O7A Manipulator Plugins

v2.4.0

Table of Contents

1 Introduction

The O7A Manipulators plugin library focusses on making changes to the content of seventh order ambisonic (O7A) streams.

A variety of manipulations are included, from simple changes to the level of sound in particular directions, through to directional compression, manipulations to move sounds around in space and equalization that can be "painted" on to the audio scene. The library also includes some specialised panner plugins, tools to split up the scene into sections for separate processing, and more.

In general we recommend the use of O7A streams primary for research purposes, or in studios with high-end modern hardware. **The CPU load generated by the O7A plugins can be very high and may not be suitable for use on standard studio computer systems.** Third order (O3A) streams are an alternative. These carry enough spatial detail for most practical applications and present a much lighter processing load. Many O3A plugins run roughly four or sixteen times faster than their O7A equivalents.

1.1 Compatibility

O7A streams require audio busses with at least 64 channels, which (at the time of writing) most Digital Audio Workstations (DAWs) cannot handle. Some are limited at 2 channel stereo and many are limited at the 8 channels used for 7.1 surround mixes. **The O7A plugins *will not work correctly* with these DAWs**, which may even crash. In general, Reaper or Pro Tools Ultimate (version 2023.6 or later) are good options.

1.1.1 AAX

Most of the O7A plugins exist as AAX versions which are compatible with Pro Tools Ultimate version 2023.6 or later and plugin support (or not) is indicated in this text.

Pro Tools keeps careful track of exactly what stem formats are present on tracks and busses; this is a powerful feature which helps avoid mistakes and helps ensure plugins are used in the right places. However, where formats are not available in Pro Tools, corresponding plugins are generally not available.

1.1.2 VST2

The plugin library works as a "shell" plugin. This means that a number of individual audio plugin effects are provided by a single library file. Some VST2 hosts may have a slightly different way of managing these plugins to ordinary ones. For instance, in Max/MSP the vst~ plugin uses "subname" messages to specify the individual plugin within the library. At the time of writing, VST2 shell plugins are not supported in Nuendo or Cubase.

Most VST2-compatible DAWs (such as Reaper) have a plugin "path", which is a list of directories which will be searched for VST2 plugins. You may need to change this path to point at the location of the plugins, or move the plugins there. By default, these plugins are installed into `/Library/Audio/Plug-Ins/VST` on macOS. Various directories may be used on Windows, but `C:\Program Files\Steinberg\VST2` is not uncommon.

1.1.3 Buffering

Some of the O7A plugins use internal buffering with a length of 128 samples. For smooth CPU load, you may wish to ensure your DAW buffer size is a multiple of this.

1.2 Getting Started

This documentation assumes you are familiar with Reaper or a similar DAW, and with the O7A Core library, which provides a number of essential tools for working with O7A streams. If you are not, you may wish to start with the documentation for the O7A Core.

1.3 The License Manager

The Blue Ripple Sound License Manager application can be used to move license keys around between computers.
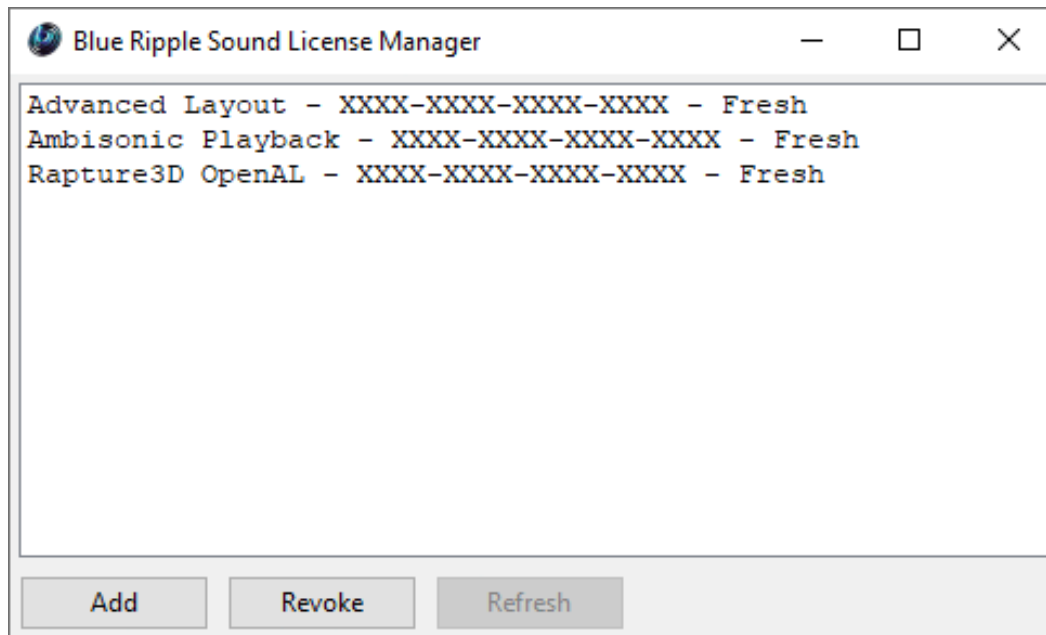
The application is generally available in the Start Menu on Windows, and in your installation directory, which is typically:

- `C:\Program Files\Blue Ripple Sound\` on Windows, and
- `/Applications/Blue Ripple Sound/` on macOS.

License keys can be removed from a computer using the 'Revoke' button and added with 'Add'. If data is not 'Fresh' this probably indicates a network connectivity issue, in which case the 'Refresh' button may be used. Generally, licenses are refreshed automatically.

1.4 Visualisation of Manipulations

Many of the manipulator plugins in this library are applied to an entire O7A mix, or part of it. This can sometimes be confusing. To help understand what is going on, we recommend use of visualisation plugins like O7A Flare and the O7A Visualiser.

1.5 Technical Requirements

1.5.1 Operating System

Supported versions of Microsoft Windows are 10 or 11, 64bit Intel.

Supported versions of Apple macOS are 10.14 to 13.5, 64bit Intel or Apple Silicon.

1.5.2 VST Host

The VST plugins require a VST 2 host with shell plugin support.

These plugins do not work with all VST 2 hosts. One reason for this is that the O7A plugins need large numbers of channels on their input or output busses. Check the individual plugins for the channel counts they need, but all of the O7A plugins need at least 64 channels on each track. Also, at the time of writing VST 2 shell plugins are not supported in Nuendo or Cubase.

1.5.3 AAX Host

The AAX plugins require **Pro Tools <u>Ultimate</u> version 2023.6** or later.

Due to channel and stem restrictions, not all plugins are supported in AAX. Please see the plugin descriptions for details.

1.5.4 PC Hardware

Please check your PC meets the following requirements:

- Intel Core i7 CPU or better, or Apple Silicon.
- 400MB of free disk space.

1.5.5 Permissions

You'll need administrator permissions while installing on Windows. The software probably won't install properly using a "restricted" account.

1.5.6 Internet Connection Required

This software requires an Internet Connection for license activation and verification.

Successful license verification isn't required every time you use the software, but it is needed during installation and needs to succeed once every couple of weeks to keep the license fresh.

The license can be "revoked" to remove it from one machine so it can be moved on to another. You should also do this if you're updating your system in case the machine appears to have changed identity.

2 Soundfield Modification

2.1 O7A Compressor
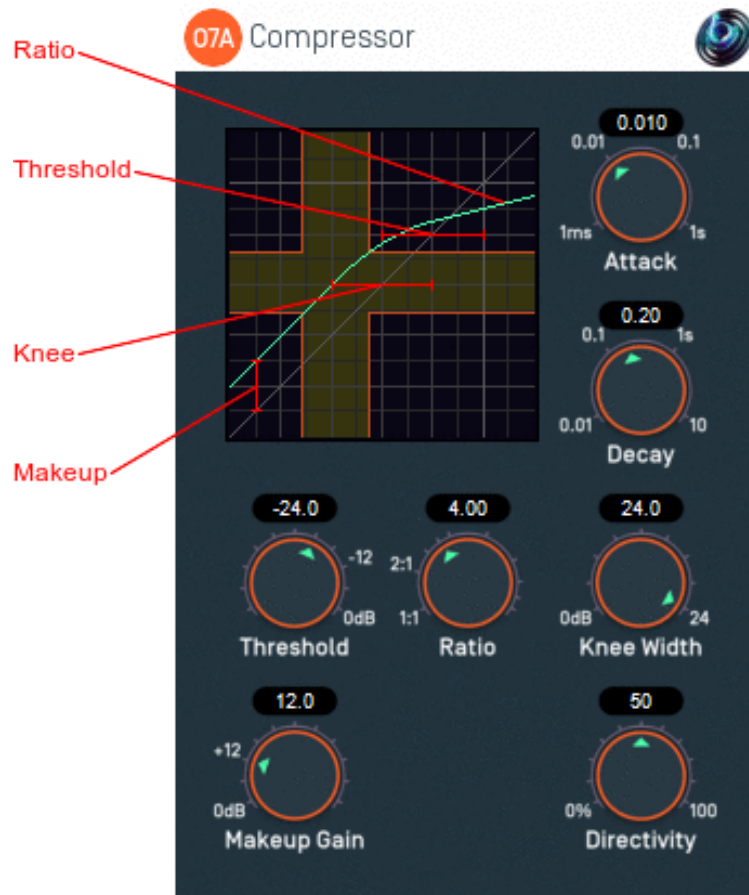
2.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.1.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.1.3 Controls

- Threshold
- Ratio
- Knee Width
- Makeup Gain
- Attack
- Decay
- Directivity

2.1.4 Description

This plugin applies compression to an O7A stream. This has the effect of decreasing the dynamic range of the stream without substantially disrupting spatial placement.

The main difference between this and conventional compressors is its spatial processing. A directivity control allows the compression to be applied consistently over the entire sound scene, or independently in different directions; or somewhere in between.

2.1.4.1 The Graph

The graph at the top left of the panel shows the compressor response curve, plotting the input level along the horizontal axis and the output level along the vertical axis. Grid lines are shown at 6 decibel intervals.

The current ranges of input and output levels are also shown in real-time, in blue. These ignore the current attack and decay settings.

2.1.5 Controls

2.1.5.1 Control: Threshold

Assuming the knee width control is set to zero, the threshold is the level (in decibels) above which compression applies. Quieter signals are not affected.

When the knee is not set to zero, the transition through the threshold is not abrupt, but is instead smoothed out. The threshold then determines the centre of the transition interval.

The threshold can be seen in the graph provided as the point around which the slope of the response curve changes.

2.1.5.2 Control: Ratio

The ratio determines how much compression is applied to the signal when its level is above the threshold (and close to it when a soft knee is in use).

The ratio determines the inverse slope of the output level versus the input level, once above the threshold (and knee), when plotted in decibels. It can be seen in the graph provided as the slope of the response curve on the right hand side.

2.1.5.3 Control: Knee Width

When the knee width is set to zero, signals quieter than the threshold are not compressed and signals above the threshold are. This can be a fairly abrupt transition in some circumstances and is known as a "hard knee".

Setting the knee width to a non-zero values changes this behaviour, arranging for the output level to change smoothly over an interval. This is known as a "soft knee".

The knee width is measured in decibels and its centre is determined by the threshold. It can be seen in the graph provided as the interval over which the response curve transitions from one slope to another.

2.1.5.4 Control: Makeup Gain

This "makeup" gain amplifies the output of the compressor. It can be seen in the graph provided as an upwards shift in the response curve. It it typically used to make up for the reduction in level that results from compression.

