

NEURALOOT

neural network based devices

www.sonusdept.com/neuraloot

a slightly technical introduction

or how the neural oscillator works

NEURALOOT is a suite of Max for Live devices built around the neural oscillator, which is a wavetable oscillator whose shape is generated by a neural network (the decoder section of an autoencoder, if you want to get more technical).

This in house neural network was trained on thousands of waveforms, and it learnt how to encode in the most exact way any shape in just eight parameters, that make up the latent space of the network. Each combination of these parameters is able to reconstruct a waveform, and changing gradually one or more components of the latent space lets you seamlessly morph a shape into another one.

The complexity and the properties of the generated shapes makes them perfect to be used as modulators, sequencers and drone generators. **NEURALOOT** takes advantage of the neural oscillator to create all this nice stuff.

neuralfo

or how the neural oscillator can modulate anything

NeuraLFO uses the neural oscillator to modulate up to eight different parameters, that can belong to any Ableton Live device or track. Mapping a control to a slot of **NeuraLFO** is as easy as clicking on the *map* button and then clicking on the control you want to modulate.

The first part of the device, that you will also encounter, with some variations, in the following modules, allows you to modulate the waveform and the resulting signal, so that it can evolve over time. A diverse and complex signal that becomes, if you want, even more complex and articulated: is there something more effective for modulations that are anything but dull?

The visual feedback let you immediately see how the waveform and the resulting signal are changing.

Turn the page and discover the details of **NeuraLFO**.

neuralfo

or how the neural oscillator can modulate anything

sonus dept. **NeuralFO** made in italy

neural network based LFO

freq	1.00 Hz	◀	ring mod	4.72 %	◀
adjust to	none	◀	ring freq	8.76 Hz	◀
window	off	◀	ring shape	sine	◀
mod amt	19.7 %	◀	sinefold	16.5 %	◀
mod freq	17.4 Hz	◀	smoothing	29.9 %	◀
mod shape	rand	◀	gain	3.1 dB	◀
params	<input type="button" value="randomize"/>		phase	<input type="button" value="invert"/>	

latent space

waveform

resulting signal

1

2

3 amount 79.9 %

4 polarity bi

5 uni mode abs

6 center 40.6 %

7

8

The first part lets you choose how to build, modulate and transform the neural signal. Some explanations for the more unusual terms: *adjust to* can sync the frequency of the wave to a time division (e.g. 1/16), in the modulation shape "rand sine" is a herd of sines whose phase is modulated by random signals, *sinefold* is a Chebyshev distortion, and *smoothing* is a lowpass filter that make the signal less jagged.

The visualization section lets you manually change the eight parameters of the latent space and see how this and the modulations of the first section affect the resulting waveform and the output signal, that will be used to modulate the chosen parameters.

The last part is more self-explanatory. Click on *map* and then on the parameter you want to modulate to control it by the LFO. The polarity of the signal can be bipolar or unipolar (and in this case positive or negative). The unipolar mode lets you choose how to transform the signal into an unipolar one: "abs" does it by calculating the absolute value of the signal, "offset" by mapping $[-1, 1]$ interval to $[0, 1]$, so when the signal is 0 the LFO is at 50% of its peak.

neuralscore & neuralscore+

or how the neural oscillator can compose nice tunes

Neuralscore is a MIDI sequencer that uses the position of the neural oscillator at a given time step to determine which note to play, chosen among the ones of the scale you set. In the updated version of **Neuraloot**, **Neuralscore+** has been added, featuring three neural waves, the first that still controls the pitch, the second controlling the actual chance of a note to be played and the third controlling the velocity of the note.

This device features four different sequencer lanes, and each one can have a different scale, extension, note velocity, root note, note length, bar length and number of steps. Regarding the steps, they can range from 2 to 32, but they will be always subdivisions of the number of bars (1 to 8) you chose. This different take on step sequencing allows you to use weird and unusual meters, but that will be always in sync with your song.

Another fancy feature is the possibility to define your own scale, specifying the distance in semitones from the root for each grade. This is not only cool for melodies, but also to control drum machines the way you want.

Turn the page to discover more about **Neuralscore** and **Neuralscore+**!

neuralscore


or how the neural oscillator can compose nice tunes

sonus dept. **Neuralscore** made in italy

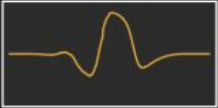
neural network based tunes

freq	0.71 Hz	◀	ring mod	3.15 %	◀
adjust to	none	◀	ring freq	3.32 Hz	◀
window	on	◀	ring shape	sine	◀
mod amt	0.00 %	◀	sinefold	11.8 %	◀
mod freq	1.00 Hz	◀	smoothing	0.00 %	◀
mod shape	rand	◀	gain	0.0 dB	◀
params	<input type="button" value="randomize"/>		phase	<input type="button" value="invert"/>	


latent space



waveform



resulting signal



1 base note A#4

2 scale major

3 scale extension 7 notes

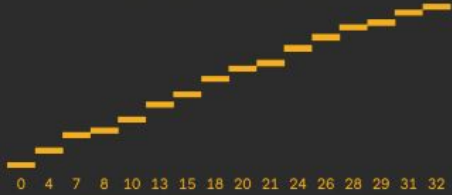
4 note length 1 / 8

note velocity 100

steps 16

duration 1 bar(s)

custom scale - intervals from root



0	4	7	8	10	13	15	18	20	21	24	26	28	29	31	32
---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

The first section is identical to **NeuralFO**.

