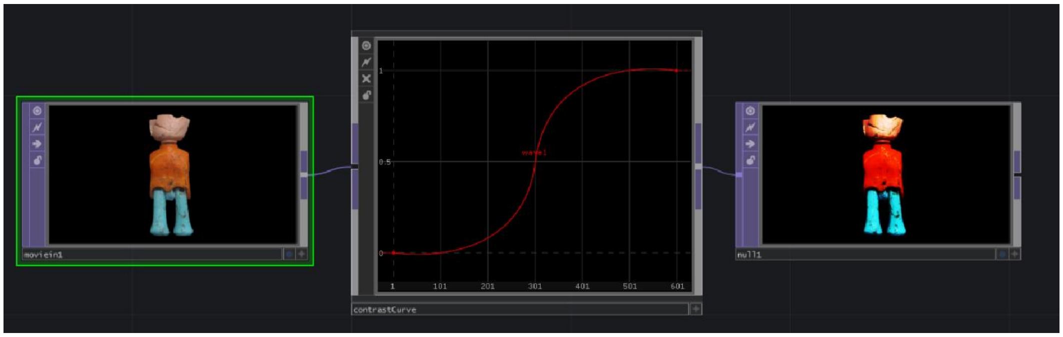
Time: /

Channel Editor

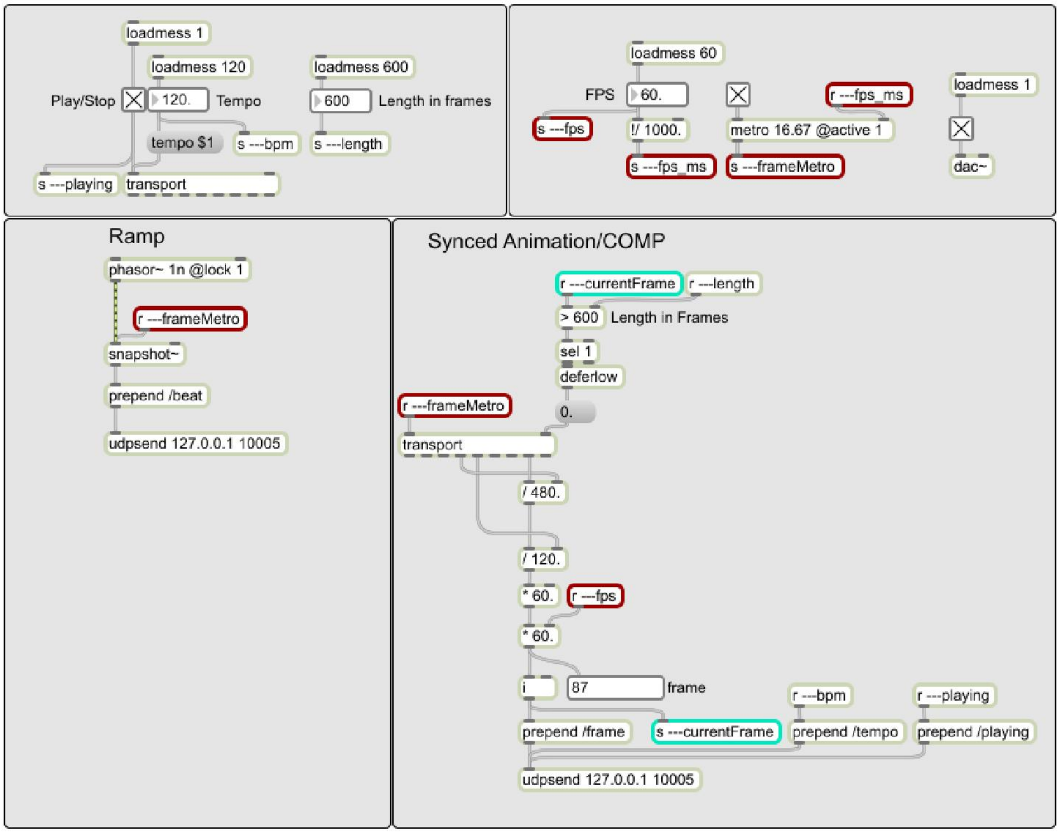
F: 204.000 V: 0.0620741 S: 6 A: 6 Function: cubic()

Grid L M S Snap X 1 Y 1.0

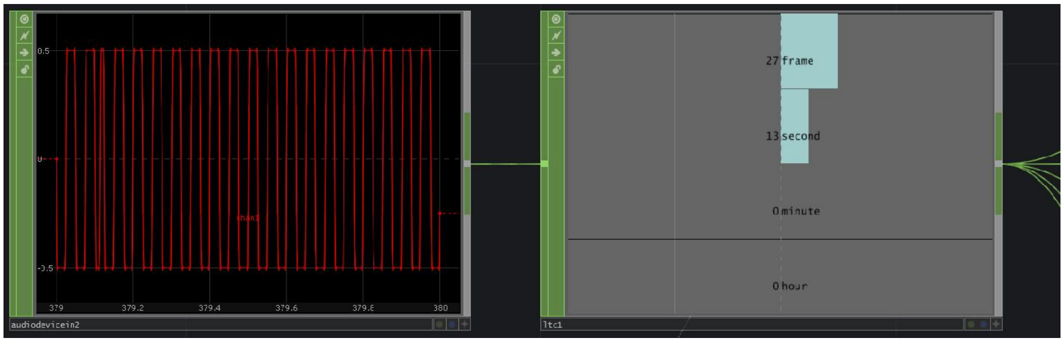
Using the animation COMP for nonlinear purposes



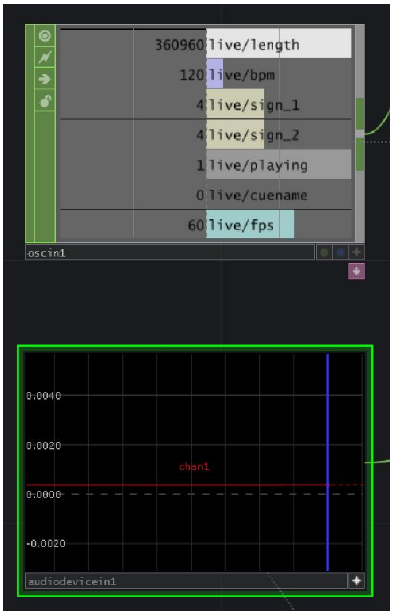
Synchronization



SMPTE LTC

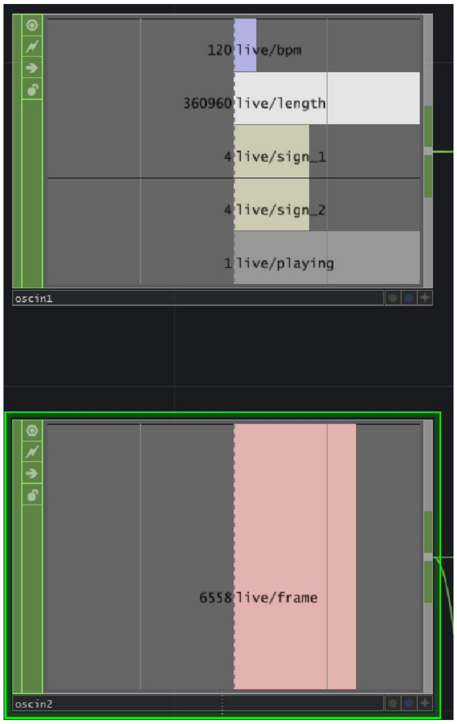


Audio ramp



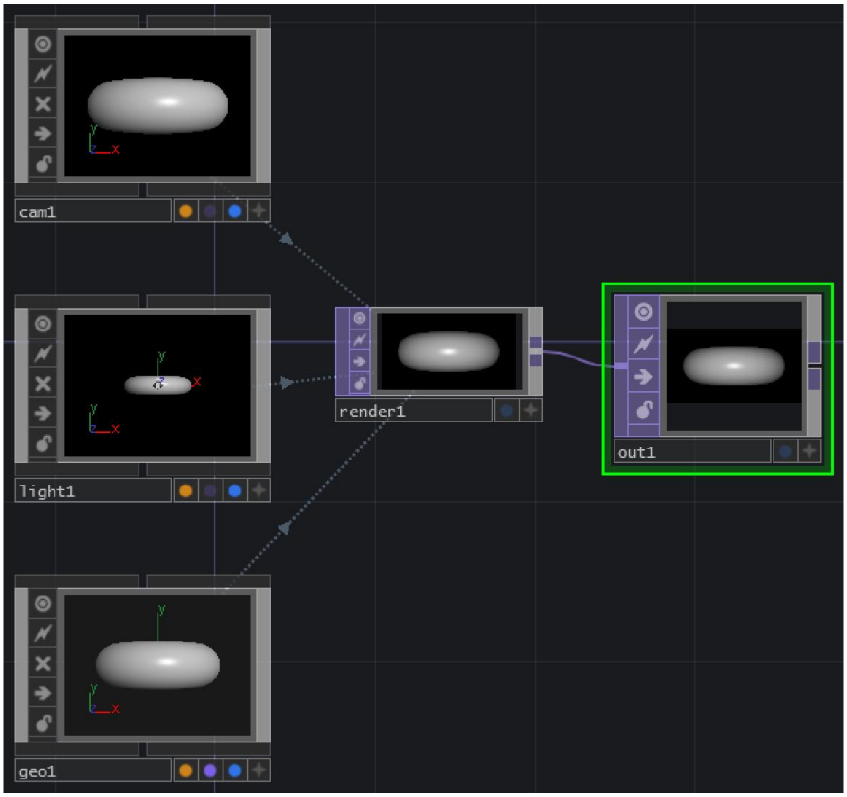
```
360960 live/length
   120 live/bpm
     4 live/sign_1
     4 live/sign_2
     1 live/playing
     0 live/cuename
    60 live/fps
```

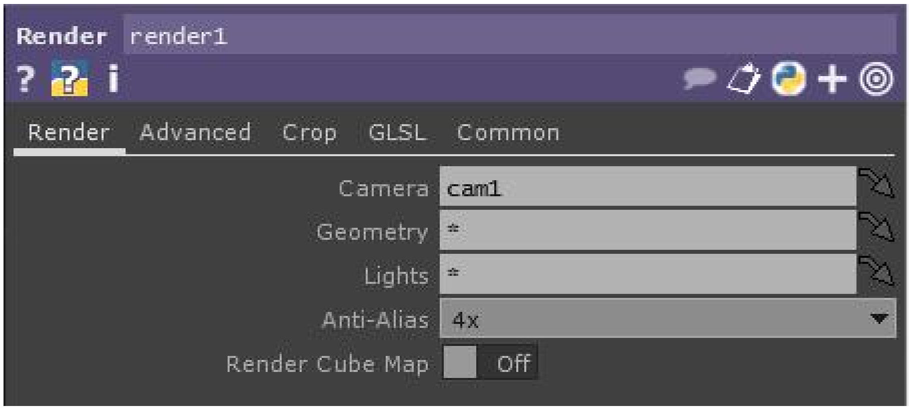
UDP



```
   120 live/bpm
360960 live/length
     4 live/sign_1
     4 live/sign_2
     1 live/playing
oscin1

  6558 live/frame
oscin2
```