2.1.5.5 Controls: Attack and Decay

The attack determines how quickly the effect responds to an increase in sound level by decreasing its gain and the decay determines how quickly the effect relaxes again when the sound level drops.

The values are defined as the time it takes the gain to move by 10 decibels.

2.1.5.6 Control: Directivity

Previous controls will be familiar to those who have worked with conventional compressors before. However, the O7A Compressor affects an entire sound scene.

A directivity value of zero means that sounds in all directions are compressed using the same gain. For instance, if a mix consists of a drum track and strings in different directions, a loud event in the drum track may result in the compressor kicking in, bringing down the entire mix level (including the strings). This can be thought of as equivalent to "Stereo Linking" in a conventional stereo compressor.

Increasing the directivity means that sounds in different directions are compressed more independently. In the example above, this means that the loud event in the drum track would affect the strings less.

2.2 O7A Diffuser

2.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.2.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.2.3 Controls

- Diffusion
- Spread

2.2.4 Description

This plugin takes a 3D O7A mix and "smudges" it slightly in time and space. This can be quite a subtle effect similar to that of an all-pass filter, but has a quite wide variety of uses.

For instance, you can use it to add some spatial detail to an omnidirectional O7A mix, which provides a useful way to place a mono sound into space without giving it a definite direction. To do this, ensure that the mono sound is in the first channel of the input to this plugin and that the other inputs are silent.

You can also use this plugin to smudge a panned source that otherwise might be too sharp spatially, or to "soften" the transients in a complete 3D O7A mix.

2.2.5 Controls

2.2.5.1 Control: Diffusion

The diffusion value controls how much the mix is smudged in time. This softens transients slightly.

The effect is analogous to that produced by the feedback gain control in an all-pass filter, but the smudging varies slightly in different spatial directions, so omnidirectional sounds become diffuse.

2.2.5.2 Control: Spread

The spread value controls how much the mix is smudged in space.

Some spatial spreading occurs with a zero value, but when the value increases the spread increases. For non-zero spreads, the diffusion value also increases the amount of spread.

2.3 O7A Low/High Pass Filter

2.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.3.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.3.3 Controls

- Slope
- Cutoff

2.3.4 Description

This plugin applies a simple low-pass or high-pass Butterworth filter to all sound in a 3D O7A soundfield.

2.3.5 Controls

2.3.5.1 Control: Slope

The slope control switches between different filter configurations. Low-pass and high-pass filters with different rolloff slopes are available in -6dB/octave steps down to -48dB/octave. The control can also be set "Off" in which case audio is passed through without filtering.

Changing this control switches the internal filter configuration and will not generally result in smooth transitions (i.e. you may hear clicks or pops).

2.3.5.2 Control: Cutoff

The cutoff control changes the filter's -3dB cutoff frequency. The control has a range from 1Hz to 200kHz. The cutoff frequency actually used is limited just below the Nyquist frequency.

2.4 O7A Move
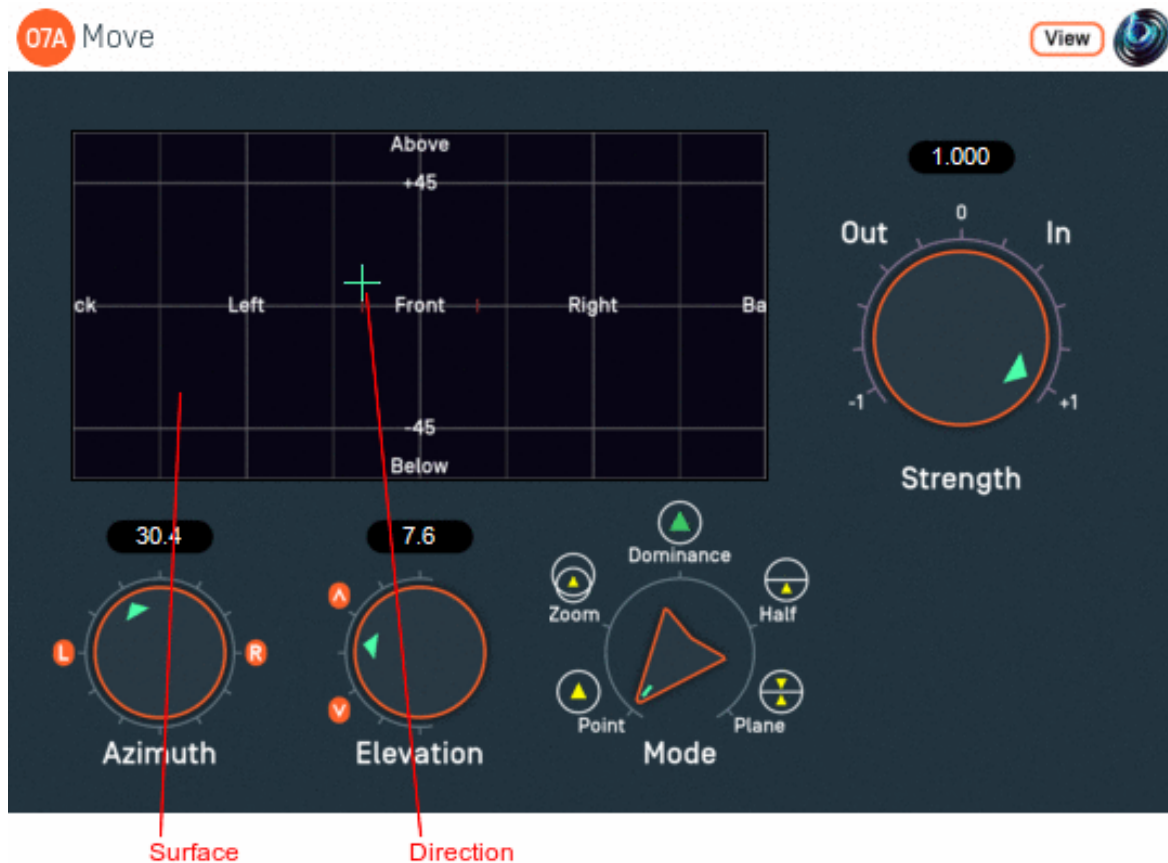
2.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.4.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.4.3 Controls

- Azimuth
- Elevation
- Mode
- Strength

2.4.4 Description

This plugin modifies a 3D O7A mix by moving sounds from some directions to others.

Sounds can be moved towards or away from a particular reference direction, which is set using the azimuth and elevation controls, or the control surface, which can also be used to visualise the current direction. The current direction (indicated by the crosshairs) can also be changed by clicking

on the surface with the mouse.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O7A Visualiser which lays out its viewing region in the same way.

For instance, this effect can be used to move the whole soundfield smoothly towards a single point and then expand it back out into full 3D. In addition to moving the soundfield towards a point, other movement modes can be used. The available modes are:

- Point - moves sounds towards or away from a point.
- Zoom - performs a change of perspective.
- Dominance - an O7A equivalent to "classic" dominance.
- Half - moves sounds in half of the scene towards a plane.
- Plane - moves all sounds towards or away from a plane.

2.4.4.1 "Point" Mode

In "Point" mode positive strength values move sounds smoothly towards the selected direction. Negative values move sounds away.

2.4.4.2 "Zoom" Mode

In "Zoom" mode, positive strength values move sounds smoothly towards the selected direction, as with "Point" mode. However, significant levels changes are also made, to help give the overall impression that the entire sound scene is being moved forwards (positive strength) or backwards (negative strength).

In this mode, strength values between -0.5 and +0.5 indicate that the scene remains around the listener, so for many uses it is best to stay in that range. Beyond that, the scene begins to disappear into the distance.

This plugin does not change the time alignment of sounds.

If you are particularly interested in this mode as a way to change the scene perspective, you may also want to try the O7A Zoom plugin which is based around the same algorithm but has additional controls.

2.4.4.3 "Dominance" Mode

"Dominance" mode is similar to the "Point" and "Zoom" modes in that positive strength values move sounds towards the selected direction and negative values move them away. Like "Zoom", dominance changes the level of sounds significantly, but in a different way.

From a technical perspective, this mode is based on "classic" first order dominance and in fact, if only first order components are considered, it is the same. It is included primarily for those who are familiar with dominance from work with first order ambisonics and wish to use an equivalent at higher orders.

2.4.4.4 "Half" Mode

In "Half" mode, sounds on one side of a plane through the centre of the room are moved towards the plane, so half the sounds in the scene are moved to form a gap. The plane is shown using dots on the control surface and is controlled using the azimuth and elevation controls; the reference direction is the "normal" of the plane, i.e. it is at right angles to it.

Sounds that are moved are in the half of the scene *opposite* the reference direction for positive strength settings, or in the same half for negative strength settings. In both cases, movement is towards the plane.

In practice, this mode is normally used with the elevation set to +90, so the plane is the horizontal plane. Positive strength values can then be used to pull sounds in the lower hemisphere up towards the horizontal plane without disrupting the upper hemisphere significantly.

2.4.4.5 "Plane" Mode

In "Plane" mode, sounds are moved towards or away from a plane through the centre of the room. The plane is shown using dots on the control surface and is controlled using the azimuth and elevation controls; the reference direction is the "normal" of the plane, i.e. it is at right angles to it.

In practice, this mode is normally used with the elevation set to +90, so the plane is the horizontal plane. Positive strength values can then be used to pull upper and lower sounds towards the horizontal plane.

2.4.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.
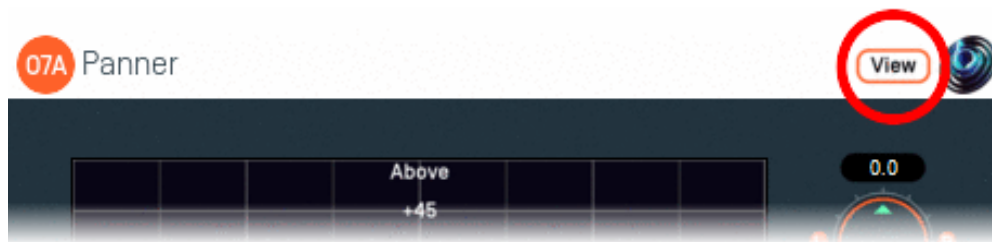
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

2.4.6 Controls

2.4.6.1 Controls: Azimuth and Elevation

These controls move the reference direction used in the movement.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.4.6.2 Control: Mode

The mode dial selects one of five movement modes. See above for details of the each mode.

2.4.6.3 Control: Strength

This controls how much movement is applied. A value of 0 indicates that no change is made to the soundfield. A value of +1 or -1 indicates a full strength movement. See above for more details of each movement mode.