1	transpose	0 st
	velocity shift	0
2	seq 1 status	<input type="button" value="active"/>
3	seq 2 status	<input type="button" value="active"/>
4	seq 3 status	<input type="button" value="active"/>
	seq 4 status	<input type="button" value="active"/>
	clear patterns	<input type="button" value="clear"/>
G	random patterns	<input type="button" value="randomize"/>

The *G* (read global) part of the second section allows to specify some global settings: transpose and velocity shift, i.e. a number (which can also be negative) to sum or subtract to all notes' velocities.

Then you have handy switches to turn on and off the four lanes, a button to clear all patterns at once and another one to randomize the patterns.

The second part features four sequencer lanes, each one with a number of steps that ranges from 2 to 32, and that can be spread in up to eight bars.

The parameters are pretty self-explanatory. The *custom scale* allows to specify your own scale, by selecting the interval in semitones of each grade from the root. Remember to choose "custom" from *scale* list to use your custom scale.

neuralscore+

or how the neural oscillator can compose nice tunes

sonus dept. **Neuralscore+** made in Italy
neural network based tunes

P	freq	1.00 Hz	ring mod	11.0 %
	adjust to	none	ring freq	2.77 Hz
C	window	off	ring shape	sine
	mod amt	29.9 %	sinefold	4.72 %
	mod freq	1.00 Hz	smoothing	18.9 %
V	mod shape	rand	gain	0.0 dB
	params	randomize	phase	invert

latent space



waveform



resulting signal



base note **A3** custom scale - intervals from root

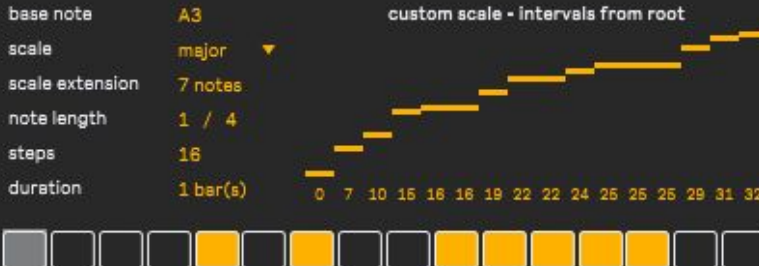
scale **major**

scale extension **7 notes**

note length **1 / 4**

steps **16**

duration **1 bar(s)**



0	7	10	15	18	16	19	22	22	24	25	25	25	29	31	32
---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----

The first section has the controls to edit the parameters of the three neural waves: *P* controls the pitch, *C* the chance of the note to be played, *V* the velocity. Chance threshold and velocity range can be set in the *G* tab of the second section (see below).

The second part features four sequencer lanes, each one with a number of steps that ranges from 2 to 32, and that can be spread in up to eight bars. The parameters are pretty self-explanatory. The *custom scale* allows to specify your own scale, by selecting the interval in semitones of each grade from the root. Remember to choose "custom" from *scale* list to use your custom scale.

1	transpose	+3 st		
	velocity shift	17	chance	velocity range
2	seq 1 status	active	71.0 %	
3	seq 2 status	active	97.0 %	
4	seq 3 status	inactive	11.0 %	
	seq 4 status	active	35.0 %	
	clear patterns	clear	init params	init
G	random patterns	randomize	random params	randomize

The *G* (read global) part of the second section allows to specify some global settings: transpose and velocity shift, i.e. a number (which can also be negative) to sum or subtract to all notes' velocities.

Then you have switches to turn on and off the four lanes, setters for chance threshold, sliders for velocity ranges and buttons to clear or randomize patterns and parameters.

neuralscape

or how the neural oscillator can generate and control weird drones

Neuralscape is a drone generator. If you already know Sonus Dept.'s Max for Live bundles, you know that we like to include these compact devices to create bizarre and evolving textures, that are ready to be sent to a reverb or other nice creative effects to obtain dense synthetic soundscapes.

Neuralscape uses the neural oscillator output to do different things: it controls the frequencies of a 100 oscillator bank, the playback rate of a sample and some parameters of the effects.

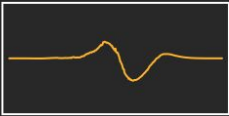

This way, you can have jagged and ever changing textures, that you can leave it as it is or you can further treat with some effects. We recommend a convolution reverb, a distortion or, even better, the device **Babel**, included in our M4L bundle [Æthernity!](#)

neuralscape

or how the neural oscillator can generate and control weird drones

sonus dept. **Neuralscape** made in italy
neural network based drones


latent space waveform



mod amt 36.0 % ◀ mod shape rand ◀
mod freq 0.02 Hz ◀ params **randomize**
window on ◀

DRONE
SAMPLE
DELAY
FILTER
OUT


scan freq 0.90 Hz
base freq 1.08 kHz
freq range 10.0 kHz
freq drift 92.4 %
drift speed 2.78 Hz
gain 3.0 dB



The first generator is an oscillator bank with 100 oscillators, with their frequencies controlled by the shape of the neural wave and by the options of the dedicated tab.