Introducing 3D rendering





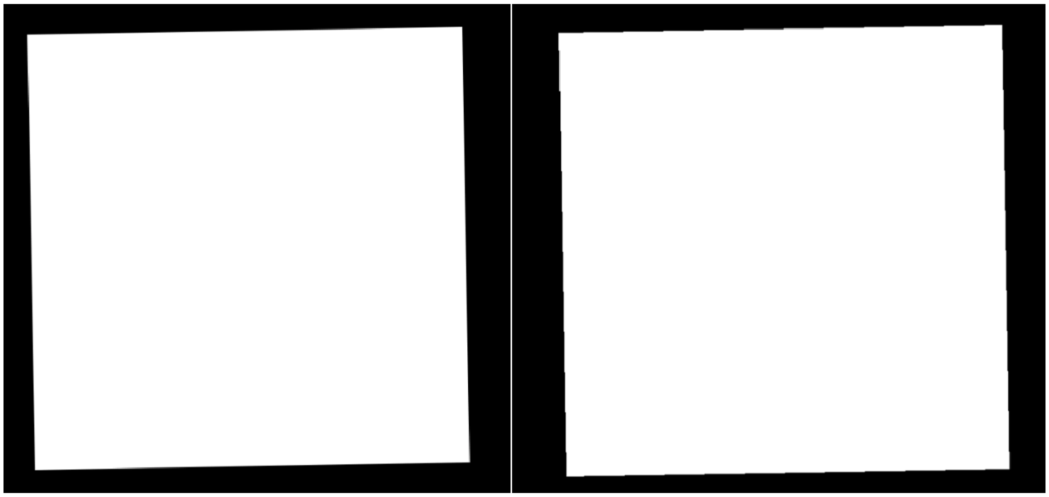
Camera cam1

Geometry *

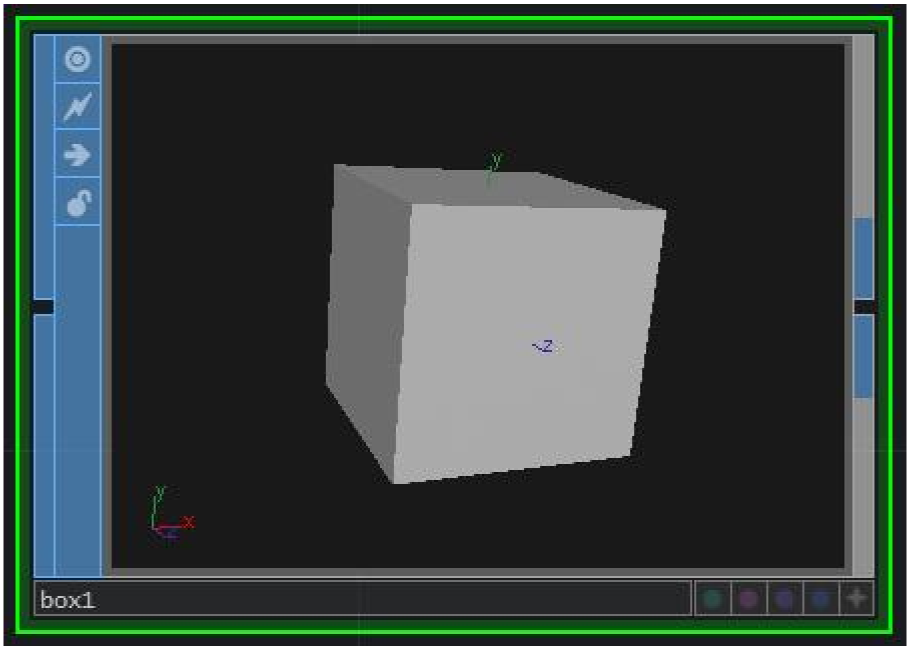
Lights *

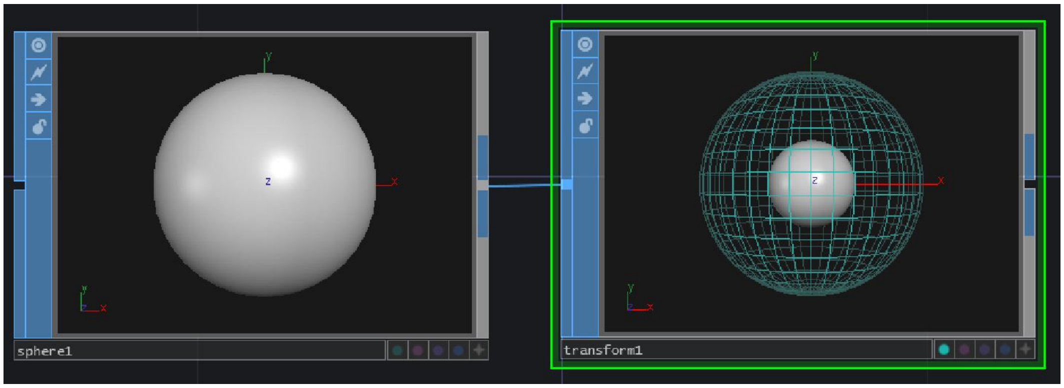
Anti-Alias 4x

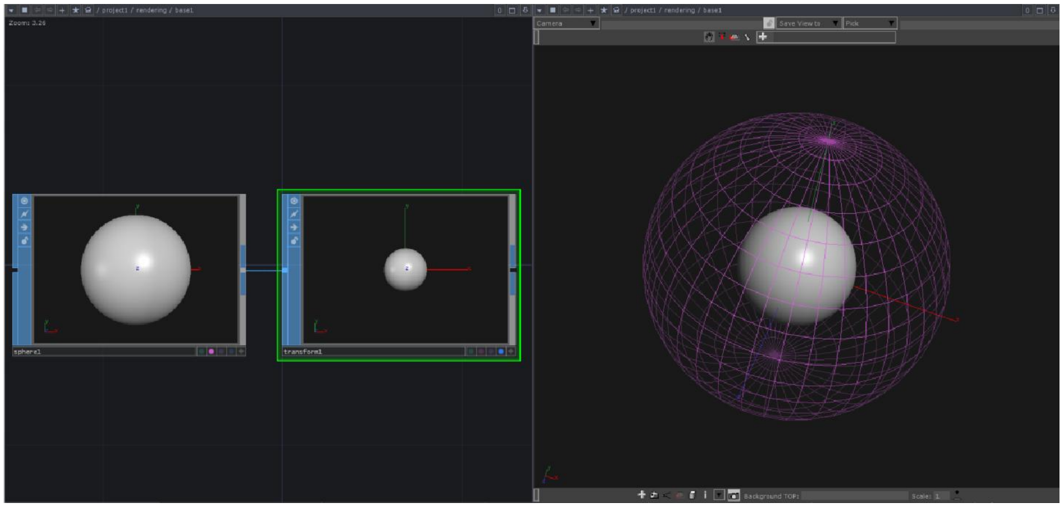
Render Cube Map Off



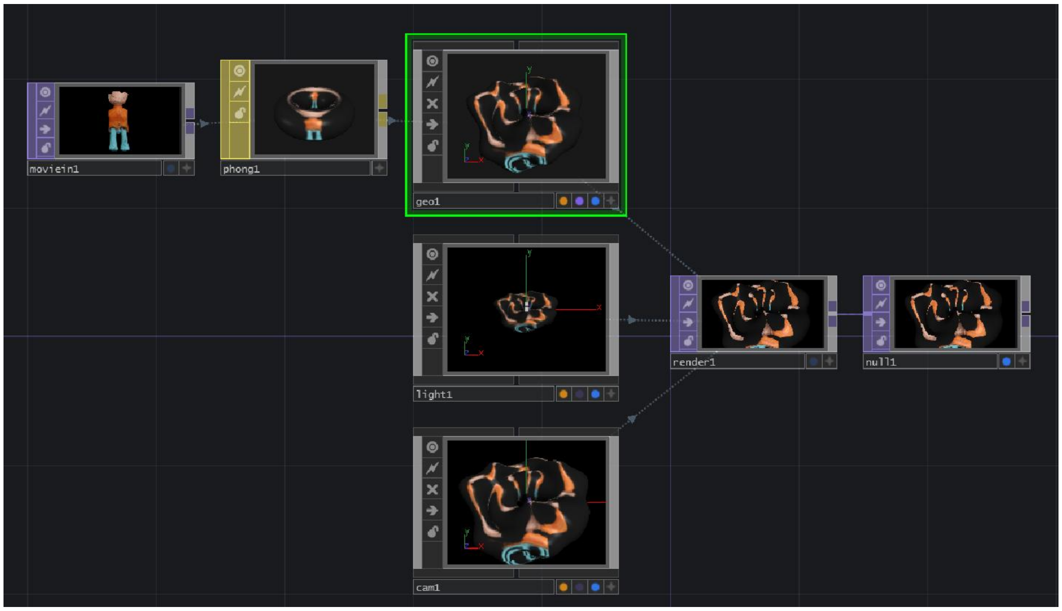
SOPs

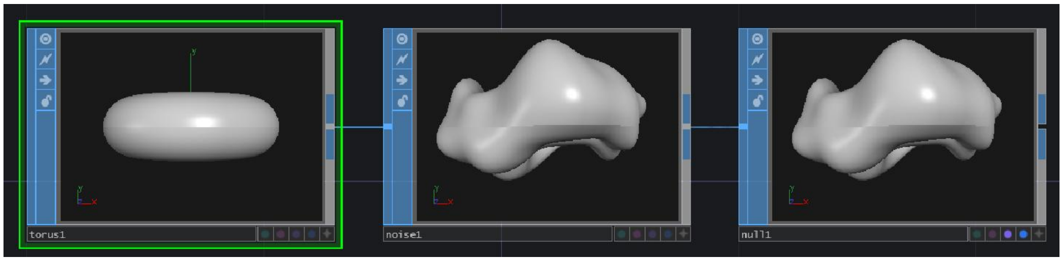



y
z
x
sphere1
y
z
x
transform1

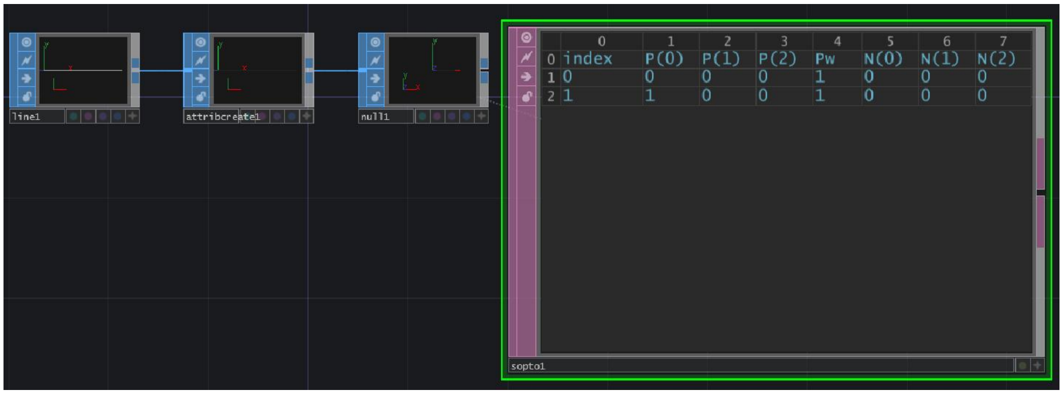

/ project1 / rendering / base1
Zoom: 3.26
sphere1
transform1
/ project1 / rendering / base1
Camera
Save View to
Pick
Background TOP:
Scale: 1