2.4.7 Presets

Presets are available for this plugin:

- Pull Towards Front
- Completely To Front
- Remove Height
- Raise Lower Sounds
- Move Front Closer

2.5 O7A Zoom and O7A Zoom XYZ
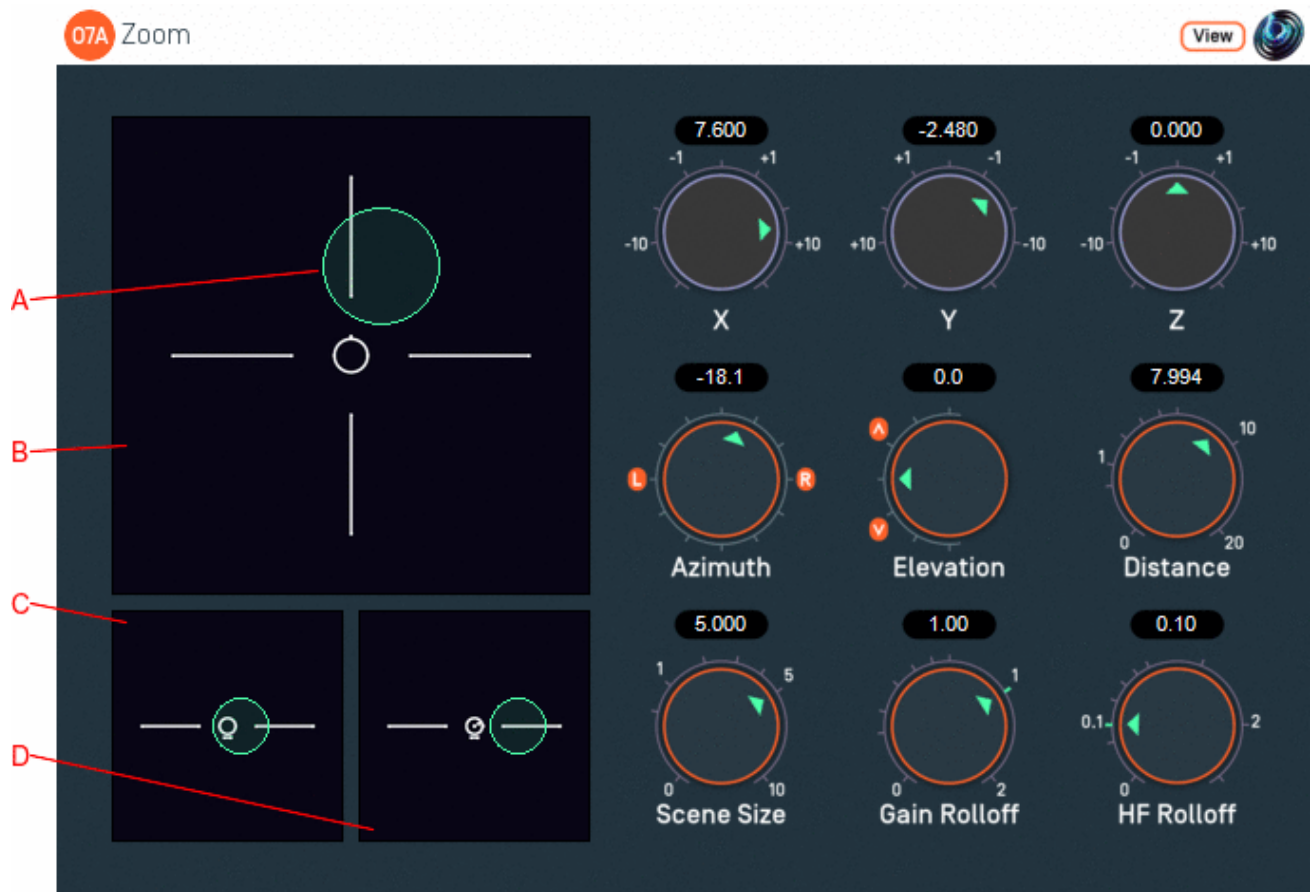
2.5.1 Host Support

2.5.1.1 O7A Zoom

Host Type	Support
AAX	Yes
VST2	Yes

2.5.1.2 O7A Zoom XYZ

Host Type	Support
AAX	Yes
VST2	Yes

2.5.2 Audio

2.5.2.1 O7A Zoom

	Channels	Content
Input	64	O7A
Output	64	O7A

2.5.2.2 O7A Zoom XYZ

	Channels	Content
Input	64	O7A
Output	64	O7A

2.5.3 Controls

- X
- Y
- Z
- Azimuth
- Elevation
- Distance
- Scene Size
- Gain Rolloff
- HF Rolloff

2.5.4 Description

This manipulator has similar controls to the O7A Panner LS plugin, but it does *not* pan mono sounds. Instead, its input is an entire O7A sound scene. It uses a change of perspective manipulation to give the impression that the listener or the entire O7A sound scene has moved. For instance, this can be used to move the listener towards a front stage, or move a 3D rainstorm recording in from the distance until we are in the middle of it. You may wish to combine its use with a rotation plugin to give more movement options.

The underlying algorithm used is very similar to the "Zoom" mode of the O7A Move plugin.

Two versions of the plugin exist. The only difference is the way that the controls are exposed to automation. The reason for this is that the X, Y and Z controls and the Azimuth, Elevation and Distance controls do essentially the same thing (move the sound) and so to avoid confusion, the plugins only expose one set of controls to automation. O7A Zoom exposes Azimuth, Elevation and Distance to automation, whereas O7A Zoom XYZ exposes X, Y and Z. This restriction only applies to automation; all controls are available in the user interface.

There are three control surfaces which can be used to move the scene "A" around. The main surface "B" is a view from above, with the front at the top of the screen. Below it is a view "C" from behind and another "D" from the right.

This plugin also has scene size controls and a distance model. The size is visible on the control surfaces. Units are nominally metres, but it is possible to give a sense of larger or smaller distances by changing the scene size and rolloffs.

This plugin does not change the time alignment of sounds.

2.5.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current 3D location is shown as a small scaled sphere, within a scaled cube, which should be in reach of the VR controllers. The unscaled location (potentially out of reach) where the audio is actually located is also shown. Hold a VR controller trigger to move the scaled sphere to the controller. The unscaled sphere will move to match.

2.5.6 Controls

2.5.6.1 Controls: X, Y and Z

The coordinates determine where the centre of the scene is in space. Units are nominally metres.

Axis	Positive	Negative
X	Front	Back
Y	Left	Right
Z	Up	Down

These coordinates are not available as automation parameters in O7A Zoom. Instead, they are translated to and from Azimuth, Elevation and Distance, which may be used instead. If you need to automate these controls you should probably use O7A Zoom XYZ instead.

When X, Y and Z are all zero, the scene passes through the plugin unmodified.

2.5.6.2 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction of the scene relative to the centre.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

Azimuth, Elevation and Distance are not available as automation parameters in O7A Zoom XYZ. Instead, they are translated to and from X, Y and Z, which may be used instead. If you need to automate these controls you should probably use O7A Zoom instead.

2.5.6.3 Control: Distance

This control indicates how far away the centre of the scene is. Units are nominally metres. When the distance is zero, the scene passes through the plugin unmodified.

Azimuth, Elevation and Distance are not available as automation parameters in O7A Zoom XYZ. Instead, they are translated to and from X, Y and Z, which may be used instead. If you need to automate these controls you should probably use O7A Zoom instead.

2.5.6.4 Control: Scene Size

The scene size is the radius of the "bubble" containing the scene that is being moved. Units are nominally metres. Changing this allows better control of whether the listener is inside or outside the scene.

2.5.6.5 Control: Gain Rolloff

This rolloff determines the rule that is used to reduce the scene's level as it moves away. It is only applied when the listener is outside the scene. A value of 1 is closest to how this occurs in reality. Reducing the value reduces the effect of the level drop and increasing the value exaggerates it. A value of 0 means that the level stays constant.

Mathematically, the gain applied is determined by the inverse square law, but raised to a power given by this control.

2.5.6.6 Control: HF Rolloff

This controls a simple low-pass filter that reduces high frequency content as the source moves away. It is only applied when the listener is outside the scene. This happens in reality due to air absorption. A value of 0.1 is close to reality at typical pressure, temperature and humidity, and changing this value reduces or increases the effect. A value of 0 means that no filtering occurs.

The value used with this control is the number of additional decibels lost at 10kHz for each metre of distance, on top of the main gain rolloff.

2.6 O7A Directional Emphasis

2.6.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.6.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.6.3 Controls

- Azimuth
- Elevation
- Focus
- Strength

2.6.4 Description

This plugin modifies levels in a 3D O7A mix to emphasise sound in a particular direction. It is similar to the O7A Directional Mask plugin.

The emphasis direction can be set using the azimuth and elevation controls, or the control surface, where the direction is indicated by the crosshairs.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O7A Visualiser which lays out its viewing region in the same way.

The algorithm used is a "passive" one and should not colour the frequency content of the sound significantly.

This plugin takes a fairly simple approach, providing control in one direction and just two further control parameters. For more sophisticated manipulations you may want to use the O7A Spatial Mask plugin.

This plugin has behaviour which is consistent with Rapture3D directional emphasis.

2.6.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.
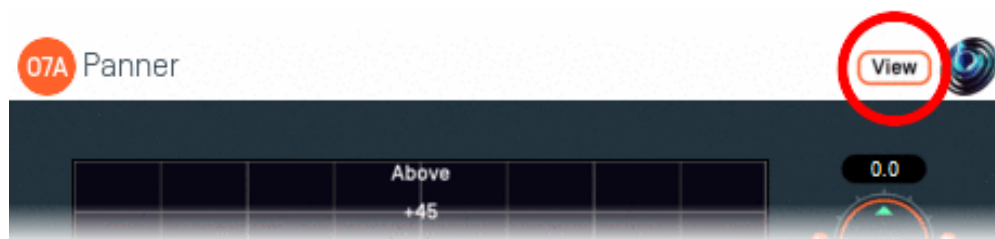
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

2.6.6 Controls

2.6.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction to emphasised.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.6.6.2 Control: Focus

Focus determines the shape of the emphasis, with higher values using a more focussed (narrow) region.

A value of zero means that no modification is made to the stream. The focus value can go up to three, for the most focussed emphasis.

2.6.6.3 Control: Strength

Strength determines how aggressively sounds not in the focussed region are reduced in level.

Strength values are between zero and one, where a value of zero means that no modification is made to the stream and a value of one provides the strongest emphasis.

2.7 O7A Directional Mask

2.7.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.7.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.7.3 Controls

- Azimuth
- Elevation
- Sharpness

2.7.4 Description

This plugin modifies levels in a 3D O7A mix to emphasise or de-emphasise sound in a particular direction. It is similar to the O7A Directional Emphasis plugin.

The emphasis (or de-emphasis) direction can be set using the azimuth and elevation controls, or the control surface, where the direction is indicated by the crosshairs.

The algorithm used is a "passive" one and should not colour the frequency content of the sound significantly.

This plugin takes a fairly simple approach, providing control in one direction and just one further control parameter. For more sophisticated manipulations you may want to use the O7A Spatial Mask plugin.

2.7.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.
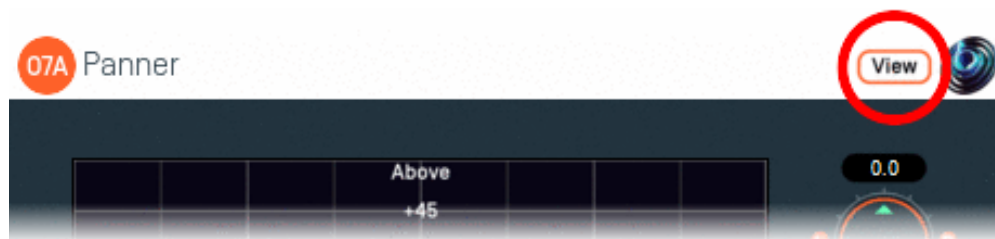
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

2.7.6 Controls

2.7.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction to modified.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.7.6.2 Control: Sharpness

This controls the sharpness and strength of the emphasis or de-emphasis.

A value of zero means that no modification is made to the stream.

Positive values leave sound in the chosen direction as it is but reduce sound elsewhere, so that the direction is emphasised. Values near +1 provide the sharpest emphasis.

