



***AEKO: 3D***

***DUB/DELAY/REVERB***

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# 1 INTRODUCTION

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Aeko is a Dub/Delay/Reverb plugin (VST/AU) that integrates a multi-effect feedback delay-line architecture with a 3D binaural far/near field panner. Motivated by the human ear's abilities to separate sound-sources beyond traditional 2D stereo fields, Aeko turns simple samples and short loops into rich sequences arranged in both the 3D acoustic field and time. Eight fully customizable feedback delay-lines drive the source signal into separate point-sources placeable on an interactive binaural sound-stage. Binaural processing support both Head-related Transfer Function (HRTF) models and pan modes, interaural delay-free/neutral/elongated variants, and source width-spread/force controls. The effects processor chain for each feedback delay-line contains high/low cut, resonator, and damp equalizers, modulation/pitch-shifter morpher, transient envelope follower, soft-clipper, and a two stage swell/blur diffuser. Moreover, inter-delay-line effects can be linked into shared parameter set or unlinked for independent modification. Last, feedback delay-lines can be cross-mixed or swirled into producing unique reverb and shimmer effects.

# 2 INSTALLATION

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To install the Aeko plugin, unzip and then copy & paste either the 32bit or 64bit VST2/AU files into the plugin directories or paths that your DAW searches for. E.g.

**x86 or Win32 build (Windows 7+)**

C:\Program Files (x86)\Common Files\VSTPlugins

**x64 build (Windows 7+)**

C:\Program Files\Common Files\VSTPlugins

**mac universal build (i386 + x86\_64) (OSX 10.7+)**

/Library/Audio/Plug-Ins/VST/

**AU build (OSX 10.7+)**

/Library/Audio/Plug-Ins/Components/

# 3 REGISTRATION

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The demo version of the plugin will have periodic silence every 30 seconds without a registration function. The full version can be downloaded after purchase and uses a simple serial-key system. Copy & paste the entire key as provided in your receipt into the supplied key.txt file in the Aeko folder

e.g. YOURNAME-AAAAA-BBBBBB-CCCCCC-DDDDD-EEEEEE-FFFFFF-GGGGG

Then save and close the file. Next, launch the plugin, click the register button and browse/select for key.txt. If successful, the bottom panel will display your information. Restart or reload your plugin in your DAW to ensure that the registration was successful.

## 4 WORKFLOW

The Aeko plugin accepts either mono or stereo inputs from your digital audio workstation (DAW) before splitting the signal for processing by a direct + 8 feedback delay-lines. Three input splitting modes are available:

1. **Left / Right (Default):** Direct delay-line's left and right inputs use stereo left and right inputs. Feedback delay-lines 1-4 use stereo left inputs. Feedback delay-lines 5-8 use stereo right inputs. Input:  
L/R
2. **Left + Right:** All delay-line left and right inputs use mono-summed stereo left and right inputs.
3. **Left – Right:** All delay-line left and right inputs use mono-differenced stereo left and right inputs.

The direct and feedback delay-lines have separate processing chains that feed into point-sources within the 3D panner (See Figure 2); details of the effects processors are covered in section 0. Delay-line processors are adjusted according to the assortment of knobs scattered around the spherical sound-stage, representing the set of parameters for the currently selected delay-line (circular-outline point-source). If the **link\*** button is enabled, then the parameters shown belong to a common set (adjusting linked parameters modify all delay-lines that use linked parameters).

The direct delay-line is given by the \* indicator and the eight feedback-delay-lines are numbered accordingly; scrolling with the mouse-wheel or individually selecting a point-source via left or right click will update the current delay-line selection. Left-click & dragging will move the point-source along the same elevation plane. Right-clicking the currently selected point-source will toggle its mute status.

Note that the direct-delay line \* ignores all but the unique point-source parameters listed under the impact, tap, and direction VU bar. For this reason, selecting its point-source on the sound-stage will instead display the linked (common) parameters.

### 4.1 3D PANNER SOURCE AND LISTENER ARRANGEMENT

Aeko's 3D panner positions point-sources around a listener centered at origin; the spherical sound-stage displays an overhead view of the listener's head facing the +X axis (see Figure 3). Spherical coordinates (azimuth, elevation, distance) specify the point-source's position relative to the listener adjusted via click/drag on the sound-stage or via precise knob controls within specific ranges to cover the entire field: Azimuth and elevation [-180 to +180] degrees, distance [0 to 3] meters.



Figure 1: Aeko sound-stage GUI. Colored indicators represent active (non-mute) delay-lines and their placement relative to the listener

The listener's orientation is adjustable for two out of three major principal rotation axes (Yaw and Pitch [-180 to 180] degrees, no Roll in Figure 4). For ergonomics and visualization, changing the listener orientation will update the sound-stage GUI by rotating all point-sources instead.