Assigning a material

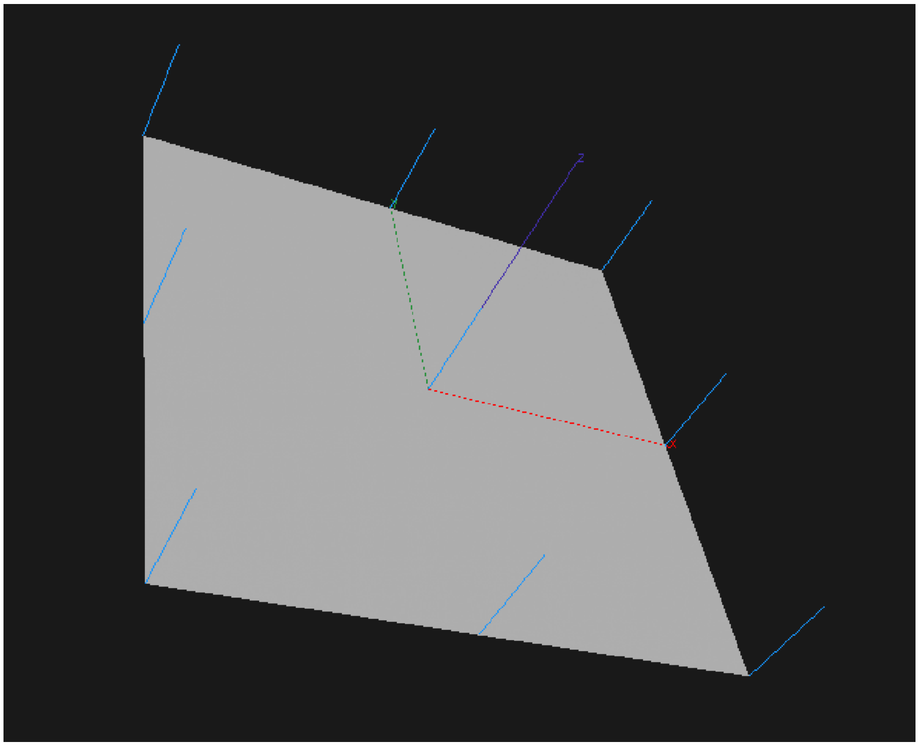


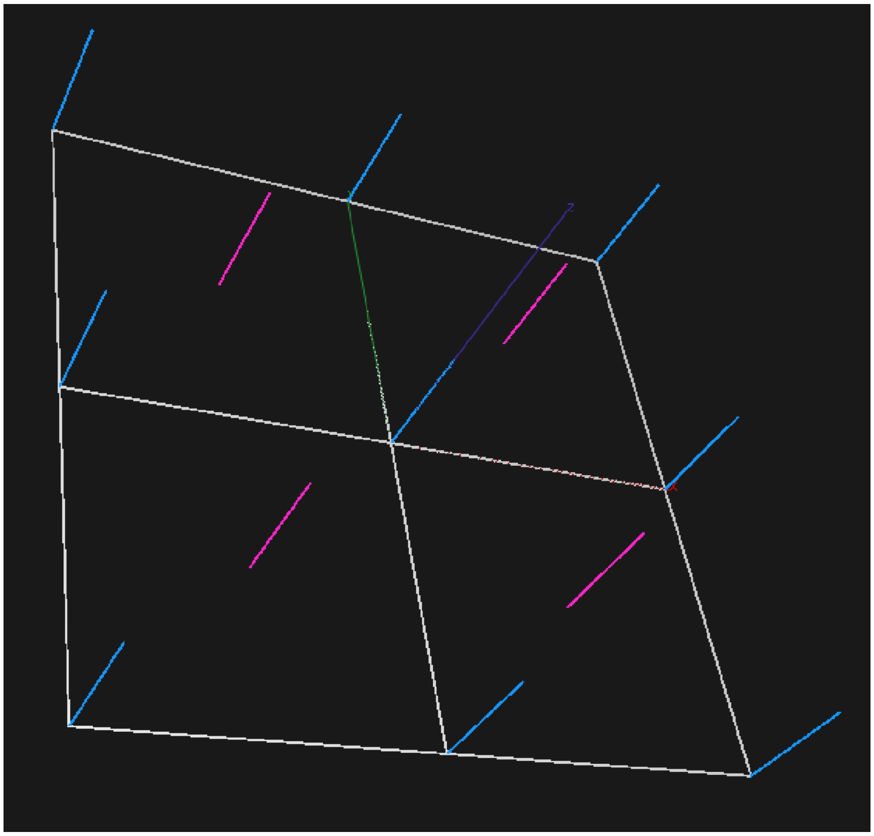


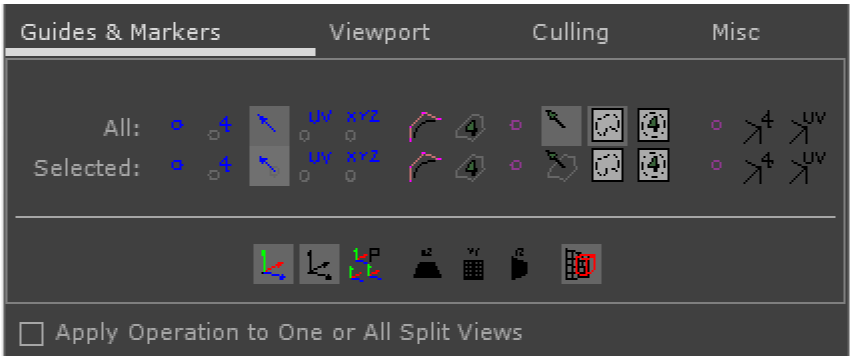
The data inside SOPs



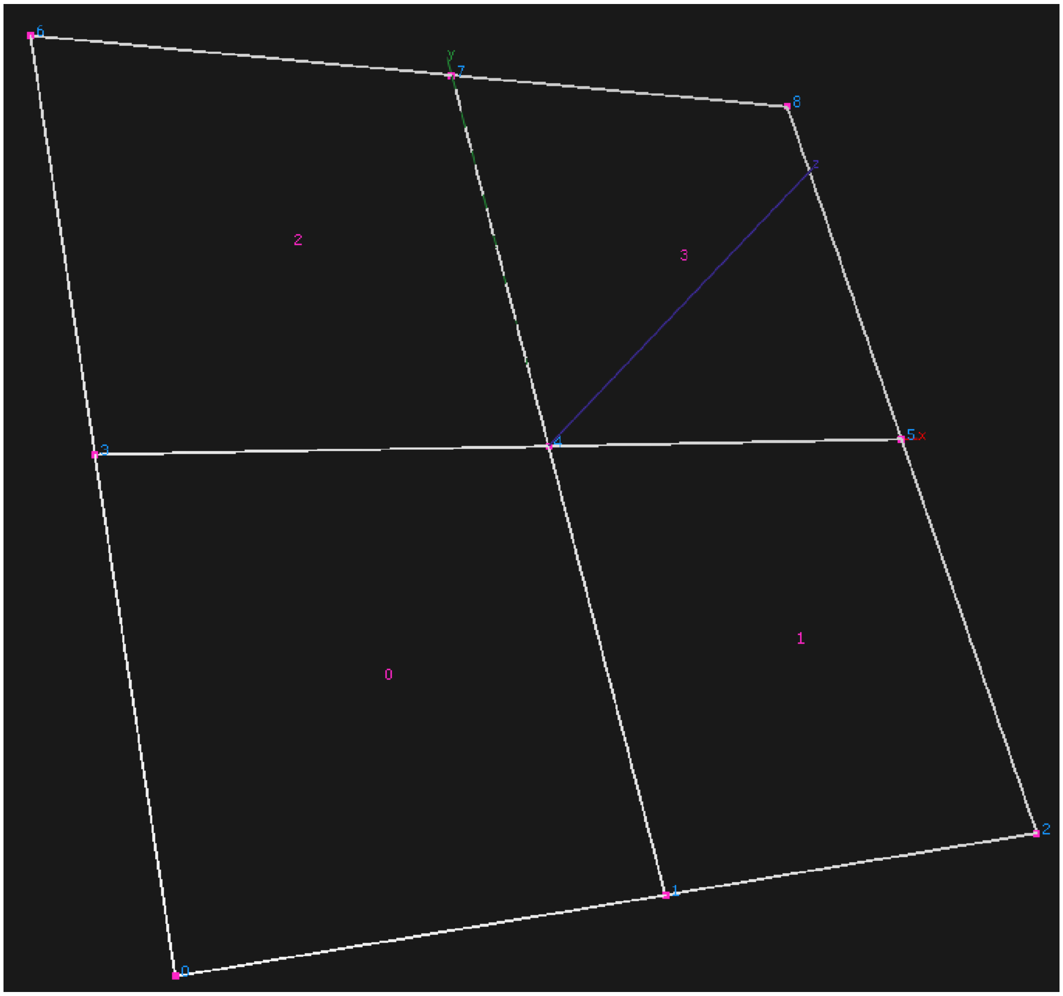
	0	1	2	3	4	5	6	7
0	index	P(0)	P(1)	P(2)	Pw	N(0)	N(1)	N(2)
1	0	0	0	0	1	0	0	0
2	1	1	0	0	1	0	0	0

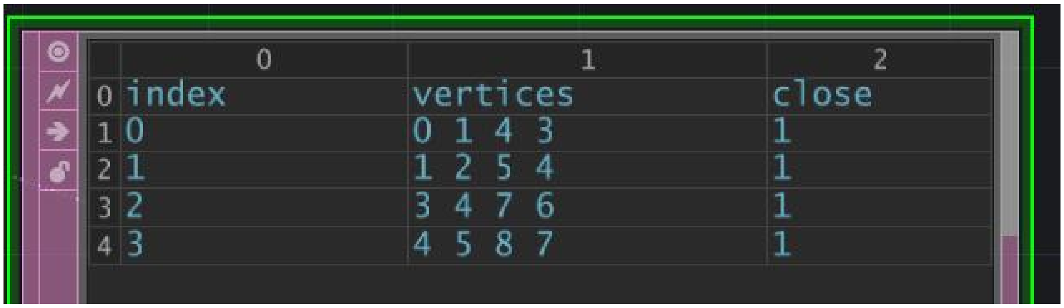




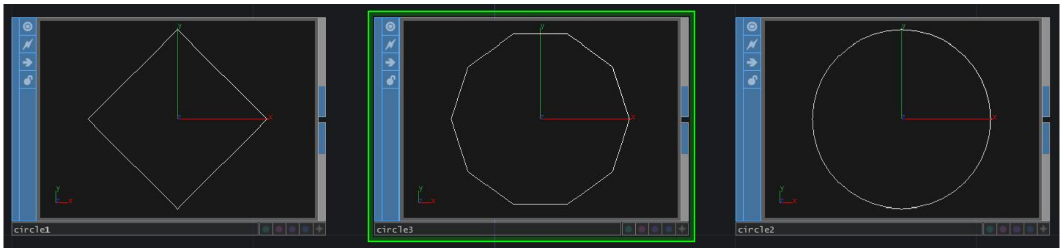


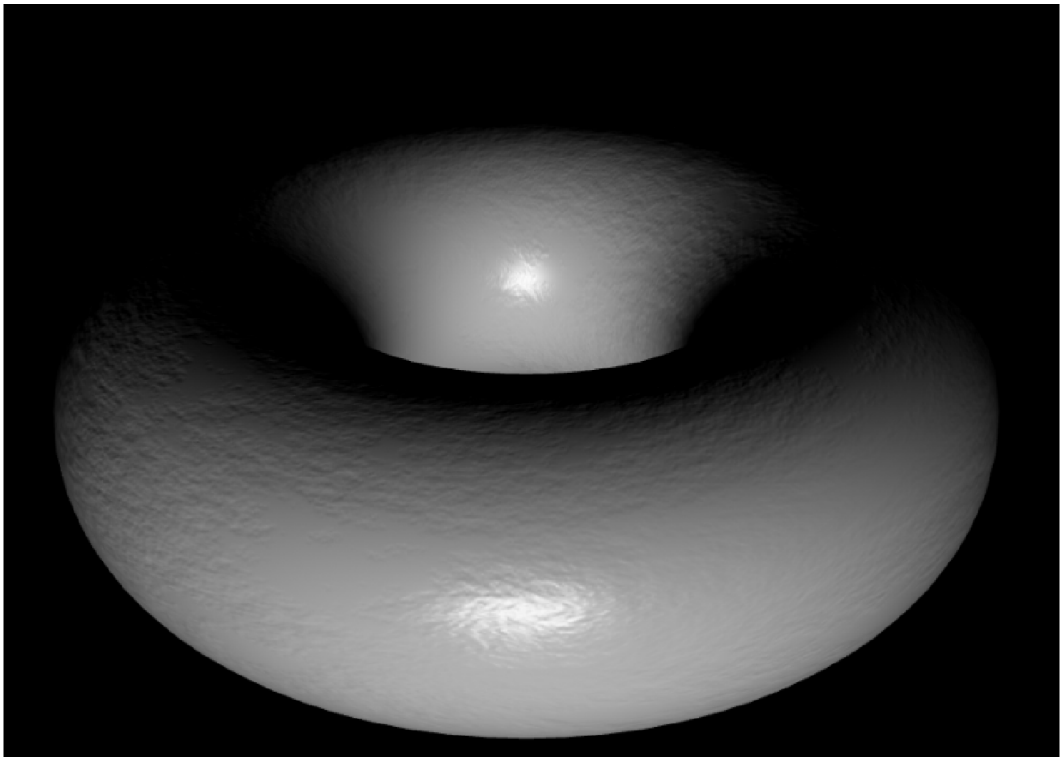
☐ Apply Operation to One or All Split Views

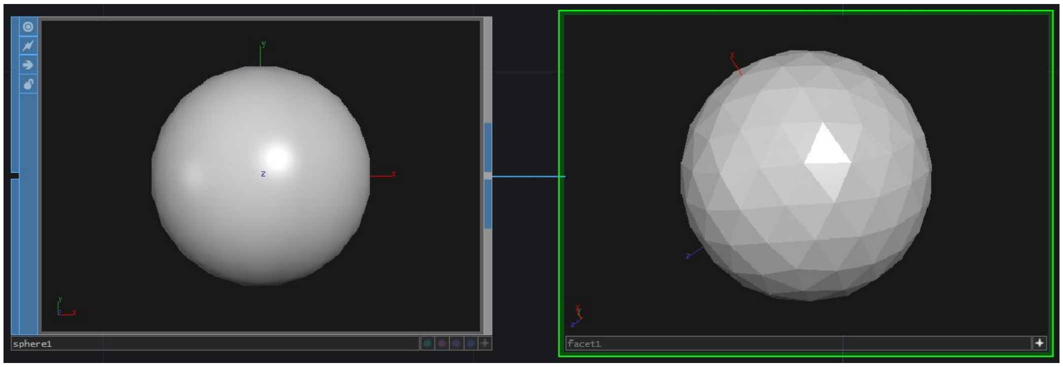


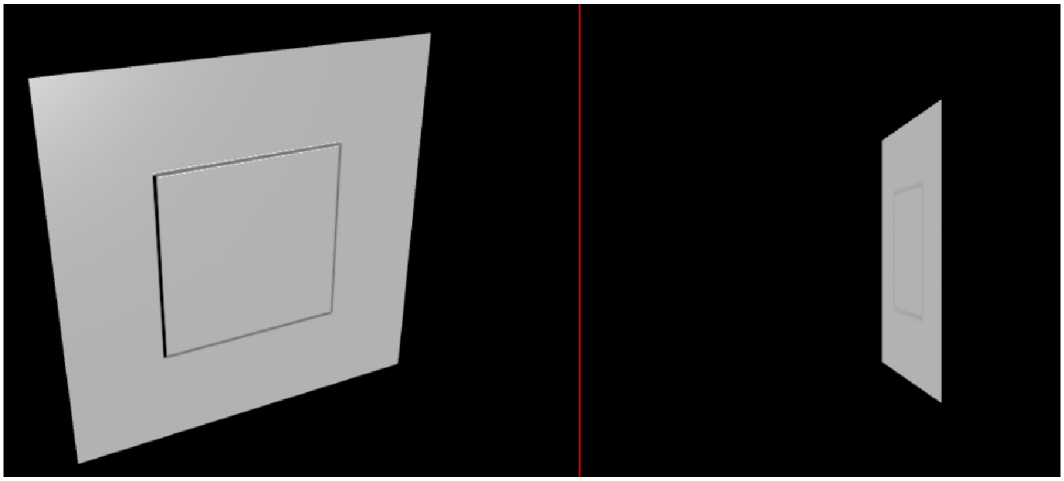


	0	1	2
0	index	vertices	close
1	0	0 1 4 3	1
2	1	1 2 5 4	1
3	2	3 4 7 6	1
4	3	4 5 8 7	1