Negative values reduce the sound in the chosen direction, so it is de-emphasised.

2.8 O7A Order Amplifier

2.8.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.8.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.8.3 Controls

- Order 0 - 7 Gains

2.8.4 Description

2.8.4.1 *You probably should not use this plugin!*

This plugin applies a simple amplifier to all channels of the O7A stream. Different gains are applied for the channels introduced at each order. If you do not know what this implies, here is not the place to find out.

We wondered if we should include this plugin at all in the library, because there are rather unnatural things that can be done with it which might sound good on a particular speaker layout and decoder, but horrid on others.

This plugin is not really intended for use an artistic effect - it is here because you might have a good reason to want to mess with the order levels, probably to do with the source material you are processing. If this is the case, you probably know the gains you want already and this plugin becomes a useful tool, which is why we did include it in the end.
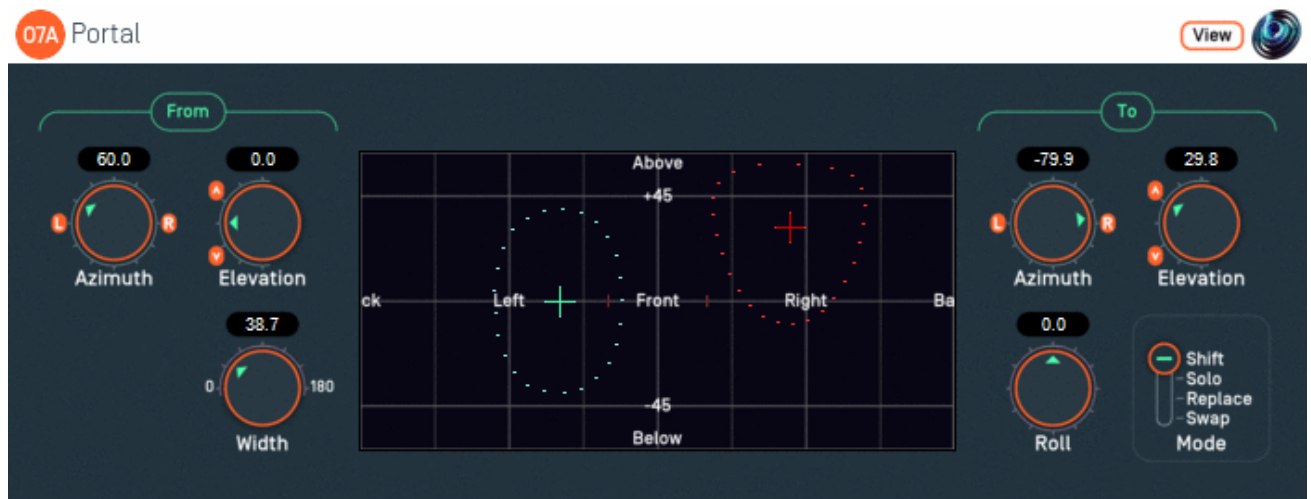
2.8.5 Controls

2.8.5.1 Controls: Order 0 - 7 Gains

This plugin represents gains directly as scalar coefficients, not as decibel values.

The order zero gain is applied to the first channel. The order one gain is applied to channels 2 to 4. The order two gain is applied to channels 5 to 9. The order three gain is applied to channels 10 to channels 10 to 15 and so on.

2.9 O7A Portal

2.9.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.9.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.9.3 Controls

- From Azimuth
- From Elevation
- To Azimuth
- To Elevation
- Width
- Roll
- Mode

2.9.4 Description

This plugin shifts a region in an O7A audio scene to another direction in the audio scene. The "from" and "to" directions for this shift are set independently. The angular width of the region to be shifted can be set, and the region can be rotated (rolled) during the shift.

The "from" and "to" directions can be set using the azimuth and elevation controls, or the control surface, where the directions are indicated by the crosshairs. The "from" direction is indicated using green/blue and the "to" direction using red. They can be changed by clicking with the mouse, using the left mouse button for the "from" direction and the right mouse button for "to". If you do not have a right mouse button, or are using a touch screen, you can hold down the 'Alt' key and press the main button instead. You can also move both directions together using the 'Shift' key.

The algorithm used is a "passive" one and should not colour the frequency content of the sound significantly.

2.9.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current 'from' and 'to' directions are shown using green/blue and red crosses, similarly to the plugin display. Point at one and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	The current 'from' and 'to' directions are shown using green/blue and red beams and crosses, similarly to the plugin display. Each VR controller moves a direction and the controllers show short green/blue and red beams to indicate which is which. Hold a VR controller trigger to set an azimuth and elevation.

2.9.6 Controls

2.9.6.1 Controls: From Azimuth and From Elevation

These azimuth and elevation controls determine the direction from which audio should be shifted.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.9.6.2 Controls: To Azimuth and To Elevation

These azimuth and elevation controls determine the direction to which audio should be shifted.

2.9.6.3 Control: Width

Width is an angle, between 0 and 180 degrees, indicating how large a region of audio should be shifted. An angle of 0 indicates a narrow beam and an angle of 180 encompasses the whole scene. Behaviour is similar to that of the O7A Spotlight plugin.

Angles are measured from the plugin "from" direction to the sound direction. When the angle is less than the width setting, the sound is in the region to be shifted. In practice, the transition out of the shifted region is a gradual slope rather than a hard transition.

2.9.6.4 Control: Roll

If roll is set to zero, the shifted audio will be oriented so "up" is where it was before shifting. However, this can be changed using this control. The shifted audio can be rotated (rolled) around its central direction using any angle from -180 to +180 degrees, where positive angles are clockwise on the canvas.

2.9.6.5 Control: Mode

Four slightly different modes of operation are supported:

Shift	In this mode, the audio is shifted by removing it from its old direction and adding it back to the new one. This provides a simple way to shift a sound from one place to another, but can leave a gap where the sound was shifted from. This is the default mode.
Solo	In this mode, the audio is shifted by removing it from its old direction and adding it back to the new one. However, all other audio is removed. This is typically used as a way of testing that the correct audio has been selected for shifting.
Replace	In this mode, the audio is shifted by removing it from its old direction and replacing the audio at the new direction. This leaves a gap where the sound was shifted from and reduces sound energy where sounds are overwritten. This mode can be useful when the mix contains unwanted sounds.
Swap	In this mode, the audio is shifted by removing it from its old direction and swapping it for the audio at the new direction. This does not create a gap in the scene. Audio swapped back is reflected to help maintain audio content when regions overlap.

2.10 O7A Reflection
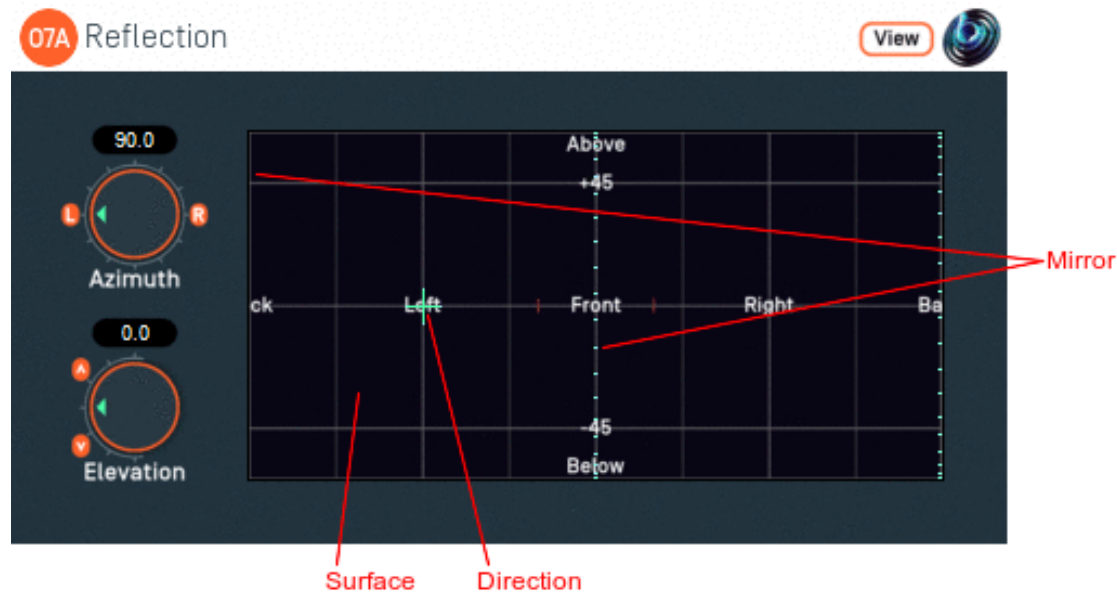
2.10.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.10.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.10.3 Controls

- Azimuth
- Elevation

2.10.4 Description

This plugin reflects the entire O7A soundfield in a "mirror" plane through the centre of the room. For instance, it can swap sounds on the left with those on the right.

Azimuth and elevation controls are provided to control the direction in which the mirror plane is placed. For instance, setting the azimuth to +90 and the elevation to +0 points sets the direction to the left. This mirror will transfer sounds on the right over to the left and vice versa. Similarly, setting the direction to the front transfers sounds at the front to the back and vice versa. Technically, this direction is the "normal" to the plane.

The direction can be set using the azimuth and elevation controls, or the control surface. The mirror plane is indicated on the surface by a dotted line and the direction by crosshairs, which can be changed by clicking with the mouse.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O7A Visualiser which lays out its
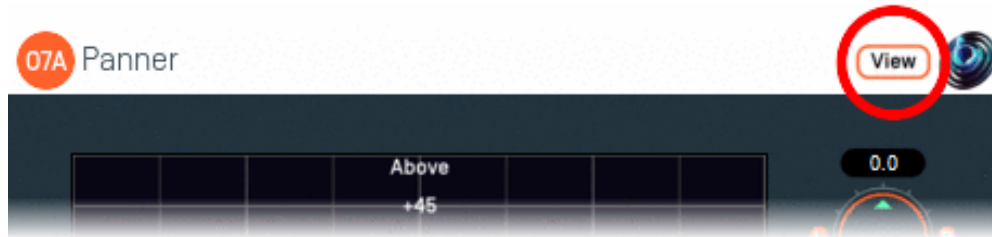
viewing region in the same way.