DRONE
SAMPLE
DELAY
FILTER
OUT

scan freq 0.10 Hz
lowest rate 0.25 x
highest rate 4.00 x
reverse negatives
gain -6.0 dB
sample **load**



The second generator is a sample player, with the playing rate controlled by the shape of the neural wave. You can load a sample with the dedicated button or by dragging it directly in the bottom part of the tab. With the *reverse* option you can choose when the sample should play backwards: only when values of the wave are negative, never or always.

The first part of the device should look familiar if you read the previous pages of the manual.

DRONE wet 33.0 %
left time 1.60 s

SAMPLE right time 1.40 s
feedback 25.0 %

DELAY lfo left 0.00 %


FILTER lfo right 0.00 %
lfo freq 1.00 Hz

OUT lfo shape neurosc

DRONE rm amount 0.00 %
rm shape neurosc

SAMPLE rm freq 50.0 Hz
audio in -inf dB
gain 0.0 dB

DELAY playback **transport**



The remaining tabs feature a stereo delay, with its delay times that can be modulated by a LFO, a filter and an output control, with a bonus ring modulator!

neurooscillator & neurooscillatorM

or how the neural oscillator can have its own life

Neurooscillator and **NeurooscillatorM** are two (not only) utility modules, that generate the neural wave and output it as audio. This way, it can be further modified by any effect you like and then be used as modulator signal feeding the manipulated output to another utility module of this package, **AnyMapper**.

But this is only a part of the story! These modules have extended frequency range for the oscillator, so that it can be used as a (not so) classic sound signal. Try it with some reverberation, a glitch effect or anything else that comes to your mind: the neural oscillator can be the starting point of a whole world of timbres!

Is that all? No, because while **Neurooscillator** acts as audio device, **NeurooscillatorM** is an instrument device where the frequency of the neural oscillator can be controlled by MIDI notes, and it also have an optional basic envelope that turns this device in a minimal yet complete monophonic synthesizer. The first step for a complete neural synthesizer? Mmm, stay tuned and you'll see...

neuroscillator & neuroscillatorm


or how the neural oscillator can have its own life

sonus dept. **Neuroscillator**
neural network based waves

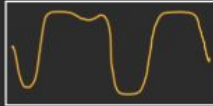
freq	1.00 Hz	ring mod	0.00 %
adjust to	none	ring freq	1.00 Hz
window	off	ring shape	sine
mod amt	0.00 %	sinefold	0.00 %
mod freq	1.00 Hz	smoothing	0.00 %
mod shape	rand	gain	0.0 dB
params	<input checked="" type="button" value="randomize"/>	phase	<input type="button" value="invert"/>

made in italy

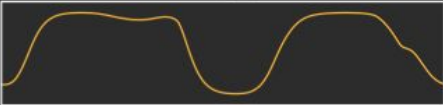
latent space



waveform



resulting signal

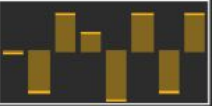


sonus dept. **Neuroscillatorm**
neural network based waves

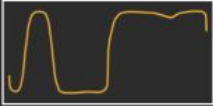
freq	6.52 Hz	ring mod	46.5 %
adjust to	none	ring freq	17.4 Hz
window	off	ring shape	saw
mod amt	0.00 %	sinefold	40.2 %
mod freq	1.00 Hz	smoothing	45.7 %
mod shape	rand	gain	4.8 dB
params	<input checked="" type="button" value="randomize"/>	phase	<input type="button" value="invert"/>

made in italy

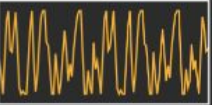
latent space



waveform



resulting signal



ar envelope

envelope	off
attack	500 ms
release	500 ms

The two siblings one next to the other. As explained before, **Neuroscillator** is an effect device while **Neuroscillatorm** is an instrument device. Other differences are the frequency range (up to 880 Hz for the former, up to 20 kHz for the latter) and the optional AR envelope in **Neuroscillatorm**. When the envelope is turned off, the generation is continuous but its frequency can still be changed either manually or by sending a MIDI note (in addition, of course, to automating the parameter).

anymapper

or how anything can modulate anything

AnyMapper is another utility module that uses its audio input as modulation source for up to eight different parameters. Basically, it is the second part of **NeuraLFO**, and not only it allows manipulated signal from **Neuraloscillator** to be used as modulator, but it can use any audio signal to control any automatable parameter within Live.

The device is similar to the second half of **NeuraLFO**. Here you can also select which audio channel to use, with ring modulation between channels and mono mixing as additional options.



Moreover, for each slot you can adjust the gain of the incoming signal.