circle1
circle3
circle2




sphere1
facet1

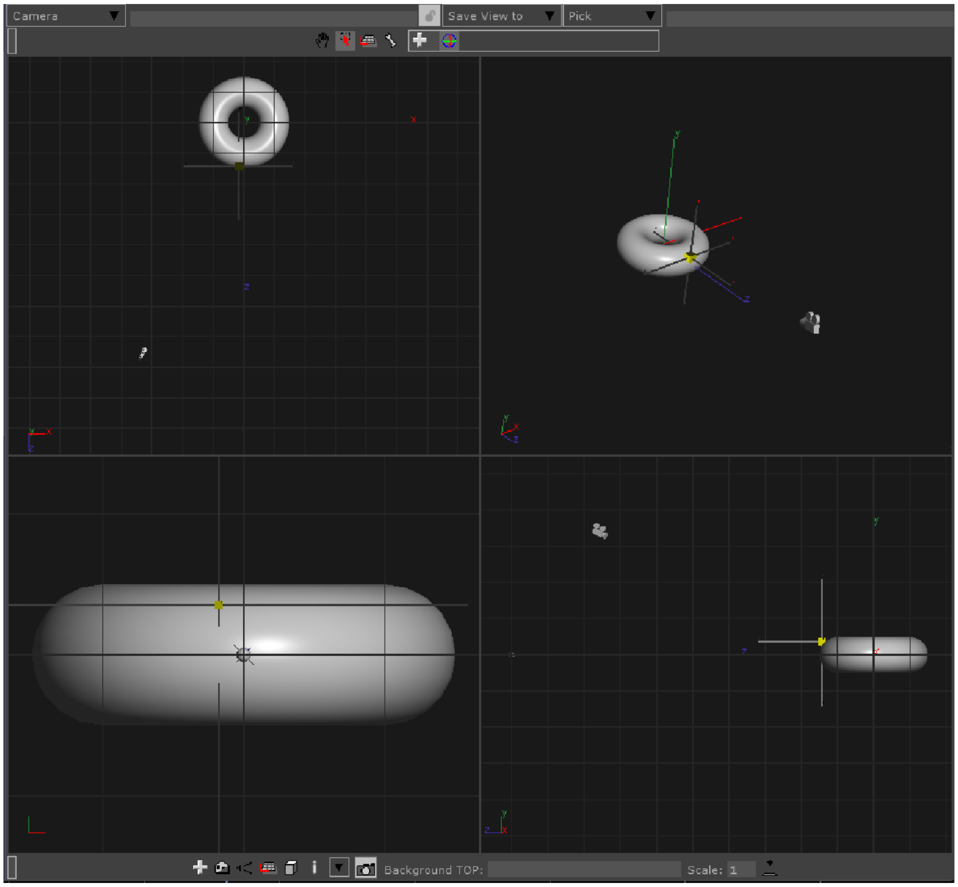


11

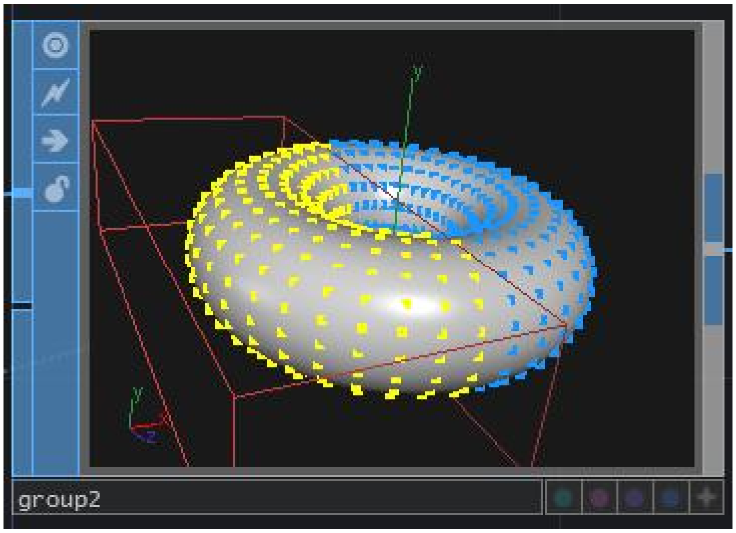
3D Rendering and Examples

Interactive and non-procedural tools

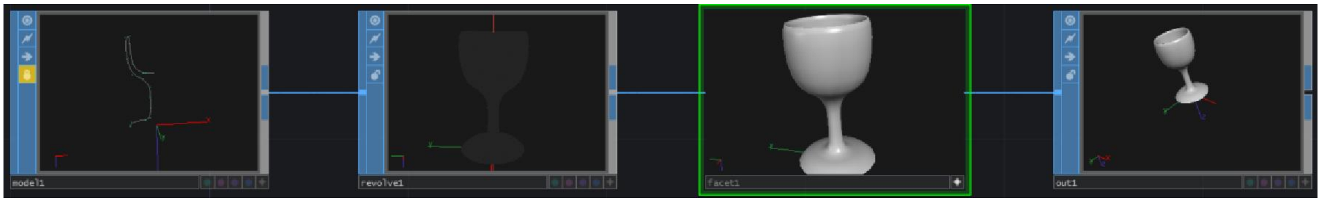
The geometry viewer



Grouping by selection

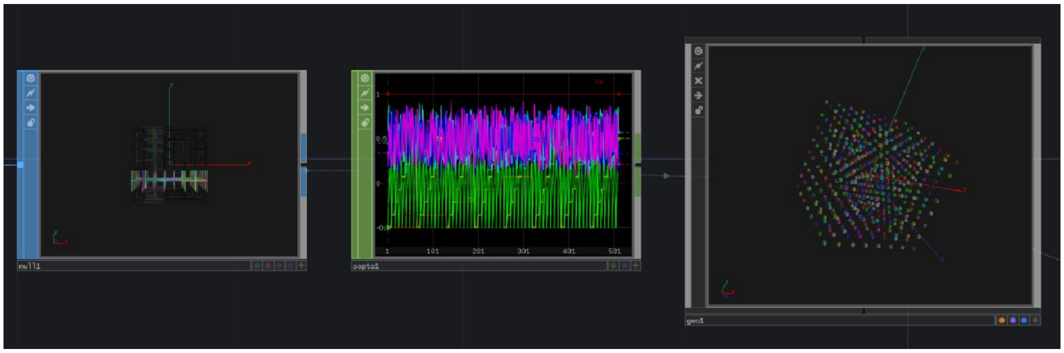


The Modeler



The Geo COMP

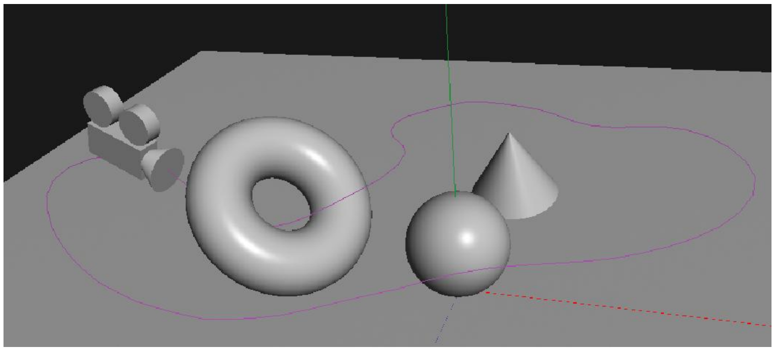
Instancing



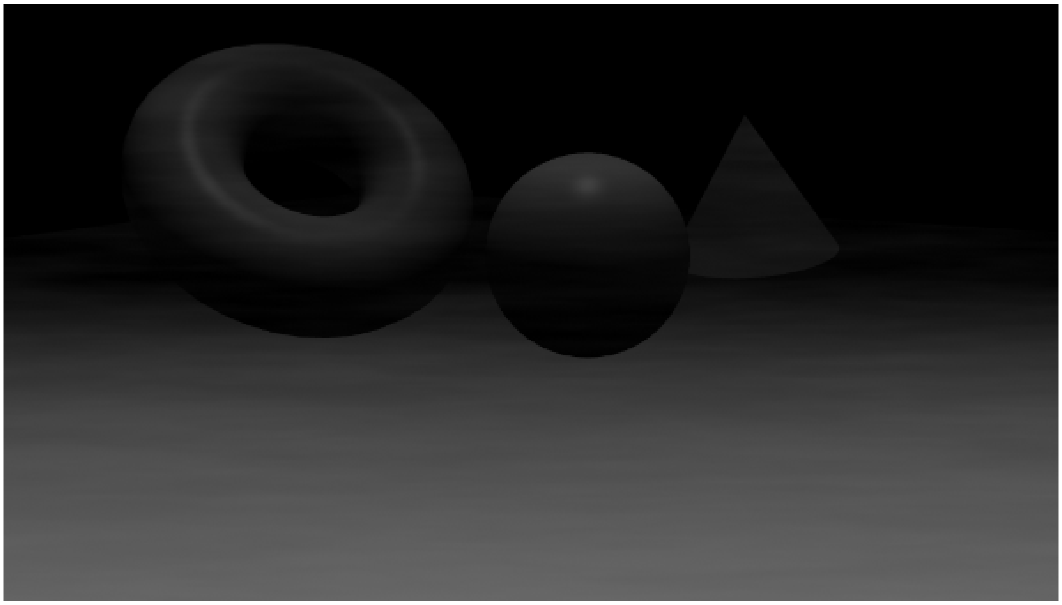
Camera, light, and shading

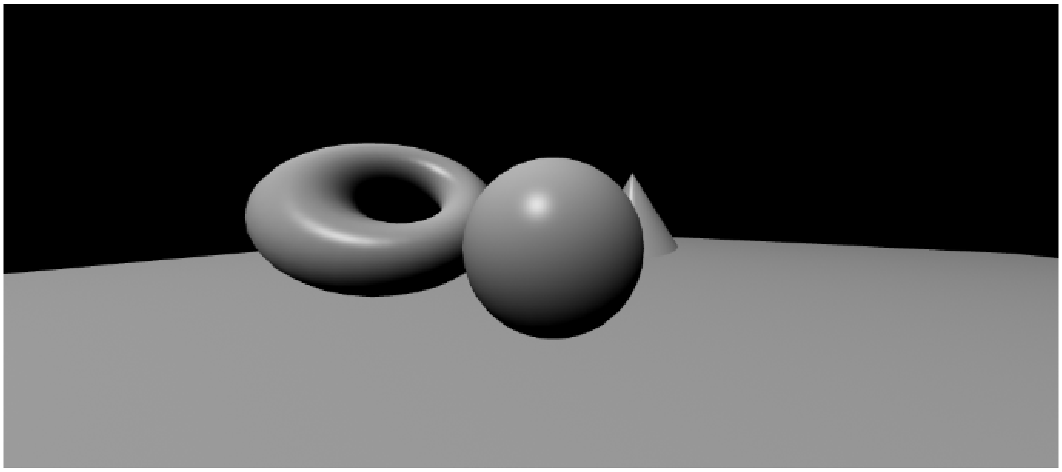
Cameras

A camera path

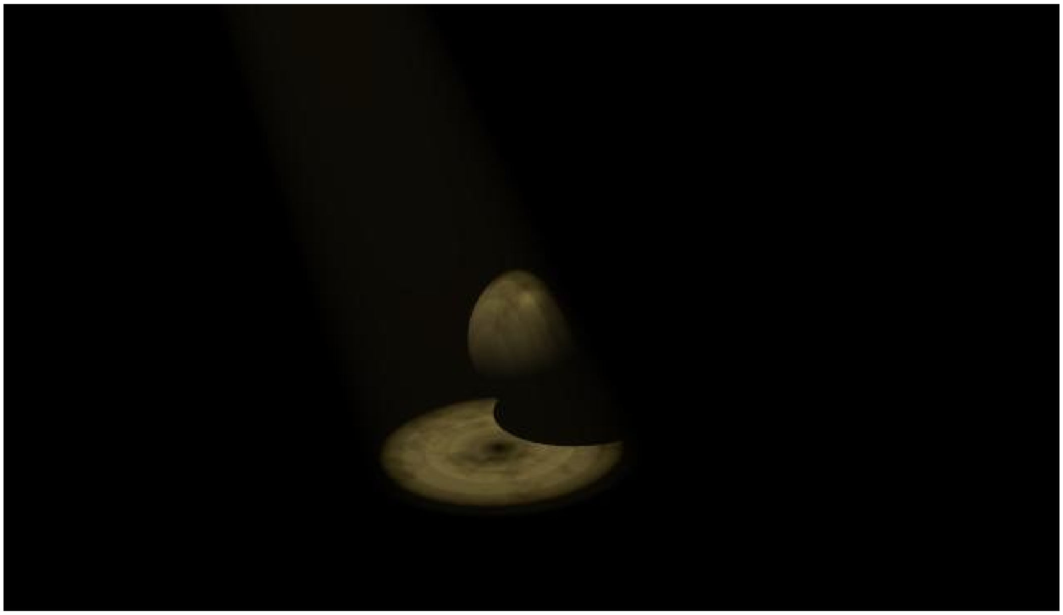


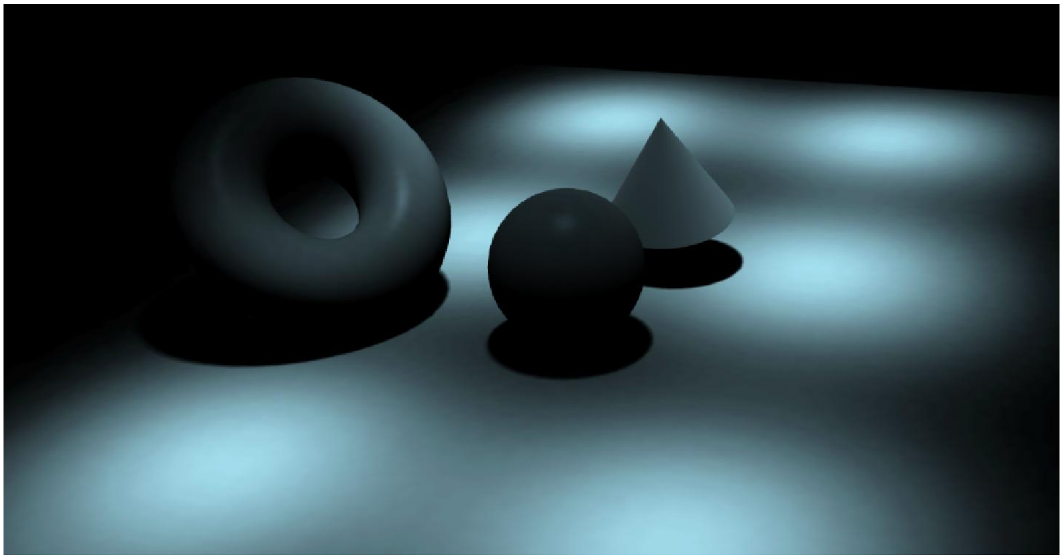
Fog and FOV



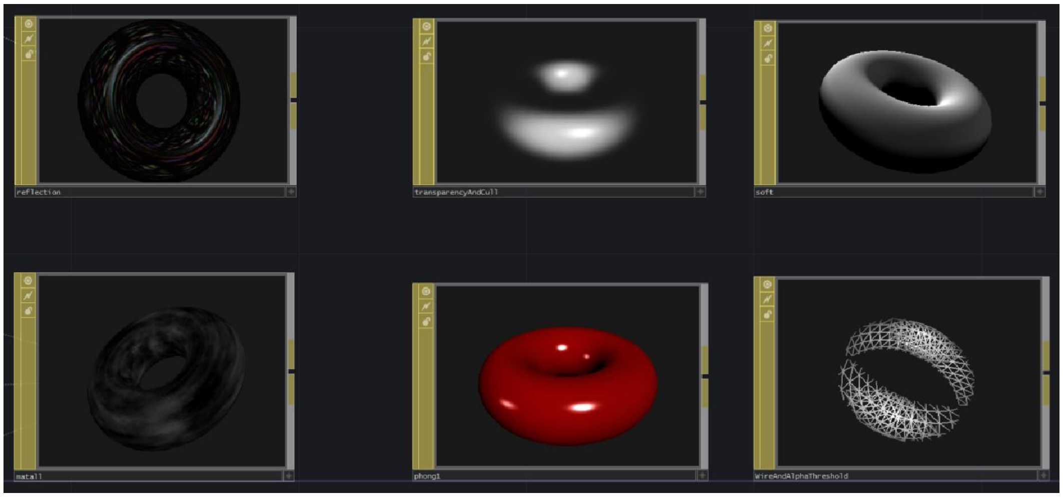


Lights and shadows

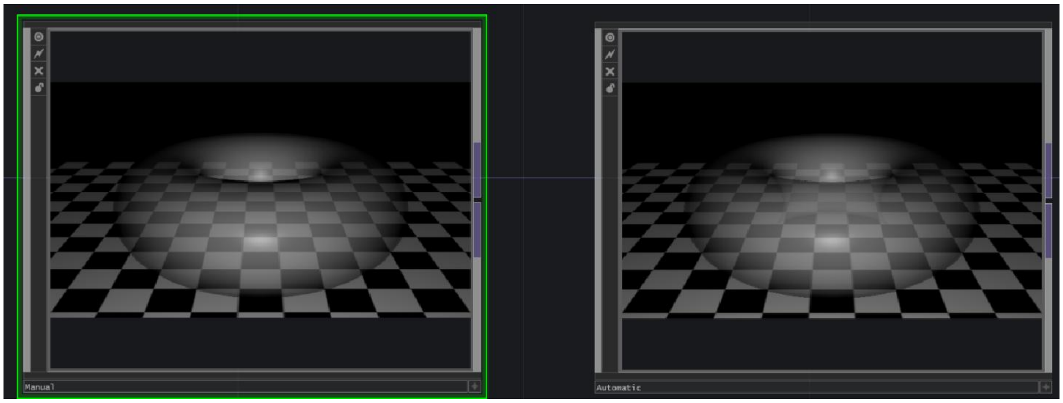




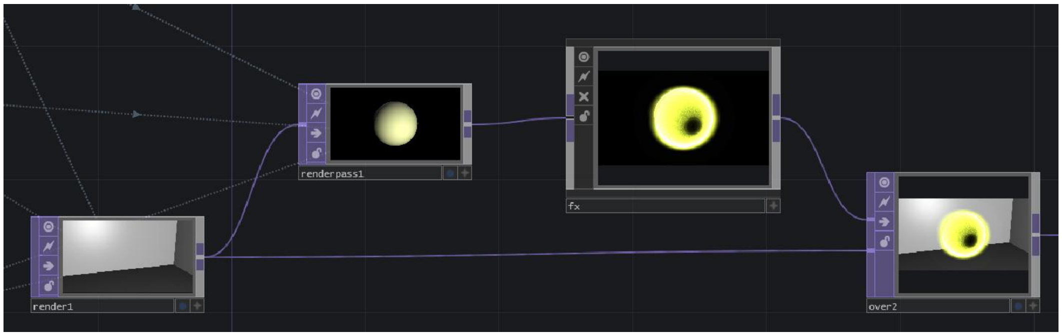
Materials



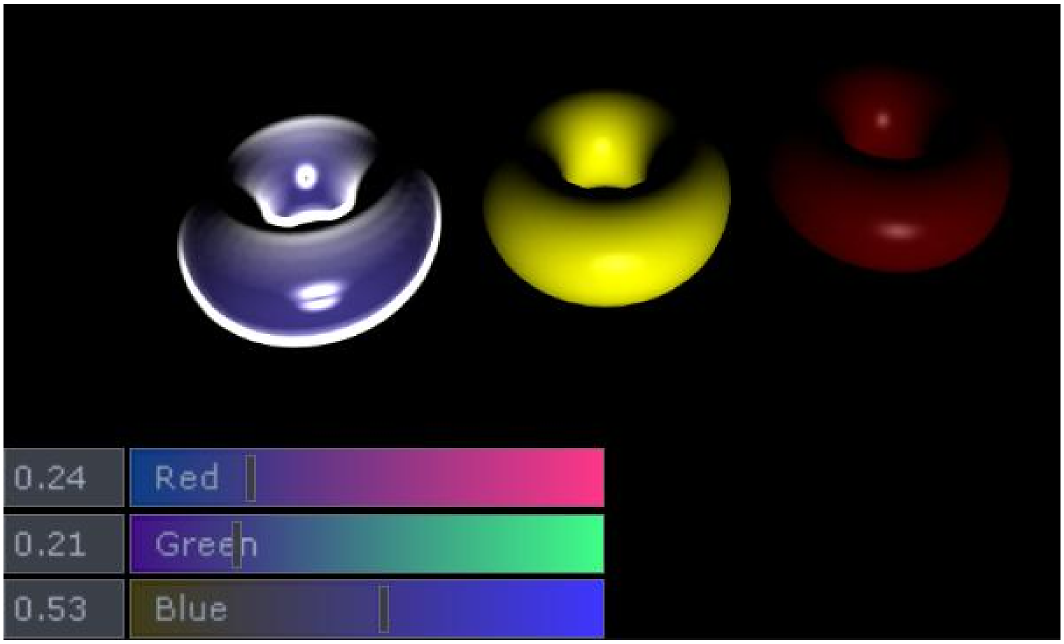
Transparency

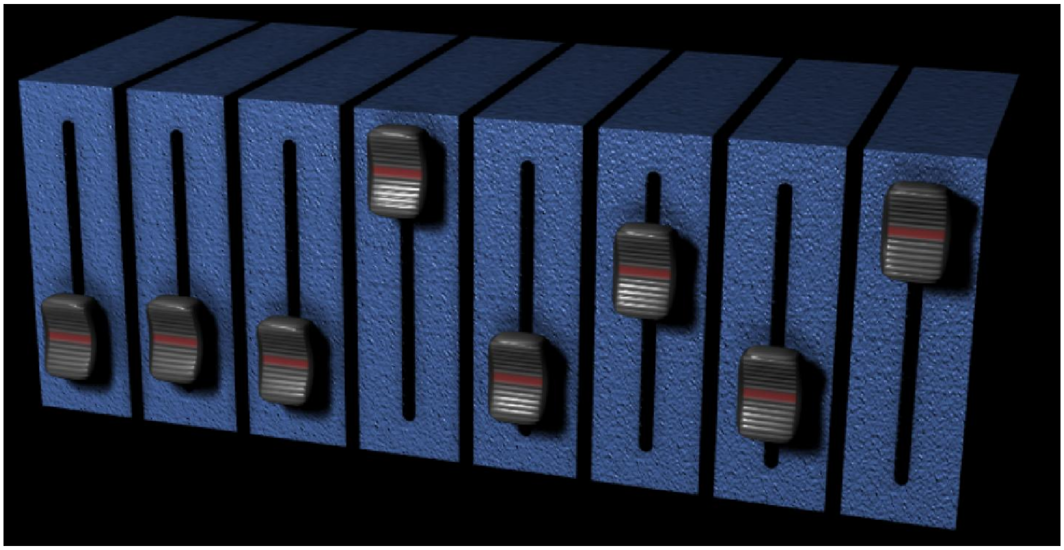