2.10.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

2.10.6 Controls

2.10.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction towards the mirror plane.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.
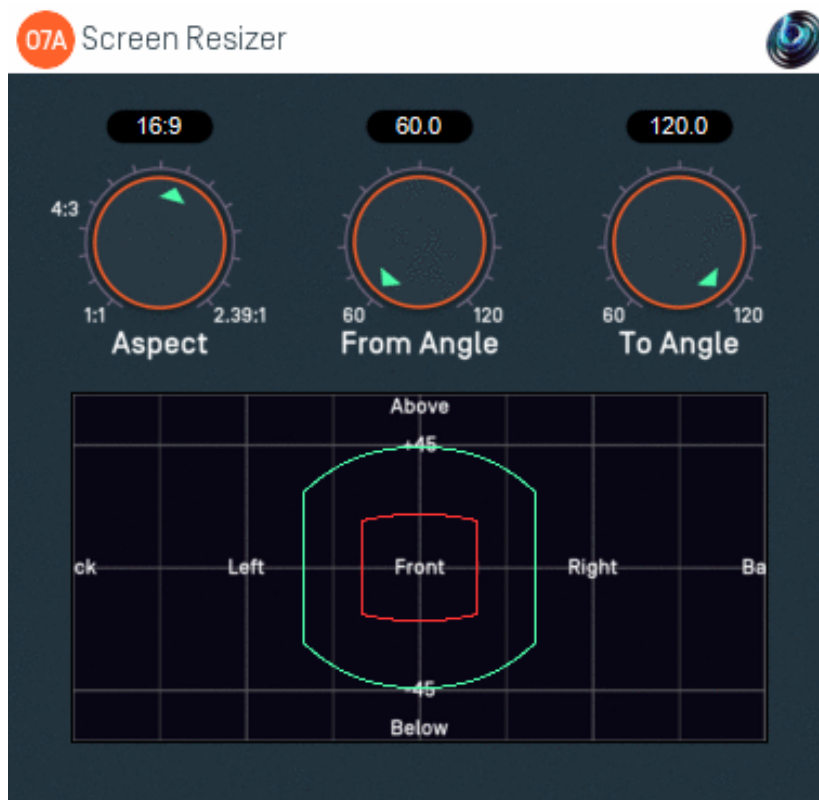
For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.10.7 Presets

Presets are available for this plugin:

- Left - Right
- Front - Back
- Up - Down

2.11 O7A Screen Resizer

2.11.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.11.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.11.3 Controls

- Aspect
- From Angle
- To Angle

2.11.4 Description

This plugin modifies a 3D O7A mix by moving sounds from some directions to others. It is designed for use with 3D mixes which match a film image. The plugin moves sounds to compensate for a change in the screen size on which the film is to be presented, moving on-screen sounds to keep them in the same position relative to the image.

This plugin produces a very specific movement. Other movements are available in the O7A Move plugin.

The screen is assumed to be in front of the audience. Sounds outside the screen but in front of the audience are stretched or expanded to make up the remaining space around the new screen.

The original screen size is shown in a display in red and the new screen size in green/blue. The screen is assumed to be flat; if it seems surprising that the upper and lower edge of the screen as shown on the display are curved, consider the elevation of the top centre and top left points on the screen (the top left point is further away).

2.11.5 Controls

2.11.5.1 Control: Aspect

This is the aspect ratio of the screen (for instance, 4:3, 16:9 or 2.39:1). This is the ratio of the width to the height of the image.
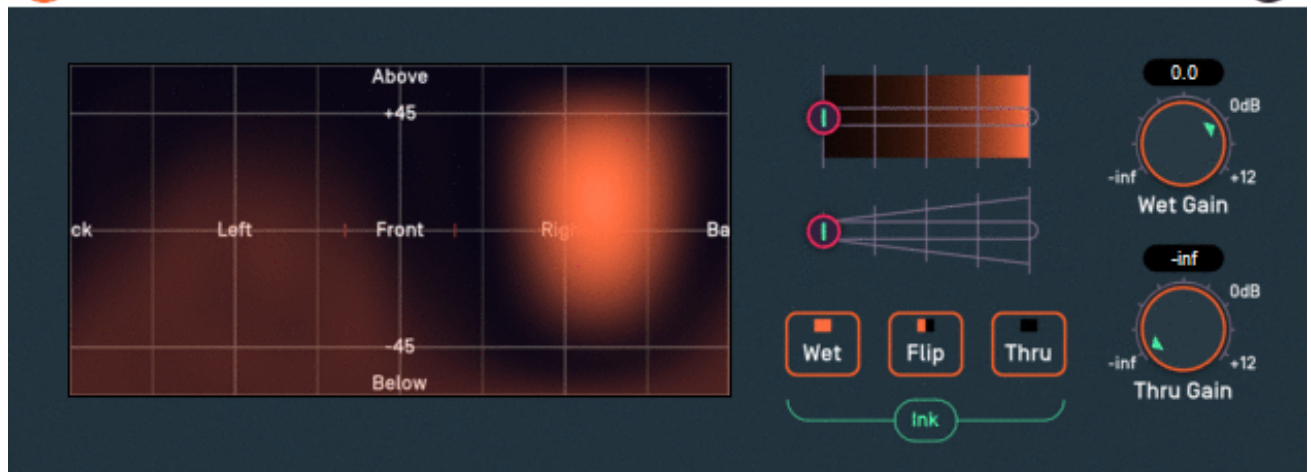
2.11.5.2 Control: From Angle

This is the original angular width of the screen, measured in degrees. This is visible in the display as the width of the red image.

2.11.5.3 Control: To Angle

This is the new angular width of the screen, measured in degrees. This is visible in the display as the width of the green/blue image.

2.12 O7A Spatial Mask

2.12.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.12.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.12.3 Controls

- Ink Control
- Brush Size Control
- Thru Button
- Wet Button
- Flip Button
- Wet Gain
- Thru Gain
- ACN00 - ACN63 Elements

2.12.4 Description

This plugin modifies a 3D O7A mix by changing the level of sound in different directions. For instance, you can use this to lower the level of a cough from an audience. A canvas is shown on the left which can be "painted" on to control the directions that will be changed. The canvas is set out in the same way as in the O7A Visualiser.

Sounds in different directions are separated out into two spatial channels, the "Thru" channel and the "Wet" channel. These names may seem wrong, but they should make more sense if you are familiar with the O7A Spatial Equalizer plugin.

An ink control determines how the canvas is changed when it is clicked/drawn on. Dark ink means that sound in a particular direction should be sent to the "Thru" channel and light ink means to the

"Wet". Ink in between indicates that an intermediate amount is sent to each of the two different channels. A gain is applied to each of the Thru and Wet channels, controlled by the dials, and then the results are brought back together.

This means that sound directions painted dark are affected by the Thru gain and sound directions painted light are affected by the Wet gain. Colours in between are a mix.

The algorithm used is a "passive" one and should not colour the frequency content of the sound significantly.

2.12.4.1 That was all a bit confusing...

An earlier version of the plugin did not have the Thru and Wet dials and these are normally the source of confusion. If you just leave them so Thru is set to "-inf" and Wet to "0.0", then the panel on the left can be used simply to paint the sounds you want to keep. Light to keep, dark for silent, or somewhere in between.

You might like to set up two O7A Visualiser plugins, one before and one after this effect. If you set up the Thru and Wet gains in this way, you will see that sounds disappear from the visualisation of the output when they are painted dark and are unchanged when they are light.

The dials then come in useful if e.g. you want to fade between the shape you have drawn and an unmodified stream. For instance, you can paint the canvas in a way which roughly isolates a singer. (You can use the "flip" button to check that you are flipping between the singer on their own and "everything else".) Once you have done this, you can bring the Thru gain up to "0.0" so everything else is unmodified and use the Wet gain control to control the singer's level.

If you just want to emphasise or isolate a particular direction, you also might want to try the much simpler O7A Directional Emphasis or O7A Directional Mask plugins. On the other hand, if you want more control, you may want to try the O7A Spatial Equalizer.

2.12.4.2 Automation

Most of this plugin *can* be automated. Pressing the buttons or drawing on the canvas are converted into changes in the internal ACN elements, so you can record these changes and play them back to reproduce canvas paint changes.

To put this another way, the ink control, brush and thru/wet/flip buttons are not accessible via automation, but the changes they make to the canvas are.

2.12.5 Controls

2.12.5.1 Control: Ink Control

The first horizontal slider selects the colour of the "ink" that will be used when the panel is painted on. The grey tick marks are 6dB points.

2.12.5.2 Control: Brush Size Control

The second horizontal slider controls the amount of ink that will be painted onto the panel.

2.12.5.3 Control: Thru Button

This instantly paints the entire canvas dark ("Thru"). This means that all sound directions are then affected by the Thru Gain dial only.

2.12.5.4 Control: Wet Button

This instantly paints the entire canvas light ("Wet"). This means that all sound directions are then affected by the Wet Gain dial only.

2.12.5.5 Control: Flip Button

This instantly converts the parts of the canvas that were light to dark and the parts that were dark to light and so on. This has the effect of converting all sound direction contributions that were Thru to Wet and vice versa.

2.12.5.6 Control: Wet Gain

This sets the gain applied to sound directions that are painted as "Wet" (light).

By default this is set to "0.0" (unit gain). This means that light ink on the canvas indicates that sounds should be let through the plugin unmodified.

2.12.5.7 Control: Thru Gain

This sets the gain applied to sound directions that are painted as "Thru" (dark).

By default this is set to "-inf" (silent). This means that dark ink on the canvas indicates that sounds should be made silent, but you can bring up and modify the level of those sounds with this dial if you want.

2.12.5.8 Controls: ACN00 - ACN63 Elements

These controls are not shown on screen as numbers but are available for automation. They capture an internal representation of what is on the canvas and they can be used to automate the canvas. If you are recording them, make sure you record them all together!

We recommend that you do not attempt to interpret these numbers. However, it may be worth knowing that fading them together (linearly) will result in a natural (linear) fade of the canvas image.

Technically, these elements contain a spherical harmonic decomposition of the gain function, defined as a function mapping the surface of the unit sphere to values broadly between 0 and 1, where the spherical harmonics are encoded using the SN3D convention.

2.13 O7A Spotlight
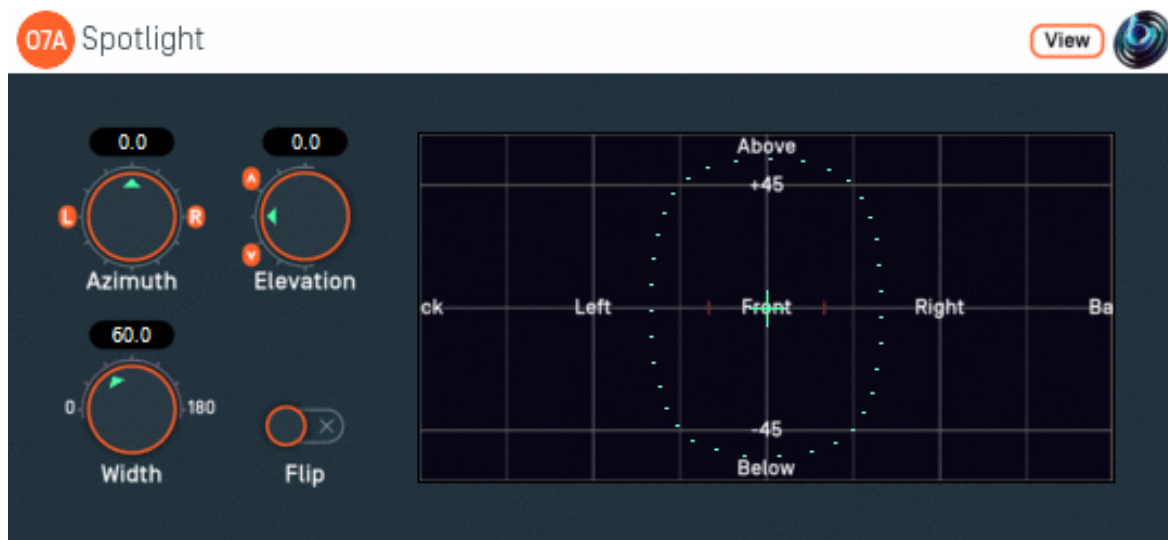
2.13.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.13.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.13.3 Controls

- Azimuth
- Elevation
- Width
- Flip

2.13.4 Description

This plugin can be imagined as a spotlight being applied to a direction in an O7A audio scene. Lit parts of the scene are kept and unlit parts are removed. The width of the spotlight beam can be controlled.