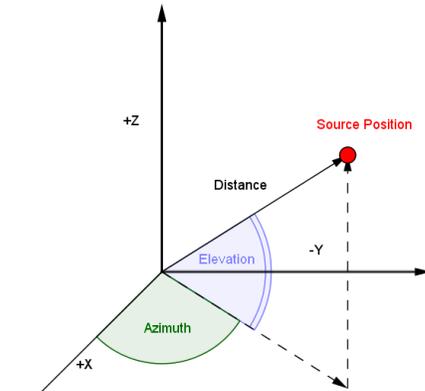


Figure 5: Spherical coordinates specify sound-source placement

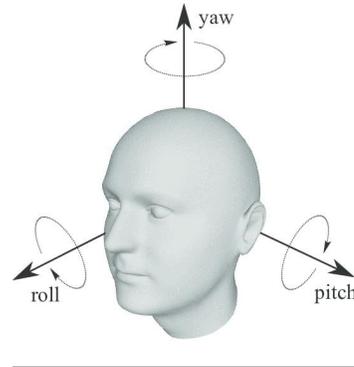


Figure 6: Principal axes orient the listener

Binaural processing of spatial audio follows from a combination of spectral coloration and time-delay sound due to the acoustic wave scattering off parts of the head-torso-pinnae before entering the ears. The relative head-orientation to point-source position determines the coloration via the application of separate Head-related Transfer Function (HRTF) models. A near-field model for point-source distances between 0-1 meters exaggerates the interaural intensity differences (IID) (especially low frequencies) by upto 24 dB. Far-field distances between 1-3 meters use a customized HRTF model by default. If coloration is undesirable, then average IID between the ears due to head-shadowing can be used (left and right signals are only gain-modified). For time-delay due to point-source distances, direction-dependent interaural time differences (ITD) between the ears are default. If delay is undesirable, then ITD can be disabled. A summary of the 3D panner's rendering modes is provided below:

- **HRTF-1 (Default):** Colored + neutral or average head-size ITD for realism
- **HRTF-0:** Colored + free or zero-ITD is useful for preserving stereo transient effects
- **HRTF-10:** Colored + elongated or 10X ITD for Haas effect
- **Pan-1:** ILD + neutral or average head-size ITD
- **Pan-0:** ILD + free or zero-ITD
- **Pan-10:** ILD + elongated or 10X size ITD

Mode:  
HRTF-1

Note for good sound-source localization above and below the horizontal plane, it is advised to use one of the HRTF rendering modes due to spectral notches present in the pinnae along elevated directions. Cutting the low to mid end may also give a better impression of elevated sound-sources due to a-priori expectation / ear-training of higher-frequency modes of every-day sounds (e.g. bird chirps). Last, pseudo-random head-movements and moving sound-sources tend to improve localization; automating head orientation and point-source directions to rotation / revolution movement patterns via automation-curves are suggested.

## 4.2 TEMPO SYNC FOR SEQUENCING

A rich set of temporal arrangements can be sequenced via setting different combinations of tempo-synced delay-lines. By default, delay-line lengths are adjustable in milliseconds when tempo-sync is free. (See Figure 7). Tempo-locked settings map the  $\frac{1}{4}$  note to the DAW's beat per minute setting;  $\frac{2}{1}$ ,  $\frac{1}{1}$ ,  $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{1}{8}$ ,  $\frac{1}{16}$ ,  $\frac{1}{32}$ ,  $\frac{1}{64}$  notes are supported along with dotted and triplet note variants. Factory presets introduce many tempo-synced combinations and organized into their # delay-lines and dominant attributes (F = fuse, A = Attack R = Resonance, M = Modulation, D = Distortion, T = Distance).

## 4.3 GENERAL MOUSE AND KNOB ADJUSTMENTS

Knobs will increment/decrement by vertical mouse drag movements or by scrolling with the mouse-wheel. Holding down shift or control while doing this enables fine-grain adjustment. Double left click will reset the value to the defaults. Right click will open a text-box for inputting exact values. Positional and orientation knobs (azimuth, elevation, yaw, pitch) have the full 360-degree wrap-around range for convenient automation.

# 5 DSP EFFECT PROCESSORS

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## 5.1 ORIENTATION

5.1.1 **Yaw:** Head-orientation rotation angle [-180 to 180] degrees about the Z axis.

5.1.2 **Pitch:** Head-orientation rotation angle [-180 to 180] degrees about the Y axis.

## 5.2 POINT-SOURCE

5.2.1 **Spread:** Relaxes point-source into a spherically wide source. -1 = left-facing, 0 = point-source, 1 = right-facing.

5.2.2 **Force:** Adds harmonic distortion. 0 = 0 dB overdrive, 1 = 40 dB overdrive.

5.2.3 **Force modes:** Selects between types of anti-aliased distortion functions. Bright/mid/dark modes add odd harmonics whereas hot/warm/cold add even harmonics. Gain adds 0-40 dB. Loss attenuates by 0 to -inf dB.