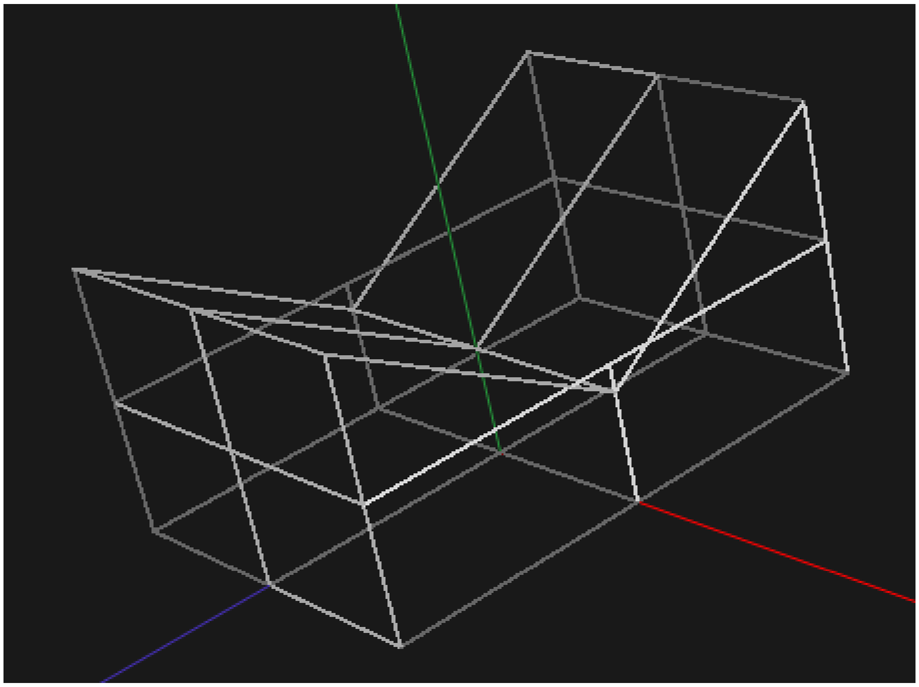
Render passes

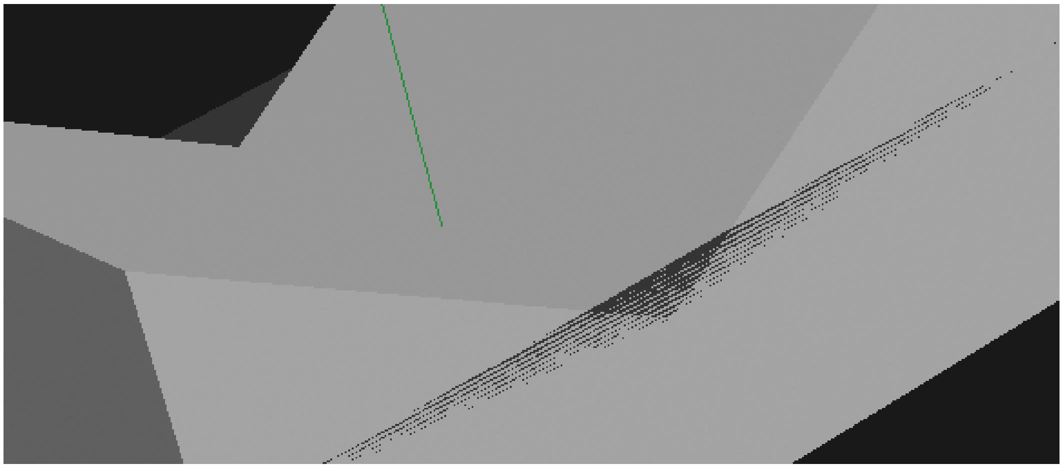


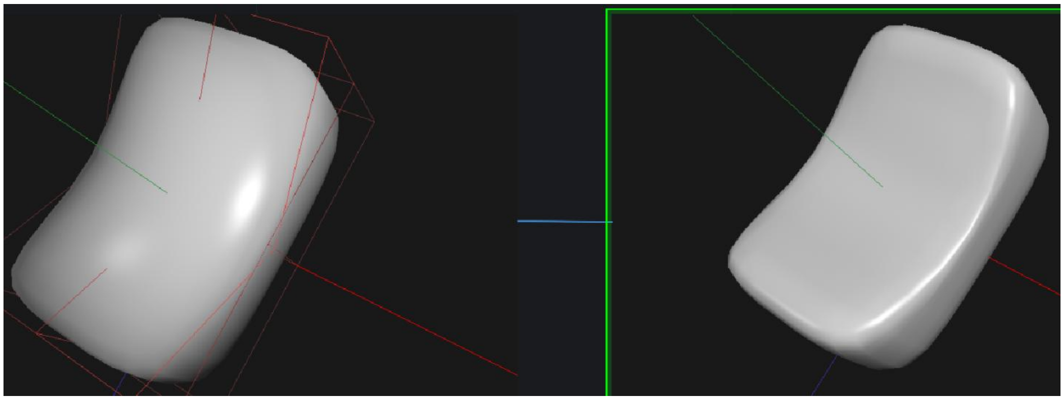
Render picking and 3D GUIs





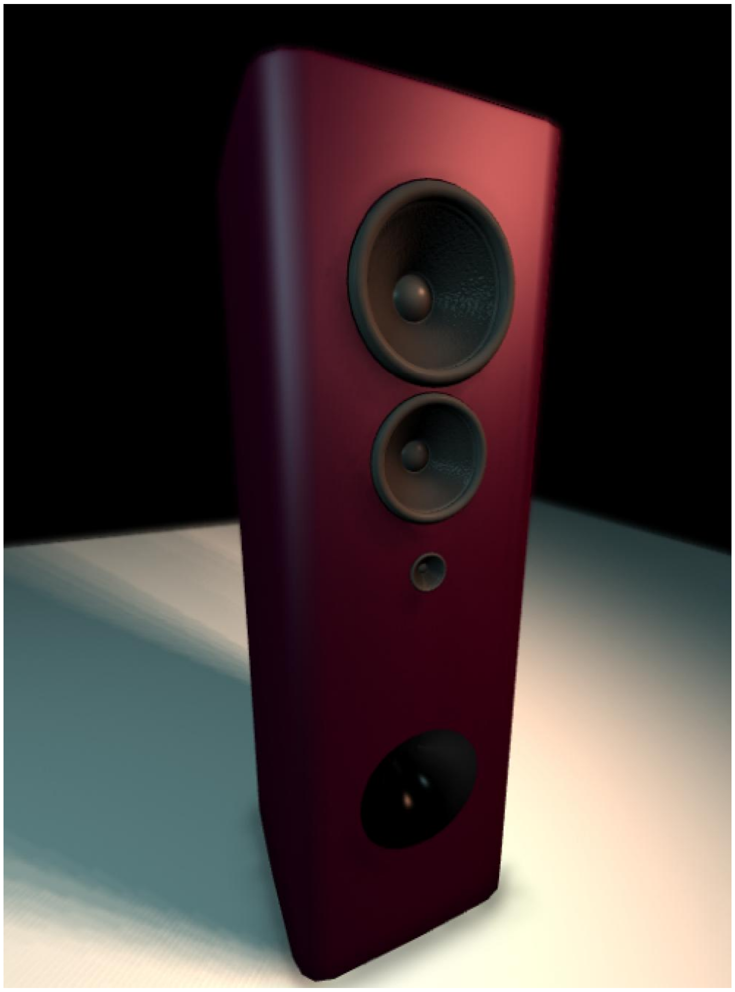


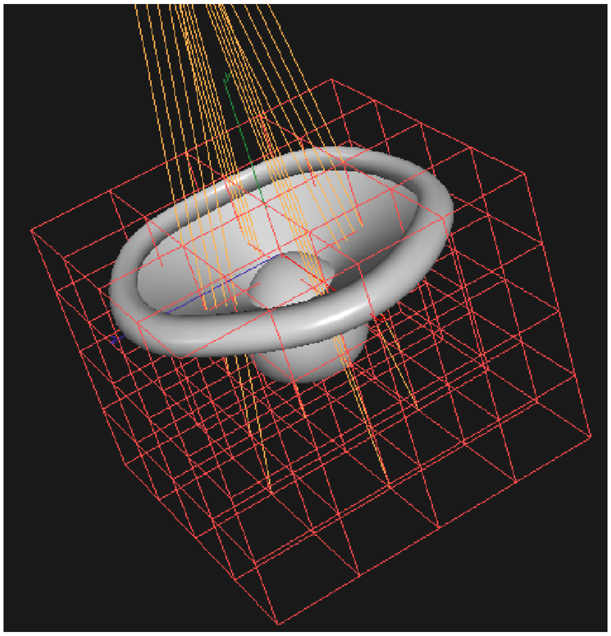




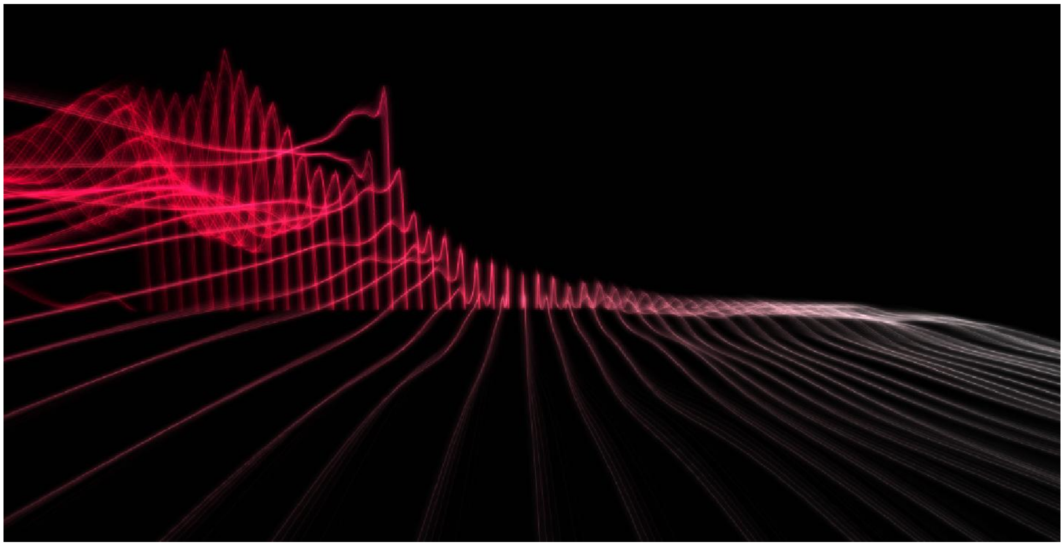
Examples of procedural modeling

A speaker

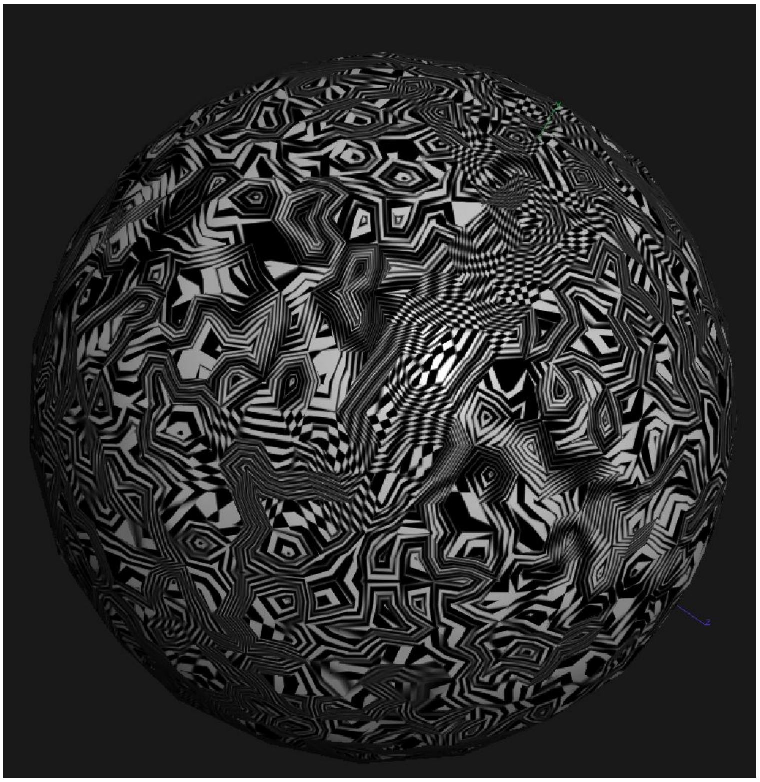




A waterfall plot

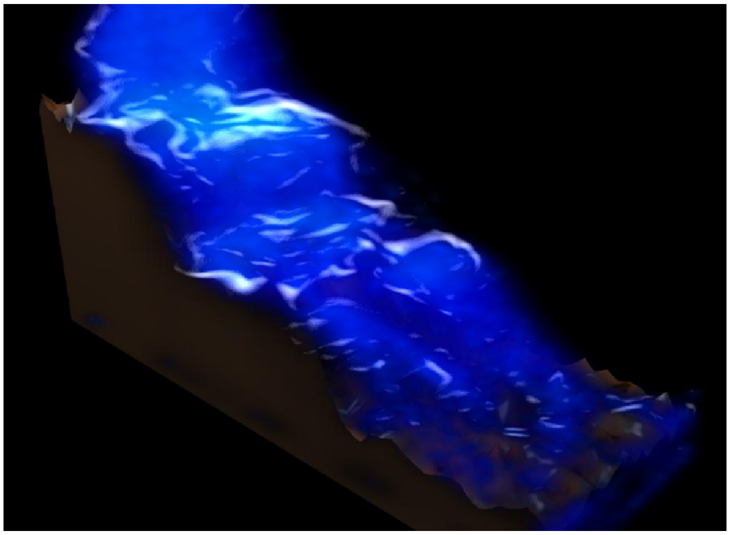


A fractal texture



Modeling

Liquid

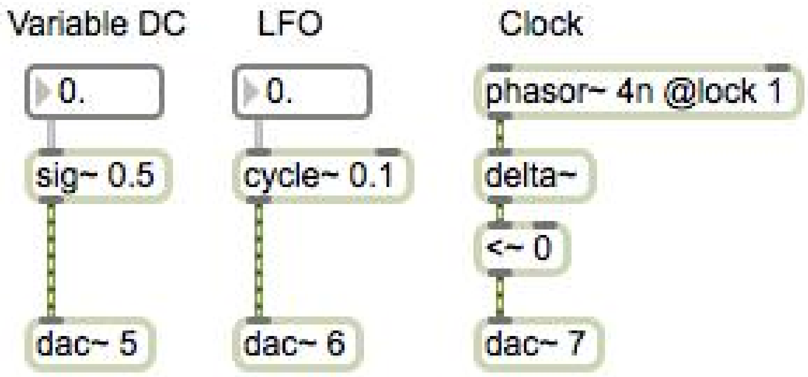


A house in a landscape

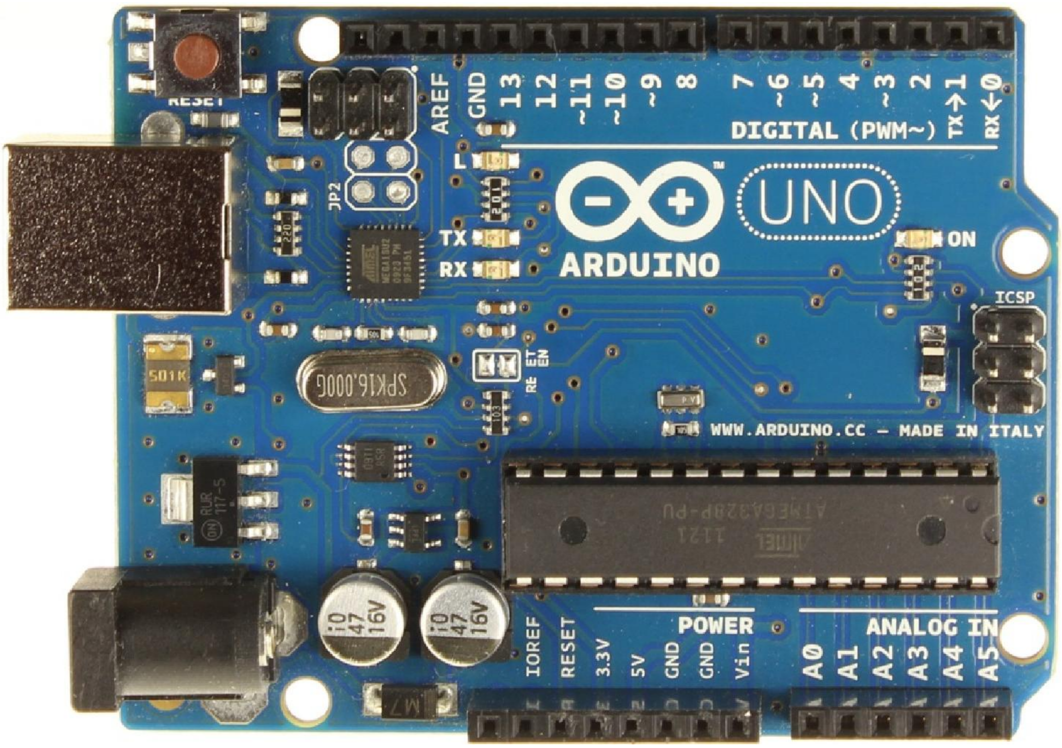
12

Connecting Our Software to the World

Analog synths and control voltage

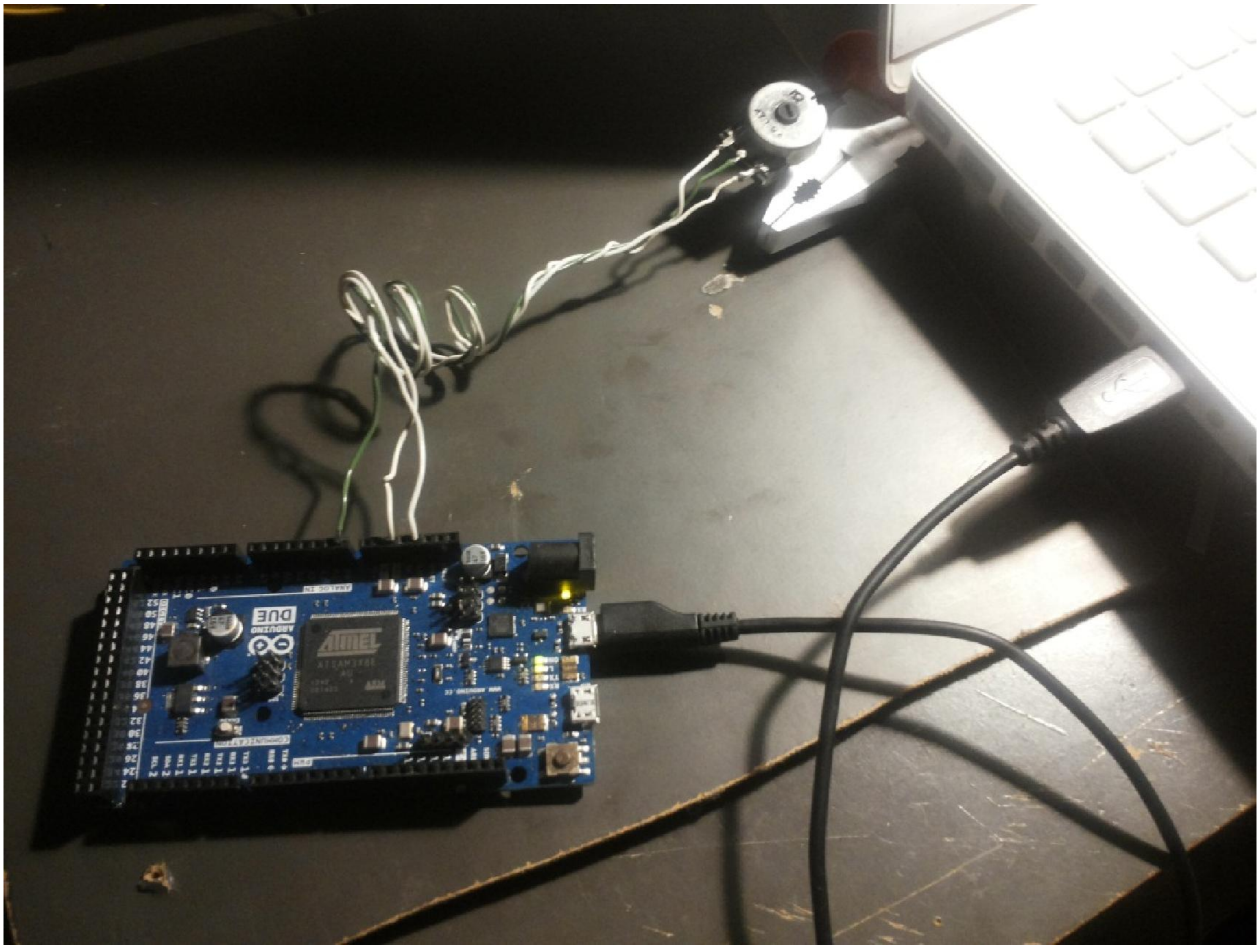


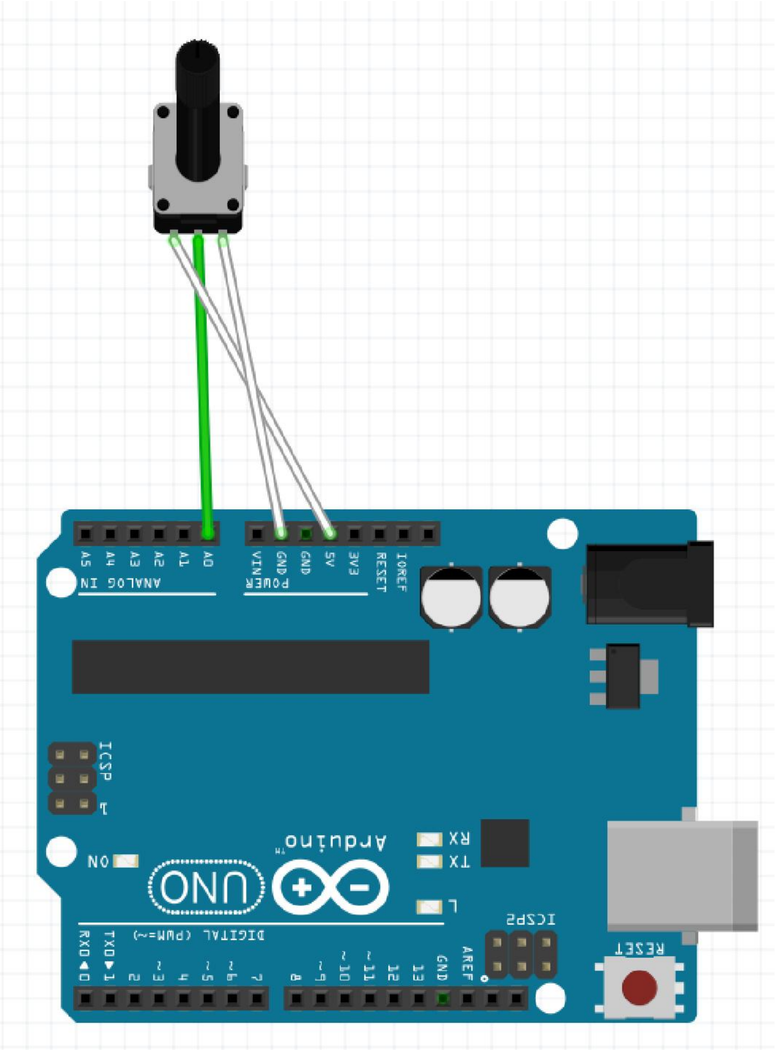
Arduino and microcontrollers



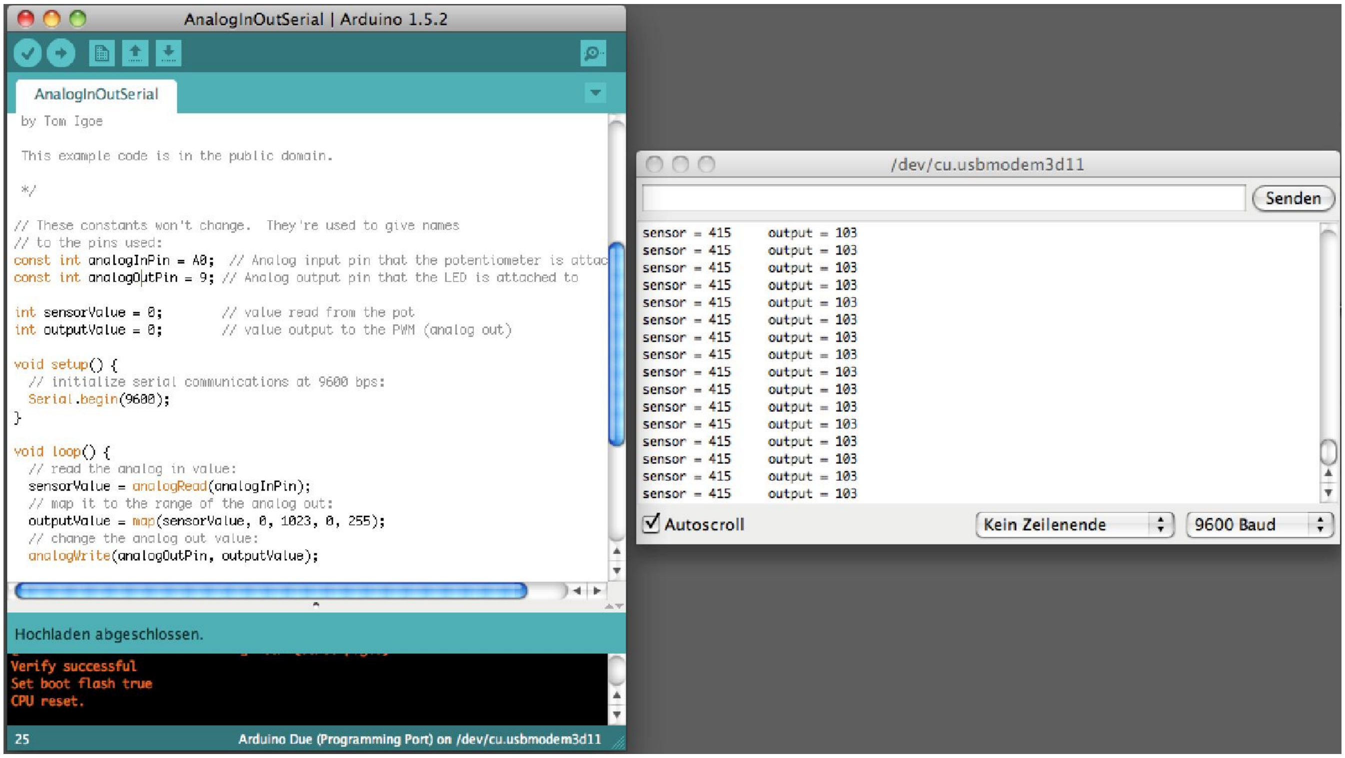
An Arduino example project

Hardware requirements for the Arduino project




ANALOG IN
A5
A4
A3
A2
A1