This plugin has features in common with the the O7A Directional Emphasis and O7A Directional Mask plugins, but aims for a cleaner transition between its lit and unlit regions. Typically, this makes it more suitable for isolating sounds in a particular region.

The spotlight direction can be set using the azimuth and elevation controls, or the control surface, where the direction is indicated by the crosshairs.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O7A Visualiser which lays out its viewing region in the same way.

The algorithm used is a "passive" one and should not colour the frequency content of the sound significantly.

2.13.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.
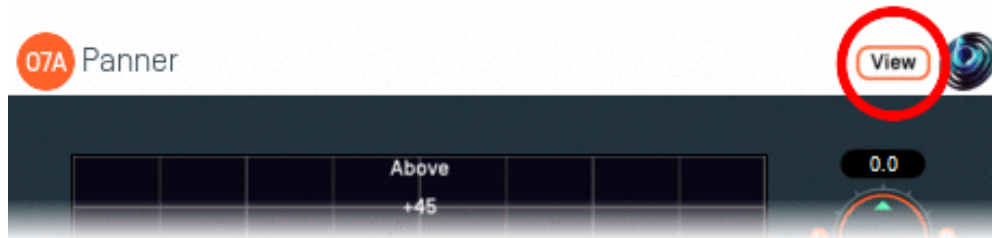
When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross.	The current direction is shown using a beam and cross.
Hold the left mouse button to set the azimuth and elevation.	Hold a VR controller trigger to set the azimuth and elevation.

2.13.6 Controls

2.13.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction to be isolated.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

2.13.6.2 Control: Width

Width is an angle, between 0 and 180 degrees, indicating how wide the beam of the spotlight should be. An angle of 0 indicates a narrow beam and an angle of 180 encompasses the whole scene.

Angles are measured from the spotlight direction to the sound direction. When the angle is less than the width setting, the sound is in the lit region and should be kept. Other sounds are in the unlit region and should be attenuated. In practice, the transition from the lit to unlit region is a gradual slope rather than a hard transition.
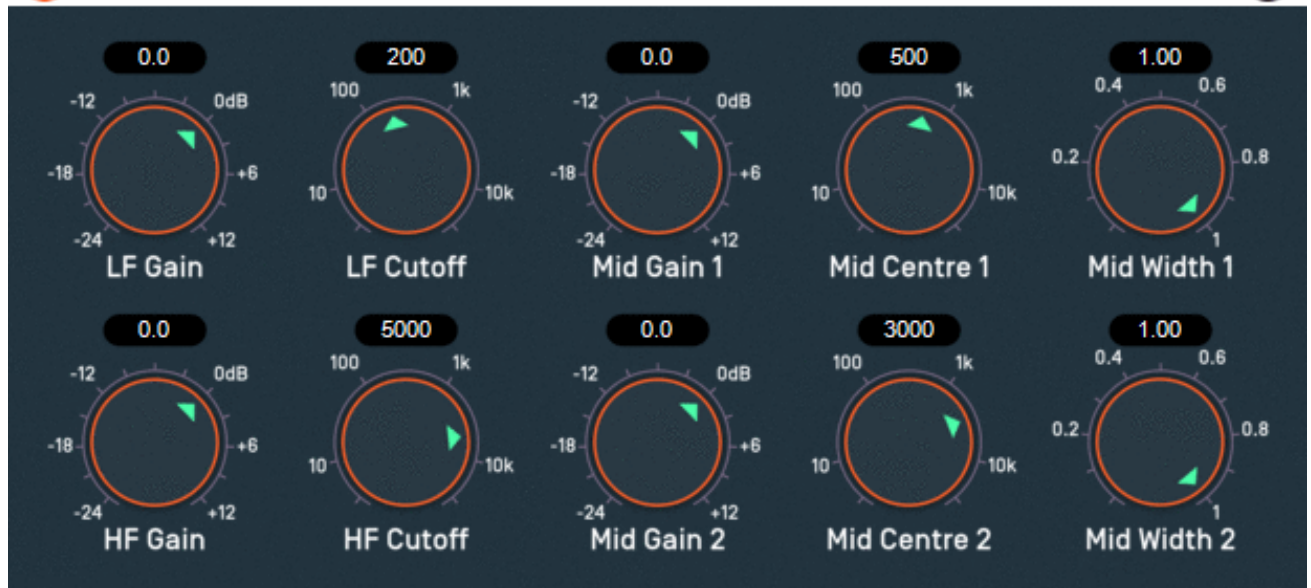
2.13.6.3 Control: Flip

Enabling this switch flips the meaning of the lit and unlit regions.

2.14 O7A Parametric Equalizer

2.14.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.14.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.14.3 Controls

- LF Gain
- LF Cutoff
- Mid Gain 1
- Mid Centre 1
- Mid Width 1
- Mid Gain 2
- Mid Centre 2
- Mid Width 2
- HF Gain
- HF Cutoff

2.14.4 Description

This plugin is a fairly conventional parametric equalizer that is applied equally to all sound in the O7A 3D soundfield. It is not particularly special except that it can be applied easily to all the O7A channels at once.

You can do this yourself with any linear equalizer by applying it equally to all O7A channels. But be careful to apply it to *all* the channels. And *identically* to them all.

You may also be interested in the O7A Graphic Equalizer and O7A Spatial Equalizer.

2.14.5 Controls

2.14.5.1 Controls: LF Cutoff and LF Gain

These two parameters control a low frequency shelf filter which can be used to boost or cut audio below a particular cutoff frequency.

2.14.5.2 Controls: Mid Centre 1, Mid Gain 1 and Mid Width 1

These three parameters control a parametric filter that can be used to boost or cut audio around a particular frequency. The centre frequency can be moved and the width changed.
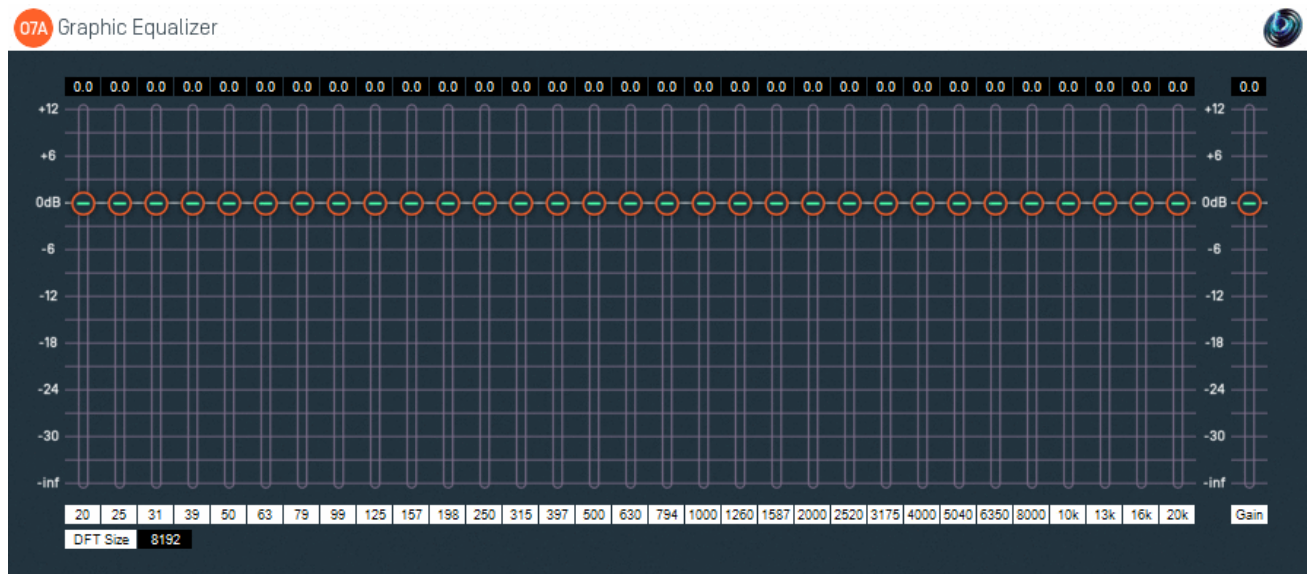
2.14.5.3 Controls: Mid Centre 2, Mid Gain 2 and Mid Width 2

These control a second parametric filter.

2.14.5.4 Controls: HF Cutoff and HF Gain

These two parameters control a high frequency shelf filter which can be used to boost or cut audio above a particular cutoff frequency.

2.15 O7A Graphic Equalizer

2.15.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.15.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.15.3 Controls

- 20Hz - 20kHz Band Gains
- Gain
- DFT Size

2.15.4 Description

This plugin is a 31-band third-of-octave graphic equalizer. It is applied equally to all sound in the O7A 3D soundfield.

The algorithm is implemented in the frequency domain. It has a significant latency, which hopefully your DAW will compensate for. It is linear-phase.

You may also be interested in the simpler O7A Parametric Equalizer and the more complex O7A Spatial Equalizer.

2.15.5 Controls

2.15.5.1 Controls: 20Hz - 20kHz Band Gains

These controls affect the frequency content of the soundfield at the frequency selected.

If the DFT size is low, some of the frequency bands are ganged together.

2.15.5.2 Control: Gain

This is an overall gain control.

2.15.5.3 Control: DFT Size

The DFT size is used in the internal processing of this plugin. The size can be 512, 1024, 2048, 4096, 8192, 16384, 32768 or 65536. Lower sizes give lower latency and use less CPU power, but provide a less sharp equalizer. In this case, the plugin may gang low frequency bands together.

2.16 O7A Spatial Equalizer
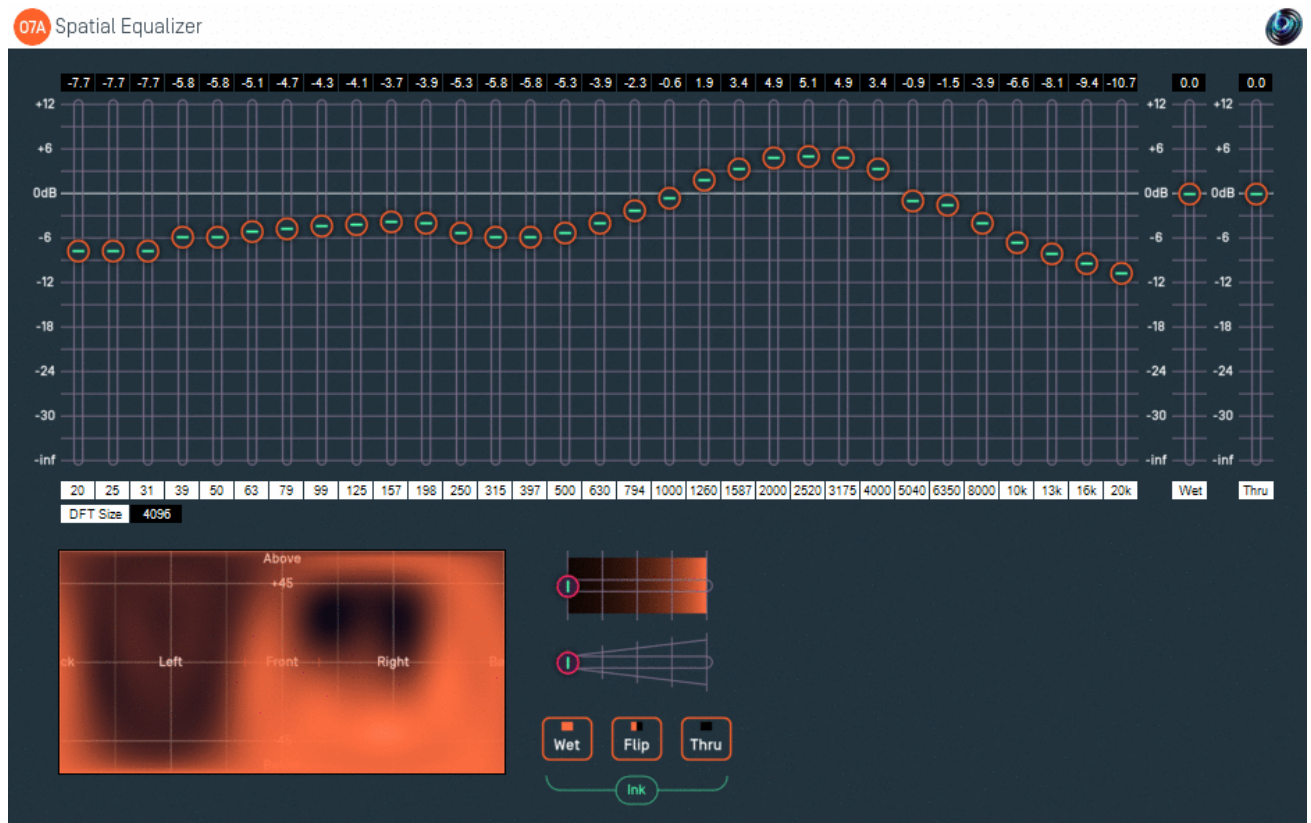
2.16.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