5.2.4 **Distance:** Point-source distance from listener origin from [0 to 3] meters.

5.2.5 **Distance modes:** Selects between filter types applied before force/spread functions. Gain attenuates signal by  $1/\text{distance}$ . low/high pass/resonance/octave/tilt filters move the central frequency by square of distance. Octave filters adds 2 additional resonant peaks spread an octave apart. Tilt filters add +/- 6 dB gain opposite central frequency.

5.2.6 **Delay:** Feedback delay-line length in milliseconds from [5 to 1000] ms. For direct delay-line, the range is [0 to 1000] ms where 0 = no latency. Ignore if tempo-sync is not set to free.

5.2.7 **Azimuth:** Point-source spherical coordinate component angle from [-180 to 180] degrees.

5.2.8 **Elevation:** Point-source spherical coordinate component angle from [-180 to 180] degrees.

### 5.3 FEEDBACK: GAIN AND DAMPENING PER ITERATION

5.3.1 **Amount:** Gain per feedback iteration at value [0 to 150] - 100 dB/sec  
Special cases: Value = 0 disables feedback loop. Value = 100 freezes loop. Value > 100 creates distortion when internally clipped.

5.3.2 **Damp:** High-frequency decay at sampling rate/2 from [0 to 240] dB/sec

### 5.4 ATTACK (TRANSIENT PROCESSOR): ATTACK-RELEASE ENVELOPE FOLLOWER

5.4.1 **Bite:** Degree of attenuation of the signal envelope [-1 to 1].  
Ranges: -1 ≤ Value < 0 attenuates the attack portion. Value = 0 no attenuation or neutral. 0 < Value ≤ 1 attenuates the release portion.

5.4.2 **Time:** Milliseconds [1 to 250] for envelope follower at 0 dB to decay to -60 dB.

5.4.3 **Soft Clip:** Modifies the sharpness of the internal clipping function [0 to 1]  
Special cases: 0 = hard limiter, 1 = soft clip.

### 5.5 CUT: EQUALIZER

5.5.1 **High:** Removes frequency content above [0.02 to 20.0] kHz.

5.5.2 **Low:** Removes frequency content below [0.02 to 10.0] kHz.

### 5.6 RESONANCE: EQUALIZER

5.6.1 **Frequency:** Resonant frequency at [0.02 to 10.0] kHz.

5.6.2 **Quality:** Sharpness of frequency decay outside of resonant frequency [0 to 1].

### 5.7 MODULATION: MULTI DELAY-LINE LFO AND PITCH-SHIFT MORPHER

5.7.1 **Rate:** Triangle LFO rate [0 to 10] Hz with retriggering.  
Special case: 0 = disable modulation but with delay.

5.7.2 **Depth:** Delay-line depth fraction [0 to 1].  
Special case: 0 = disable modulation

5.7.3 **Envelope Shift:** Morphs LFO into a pitch-shifter [-1 to 1].  
Special cases: -1 = pitch-shift down only, 0 = balanced triangle LFO, +1 = pitch-shift up only.  
Setting rate = 10, depth = 1, and shift to +/- 1 gives 12 semi-tone shift per iteration.

## 5.8 FUSE: DELAY-LINE DIFFUSER AND REVERB MORPHER

- 5.8.1 **Swell:** Adds a buildup of reflections to the early part of the delay-line [0 to 100].
- 5.8.2 **Blur:** Adds decaying reflections to the late part of the delay-line [0 to 100].
- 5.8.3 **Swirl:** Percent [0 to 100] to cross-mix all delay-lines (not delay-line specific) within feedback loop. Special cases: 0 = independent delay-line processing, 1 = maximum diffuseness or reverb. For values > 0, muted point-sources will contribute to un-muted point-sources allowing for “silent point-sources” to diffuse/blend the effects of other delay-lines.

## 5.9 MISCELLANEOUS

- 5.9.1 **Tremolo:** Pre-processes stereo inputs with a tremolo LFO [0 to 10 Hz] with retriggering.
- 5.9.2 **Mix:** Sums dry stereo input signals with the two output binaural signals [0 to 100] percent. Special cases: 0 percent outputs only dry signal only. 100 percent outputs wet signal only.
- 5.9.3 **Mix lock:** Click the U/L to the right of the mix knob to lock the mix-ratio while changing presets. “L” = locked, “U” = unlocked.



- 5.9.4 **Gain:** Controls the final gain [-60 to +20 dB] applied to the wet signal only.
- 5.9.5 **Oversample Factor:** Oversamples the input signal by a [4 to 1] factors before processing distortion functions under the Force mode. Click the “OS4/3/2/1” inside the VU meter to access the selector. Set the factor to 1 to improve CPU performance when not using force functions.