A0
POWER
VIN
GND
GND
5V
3V3
RESET
IOREF
ICSP
Arduino™
UNO
ON
RX
TX
L
ICSP2
RESET
DIGITAL (PWM=~)
TX0▶1
RX0◀0
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2

The Arduino code



```
 by Tom Igoe

 This example code is in the public domain.

 */

// These constants won't change.  They're used to give names
// to the pins used:
const int analogInPin = A0;  // Analog input pin that the potentiometer is attac
const int analogOutPin = 9; // Analog output pin that the LED is attached to

int sensorValue = 0;        // value read from the pot
int outputValue = 0;        // value output to the PWM (analog out)

void setup() {
  // initialize serial communications at 9600 bps:
  Serial.begin(9600);
}

void loop() {
  // read the analog in value:
  sensorValue = analogRead(analogInPin);
  // map it to the range of the analog out:
  outputValue = map(sensorValue, 0, 1023, 0, 255);
  // change the analog out value:
  analogWrite(analogOutPin, outputValue);
```

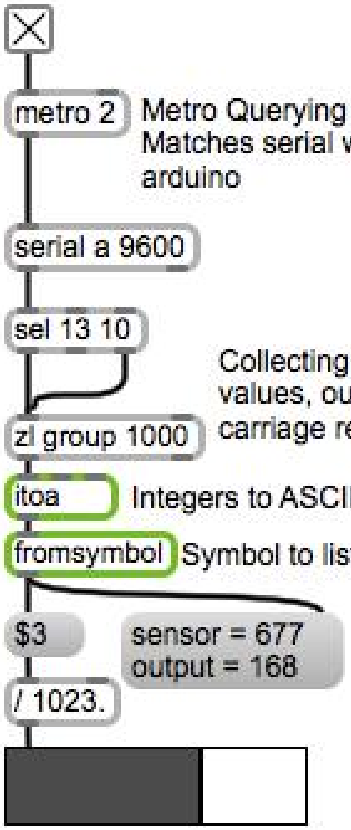
Hochladen abgeschlossen.

```
Verify successful
Set boot flash true
CPU reset.
```

25 Arduino Due (Programming Port) on /dev/cu.usbmodem3d11

```
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
sensor = 415      output = 103
```

☑ Autoscroll   Kein Zeilenende   9600 Baud

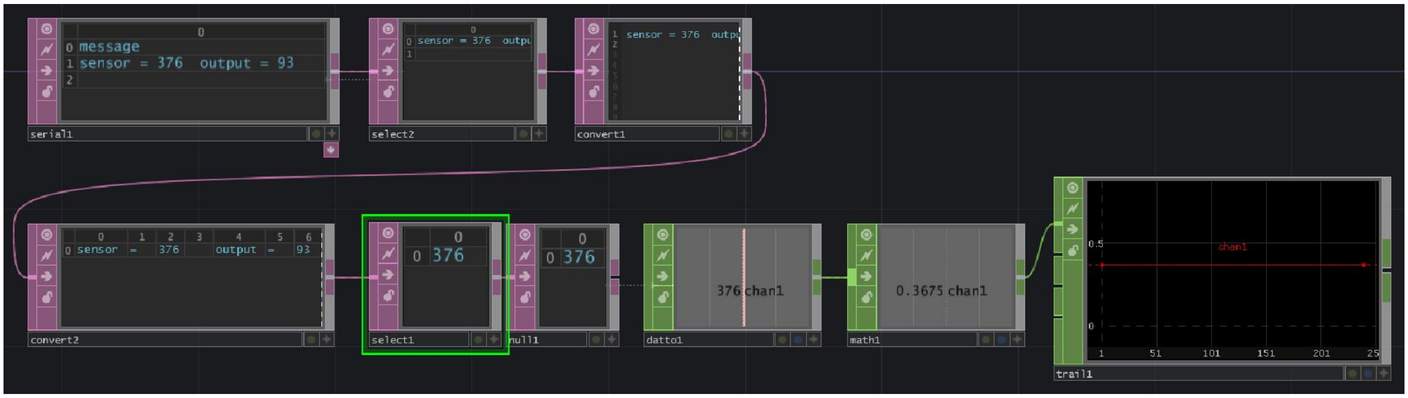


Metro Querying the serial port. Matches serial write intervall of arduino

Collecting integer ASCII values, outputting on carriage return

Integers to ASCII symbol

Symbol to list



```
  0
0 message
1 sensor = 376   output = 93
2
```

```
0 sensor = 376  outpu
```

```
1 sensor = 376  outpu
```

```
  0        1   2     3       4   5   6
0 sensor   =   376   output  =   93
```

```
  0
0 376
```

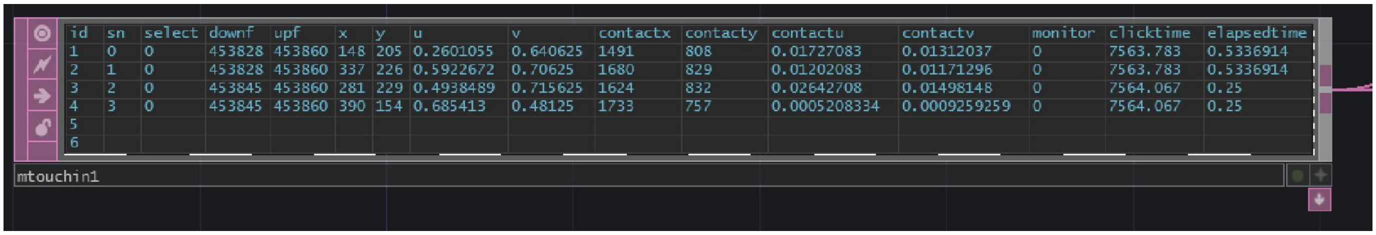
```
  0
0 376
```

```
376 chan1
```

```
0.3675 chan1
```