2.16.2 Audio

	Channels	Content
Input	64	O7A
Output	64	O7A

2.16.3 Controls

- 20Hz - 20kHz Band Gains
- Ink Control
- Brush Size Control
- Thru Button
- Wet Button
- Flip Button
- Wet Gain
- Thru Gain
- DFT Size
- ACN00 - ACN63 Elements

2.16.4 Description

This plugin modifies a 3D O7A mix by changing sound in different directions. A canvas is shown at the bottom in the middle which can be "painted" on to control the directions that will be changed. The canvas is set out in the same way as in the O7A Visualiser and O7A Spatial Mask plugins.

This plugin combines features of the O7A Spatial Mask and O7A Graphic Equalizer plugins. It allows you to make precise changes to the frequency content of an O7A mix in particular directions, for instance to enhance a particular singer without modifying the whole mix.

The graphic equalizer is of the 31-band third-of-octave type. Parts of this plugin are implemented in the frequency domain and it has a significant latency, which hopefully your DAW will compensate for. The equalizer is linear-phase.

Sounds in different directions are separated out into two spatial channels, the "Thru" channel and the "Wet" channel. By default, the "Thru" channel is passed through unmodified and the "Wet" channel is modified by the graphic equalizer.

An ink control determines how the canvas is changed when it is clicked/drawn on. Dark ink means that sound in a particular direction should be sent to the "Thru" channel and light ink means to the "Wet". Ink in between indicates that an intermediate amount is sent to each of the two different channels. The Thru channel is modified by the Thru gain and delayed to have the same latency as the Wet channel. The Wet channel is modified by the Wet gain and also the graphic equalizer provided. The two channels are then combined.

This means that sound directions painted dark are affected by the Thru gain only and sound directions painted light are affected by the Wet gain *and the equalizer*. Colours in between are a mix.

2.16.4.1 That was all a bit confusing...

Yes. You might want to play with the O7A Spatial Mask and O7A Graphic Equalizer plugins to help get your head around what is going on here, before taking this plugin on. It's worth it though; this plugin makes a lot of good things possible.

The Thru and Wet gain sliders are useful, but can make things more confusing. If you set them both to "0.0" (the default) then dark means the sounds pass through unaffected and light means the equalizer is applied fully.

2.16.4.2 Automation

Most of this plugin *can* be automated. Pressing the buttons or drawing on the canvas are converted into changes in the internal ACN elements, so you can record these changes and play them back to reproduce canvas paint changes.

To put this another way, the ink control, brush and thru/wet/flip buttons are not accessible via automation, but the changes they make to the canvas are.

2.16.5 Controls

2.16.5.1 Controls: 20Hz - 20kHz Band Gains

These controls affect the frequency content of the soundfield at the frequency selected, in the sound directions affected by the "Thru" channel (light ink on the canvas).

If the DFT size is low, some of the frequency bands are ganged together.

2.16.5.2 Control: Ink Control

The first horizontal slider selects the colour of the "ink" that will be used when the panel is painted on. The grey tick marks are 6dB points.

2.16.5.3 Control: Brush Size Control

The second horizontal slider controls the amount of ink that will be painted onto the panel.

2.16.5.4 Control: Thru Button

This instantly paints the entire canvas dark ("Thru"). This means that all sound directions are then affected by the Thru gain slider (and *not* the Wet gain or graphic equalizer).

2.16.5.5 Control: Wet Button

This instantly paints the entire canvas light ("Wet"). This means that all sound directions are then affected by the Wet gain slider and the graphic equalizer (and not the Thru gain slider).

2.16.5.6 Control: Flip Button

This instantly converts the parts of the canvas that were light to dark and the parts that were dark to light and so on. This has the effect of converting all sound direction contributions that were Thru to Wet and vice versa.

2.16.5.7 Control: Wet Gain

This sets the gain applied to sound directions that are painted as "Wet" (light).

By default this is set to "0.0" (unit gain). This means that light ink on the canvas indicates that sounds should not be changed in level. On the other hand, they *will* be affected by the graphic equalizer which is the main feature of this plugin.

2.16.5.8 Control: Thru Gain

This sets the gain applied to sound directions that are painted as "Thru" (dark).

By default this is set to "0.0" (unit gain). This means that dark ink on the canvas indicates that sounds should be let through the plugin unmodified.

2.16.5.9 Control: DFT Size

The DFT size is used in the internal processing of this plugin. The size can be 512, 1024, 2048, 4096, 8192, 16384, 32768 or 65536. Lower sizes give lower latency and use less CPU power, but provide a less sharp equalizer. In this case, the plugin may gang low frequency bands together.

2.16.5.10 Controls: ACN00 - ACN63 Elements

These controls are not shown on screen as numbers but are available for automation. They capture an internal representation of what is on the canvas and they can be used to automate the canvas. If you are recording them, make sure you record them all together!

We recommend that you do not attempt to interpret these numbers. However, it may be worth knowing that fading them together (linearly) will result in a natural (linear) fade of the canvas image.

Technically, these elements contain a spherical harmonic decomposition of the gain function, defined as a function mapping the surface of the unit sphere to values broadly between 0 and 1, where the spherical harmonics are encoded using the SN3D convention.

3 Panners

3.1 O7A Panner LS and O7A Panner LS XYZ
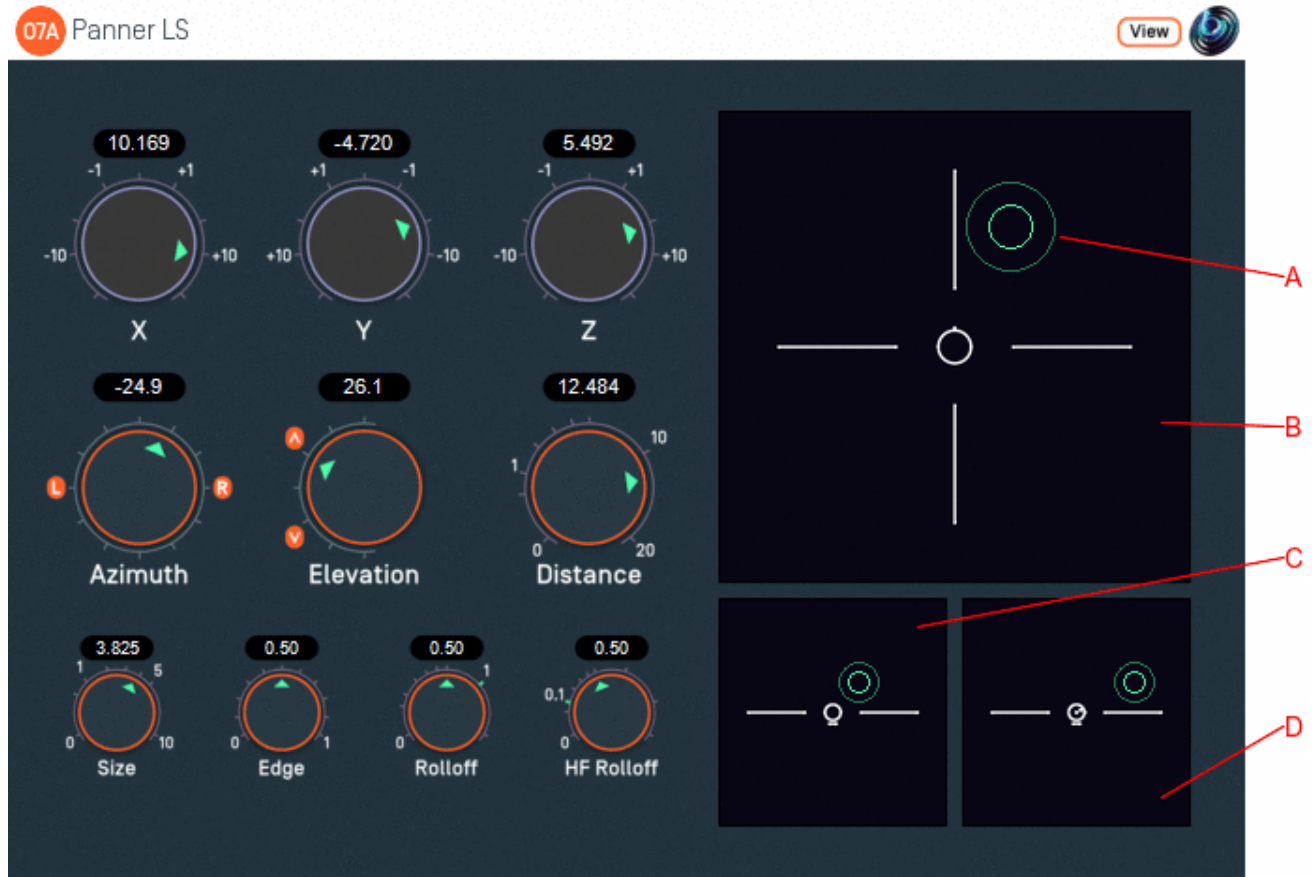
3.1.1 Host Support

3.1.1.1 O7A Panner LS

Host Type	Support
AAX	Yes
VST2	Yes

3.1.1.2 O7A Panner LS XYZ

Host Type	Support
AAX	Yes
VST2	Yes

3.1.2 Audio

3.1.2.1 O7A Panner LS

	Channels	Content
Input	1	Mono
Output	64	O7A

3.1.2.2 O7A Panner LS XYZ

	Channels	Content
Input	1	Mono
Output	64	O7A

3.1.3 Controls

- X
- Y
- Z
- Azimuth
- Elevation
- Distance
- Source Size
- Edge
- Gain Rolloff
- HF Rolloff

3.1.4 Description

This O7A panner takes a mono sound and places it in a particular place in a 3D O7A mix.

This panner is designed to help you move a sound around in 3D space. It still has azimuth and elevation controls like the standard O7A Panner, but also X, Y and Z controls that can be used instead.

There are three control surfaces which can be used to move the sound "A" around. The main surface "B" is a view from above, with the front at the top of the screen. Below it is a view "C" from behind and another "D" from the right.