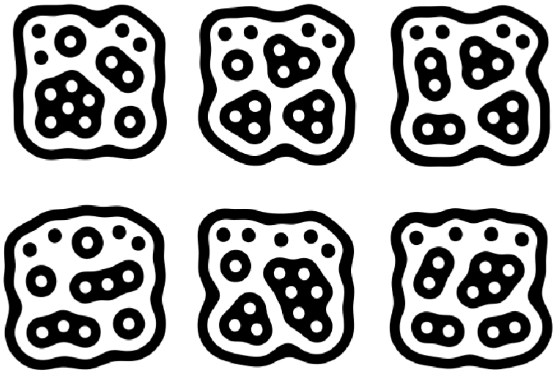
Pure Data

Multitouch screens



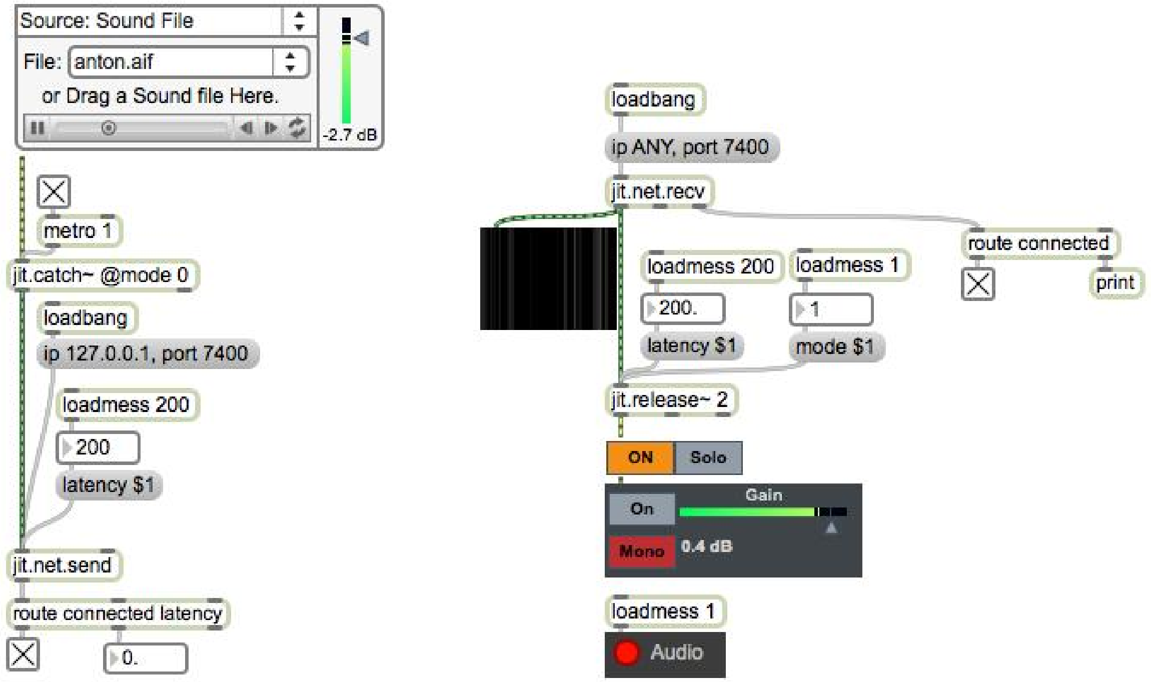
id	sn	select	downf	upf	x	y	u	v	contactx	contacty	contactu	contactv	monitor	clicktime	elapsedtime
1	0	0	453828	453860	148	205	0.2601055	0.640625	1491	808	0.01727083	0.01312037	0	7563.783	0.5336914
2	1	0	453828	453860	337	226	0.5922672	0.70625	1680	829	0.01202083	0.01171296	0	7563.783	0.5336914
3	2	0	453845	453860	281	229	0.4938489	0.715625	1624	832	0.02642708	0.01498148	0	7564.067	0.25
4	3	0	453845	453860	390	154	0.685413	0.48125	1733	757	0.0005208334	0.0009259259	0	7564.067	0.25
5															
6															

The TUIO protocol

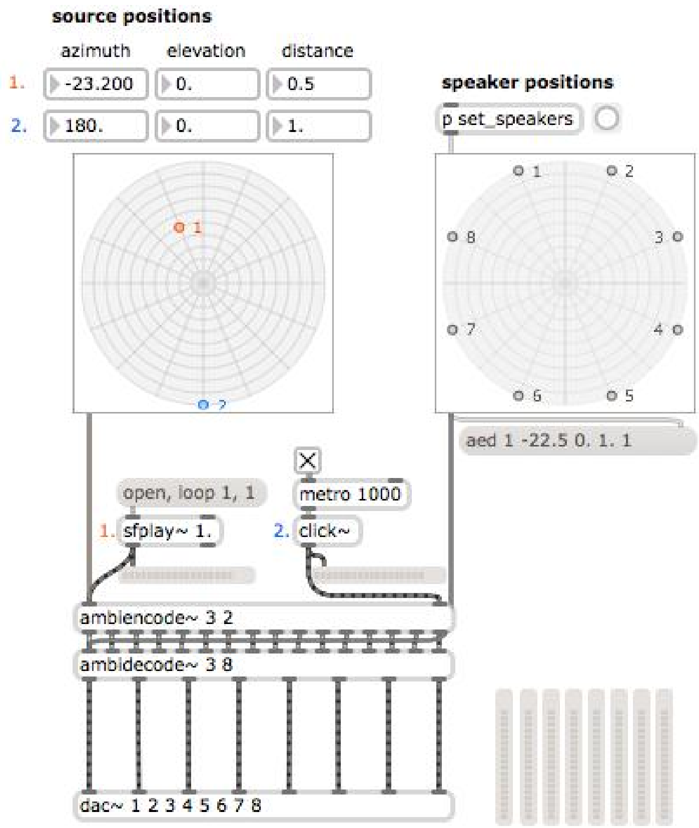


Interfacing other programs

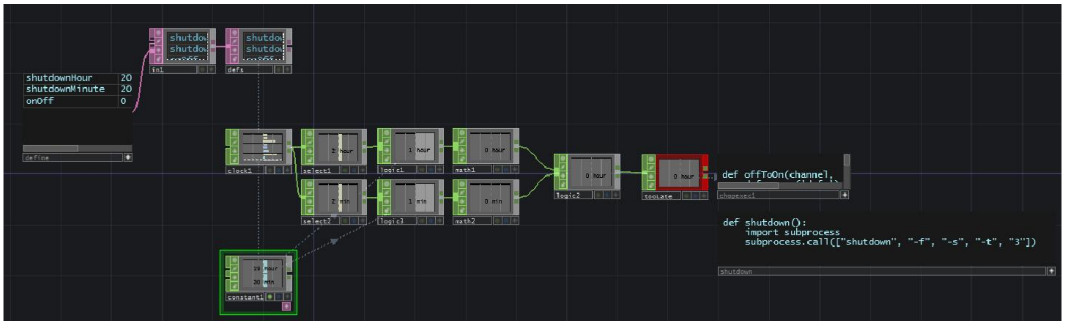
Audio and video



Multispeaker setups



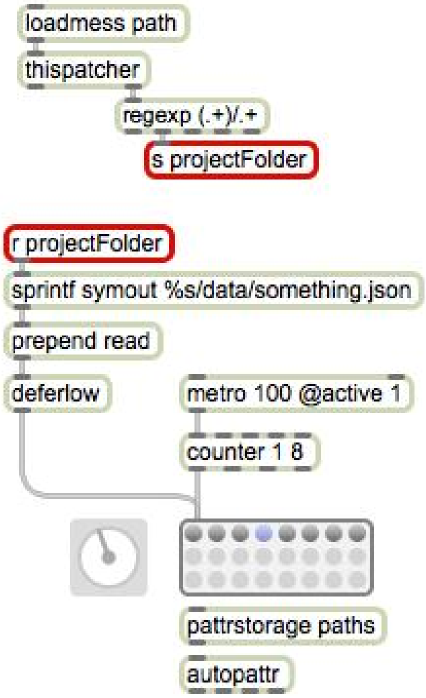
Exhibitions



shutdownHour	20
shutdownMinute	20
onOff	0

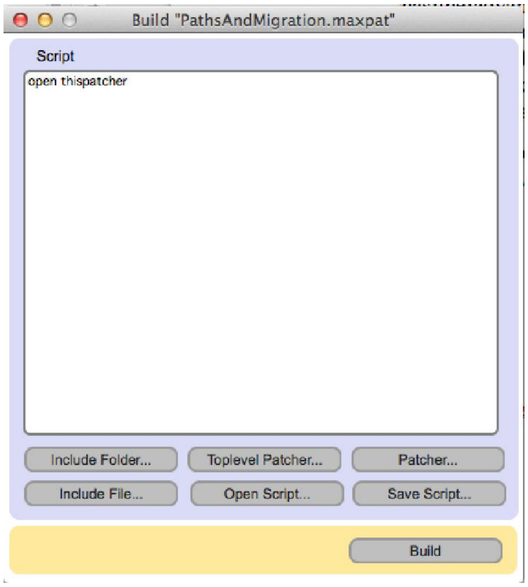
```
def offToOn(channel,
```

```
def shutdown():
    import subprocess
    subprocess.call(["shutdown", "-f", "-s", "-t", "3"])
```

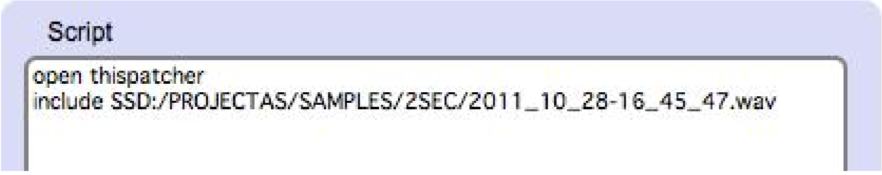


```
loadmess path
thispatcher
regexp (.+)/.+
s projectFolder

r projectFolder
sprintf symout %s/data/something.json
prepend read
deferlow
metro 100 @active 1
counter 1 8
pattrstorage paths
autopattr
```

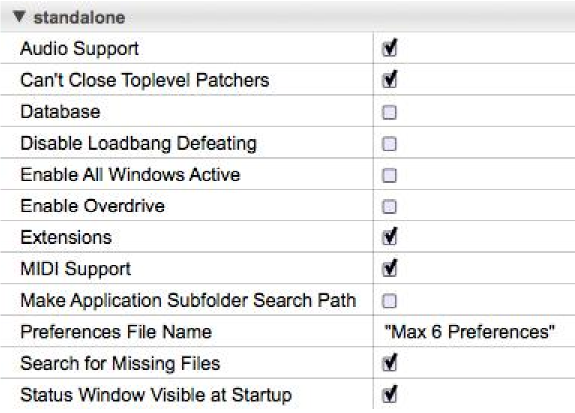
Exporting an application



```
open thispatcher
```

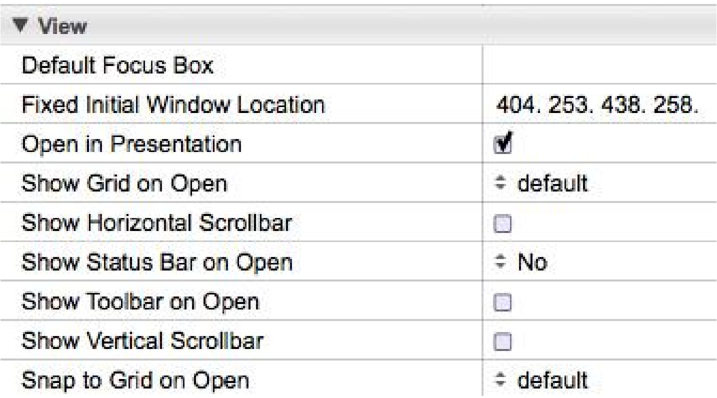


```
open thispatcher
include SSD:/PROJECTAS/SAMPLES/2SEC/2011_10_28-16_45_47.wav
```

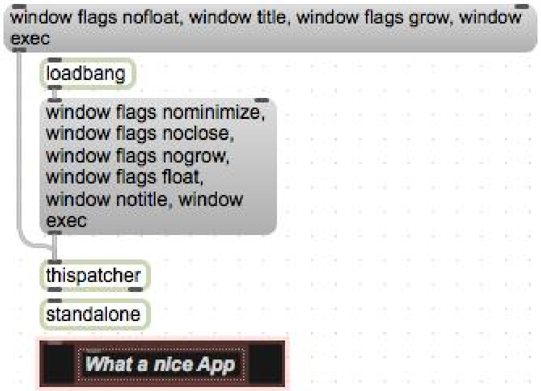


▼ standalone	
Audio Support	☑
Can't Close Toplevel Patchers	☑
Database	□
Disable Loadbang Defeating	□
Enable All Windows Active	□
Enable Overdrive	□
Extensions	☑
MIDI Support	☑
Make Application Subfolder Search Path	□
Preferences File Name	"Max 6 Preferences"
Search for Missing Files	☑
Status Window Visible at Startup	☑

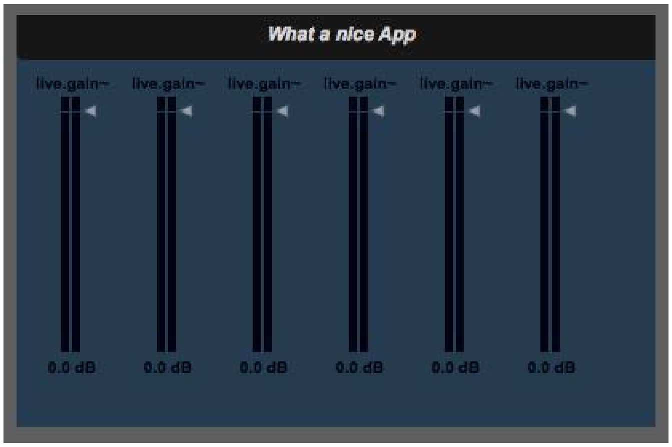
Customizing an application

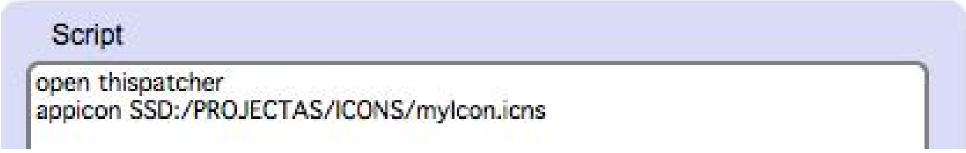


▼ View	
Default Focus Box	
Fixed Initial Window Location	404. 253. 438. 258.
Open in Presentation	☑
Show Grid on Open	default
Show Horizontal Scrollbar	☐
Show Status Bar on Open	No
Show Toolbar on Open	☐
Show Vertical Scrollbar	☐
Snap to Grid on Open	default



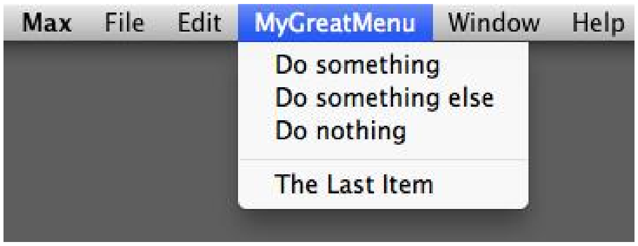
```
window flags nofloat, window title, window flags grow, window exec

loadbang

window flags nominimize, window flags noclose, window flags nogrow, window flags float, window notitle, window exec

thispatcher

standalone

What a nice App
```





Script

```
open thispatcher
appicon SSD:/PROJECTAS/ICONS/myIcon.icns
```



Max
File
Edit
MyGreatMenu
Window
Help
Do something
Do something else
Do nothing
The Last Item