This panner also has source size controls and a distance model. The size is visible on the control surfaces. Units are nominally metres, but it is possible to give a sense of larger or smaller distances by changing the source size and rolloffs.
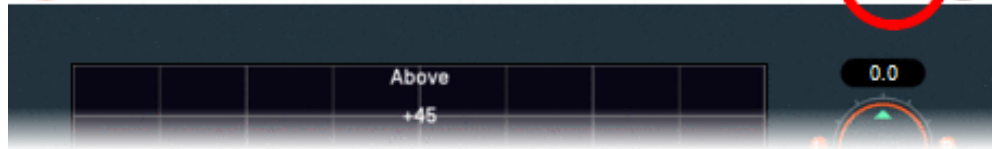
If you have access to the O7A Reverb library, you also may wish to consider the O7A Shoebox plugin. This has a similar control interface but adds an acoustic simulation of a rectangular room.

Two versions of the plugin exist. The only difference is the way that the controls are exposed to automation. The reason for this is that the X, Y and Z controls and the Azimuth, Elevation and Distance controls do essentially the same thing (move the sound) and so to avoid confusion, the plugins only expose one set of controls to automation. O7A Panner LS exposes Azimuth, Elevation and Distance to automation, whereas O7A Panner LS XYZ exposes X, Y and Z. This restriction only applies to automation; all controls are available in the user interface.

3.1.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current 3D location is shown as a small scaled sphere, within a scaled cube, which should be in reach of the VR controllers. The unscaled location (potentially out of reach) where the audio is actually located is also shown. Hold a VR controller trigger to move the scaled sphere to the controller. The unscaled sphere will move to match.

3.1.6 Controls

3.1.6.1 Controls: X, Y and Z

The coordinates determine where the sound is in space. Units are nominally metres.

Axis	Positive	Negative
X	Front	Back
Y	Left	Right
Z	Up	Down

These coordinates are not available as automation parameters in O7A Zoom. Instead, they are translated to and from Azimuth, Elevation and Distance, which may be used instead. If you need to automate these controls you should probably use O7A Panner LS XYZ instead.

3.1.6.2 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction of the source relative to the centre.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

Azimuth, Elevation and Distance are not available as automation parameters in O7A Panner LS XYZ. Instead, they are translated to and from X, Y and Z, which may be used instead. If you need to automate these controls you should probably use O7A Panner LS instead.

3.1.6.3 Control: Distance

This control indicates how far away the source is from the centre. Units are nominally metres.

Azimuth, Elevation and Distance are not available as automation parameters in O7A Panner LS XYZ. Instead, they are translated to and from X, Y and Z, which may be used instead. If you need to automate these controls you should probably use O7A Panner LS instead.

3.1.6.4 Control: Source Size

Source size can be used to give a source a volume. When the source is close, this changes the spatial response of the source (you will see it looks bigger in the O7A Visualiser). This effect continues when the listener travels inside the source.

When the listener is inside the source, there is a substantial omnidirectional component to the soundfield generated here. You may wish to make this more diffuse, for instance by using the O7A Diffuser plugin.

3.1.6.5 Control: Edge

The edge setting further determines the shape of a source with size. Increasing the edge setting introduces tapering from the edge of the source, effectively moving more of it towards its centre. This changes the spatial response of the source, particularly when it is close.

3.1.6.6 Control: Gain Rolloff

This rolloff determines the rule that is used to reduce the source's level as the source moves away. A value of 1 is closest to how this occurs in reality. Reducing the value reduces the effect of the level drop and increasing the value exaggerates it. A value of 0 means that the level stays constant.

Mathematically, the gain applied is determined by the inverse square law, but raised to a power given by this control.

3.1.6.7 Control: HF Rolloff

This controls a simple low-pass filter that reduces high frequency content as the source moves away. This happens in reality due to air absorption. A value of 0.1 is close to reality at typical pressure, temperature and humidity, and changing this value reduces or increases the effect. A value of 0 means that no filtering occurs.

The value used with this control is the number of additional decibels lost at 10kHz for each metre of distance, on top of the main gain rolloff.

3.2 O7A Panner LS8
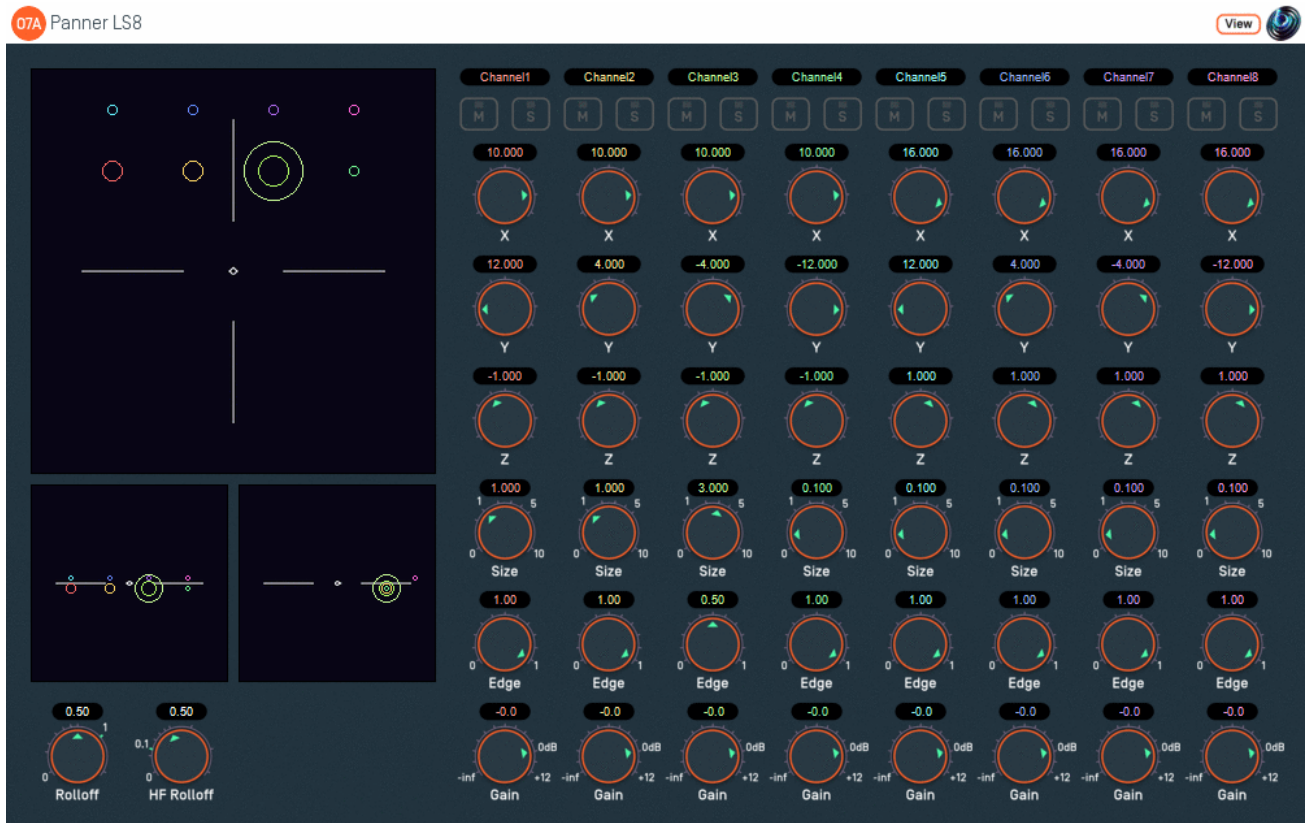
3.2.1 Host Support

Host Type	Support
AAX	Yes, input mapped to 7.1
VST2	Yes

3.2.2 Audio

	Channels	Content
Input	8	Eight channels of mono (mapped to 7.1 for AAX)
Output	64	O7A

3.2.3 Controls

- Gain Rolloff
- HF Rolloff
- X 1 - 8
- Y 1 - 8
- Z 1 - 8
- Source Size 1 - 8
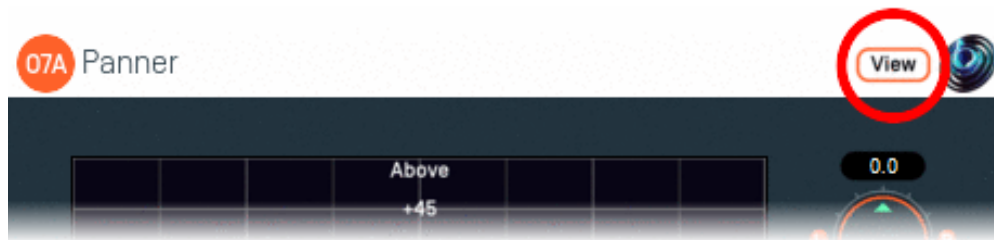- Edge 1 - 8
- Gain 1 - 8
- Mute 1 - 8
- Solo 1 - 8

3.2.4 Description

This is a multichannel variant of the O7A Panner LS. Eight channel strips are provided, each with an additional gain control and mute/solo buttons.

3.2.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current source directions are shown using colour-coded crosses and labels, similar to the display used by O7A Panner - Eight Channel. Point at one and hold the left mouse button to select it. Then, drag to set its direction.	The current 3D locations are shown as small scaled spheres, within a scaled cube, which should be in reach of the VR controllers. The unscaled locations, where the audio is actually presented from, are also shown. Grab one of the scaled locations with a VR controller and drag to move it. The unscaled sphere will move to match.

3.2.6 Controls

3.2.6.1 Control: Gain Rolloff

This rolloff determines the rule that is used to reduce the source's level as the source moves away. A value of 1 is closest to how this occurs in reality. Reducing the value reduces the effect of the level drop and increasing the value exaggerates it. A value of 0 means that the level stays constant.

Mathematically, the gain applied is determined by the inverse square law, but raised to a power given by this control.

3.2.6.2 Control: HF Rolloff

This controls a simple low-pass filter that reduces high frequency content as the source moves away. This happens in reality due to air absorption. A value of 0.1 is close to reality at typical pressure, temperature and humidity, and changing this value reduces or increases the effect. A value of 0 means that no filtering occurs.

The value used with this control is the number of additional decibels lost at 10kHz for each metre of distance, on top of the main gain rolloff.

3.2.6.3 Controls: X 1 - 8, Y 1 - 8 and Z 1 - 8

The coordinates determine where each sound is in space. Units are nominally metres.

Axis	Positive	Negative
X	Front	Back
Y	Left	Right
Z	Up	Down

3.2.6.4 Controls: Source Size 1 - 8

Source size can be used to give a source a volume. When the source is close, this changes the spatial response of the source (you will see it looks bigger in the O7A Visualiser). This effect continues when the listener travels inside the source.

When the listener is inside the source, there is a substantial omnidirectional component to the soundfield generated here. You may wish to make this more diffuse, for instance by using the O7A Diffuser plugin.

3.2.6.5 Controls: Edge 1 - 8

The edge setting further determines the shape of a source with size. Increasing the edge setting introduces tapering from the edge of the source, effectively moving more of it towards its centre. This changes the spatial response of the source, particularly when it is close.

3.2.6.6 Controls: Gain 1 - 8

Each sound source has its own gain control, with a range from -60dB to +12dB.

3.2.6.7 Controls: Mute 1 - 8 and Solo 1 - 8

Each sound source has its own mute and solo switch. These have the usual meanings and solo overrides mute.
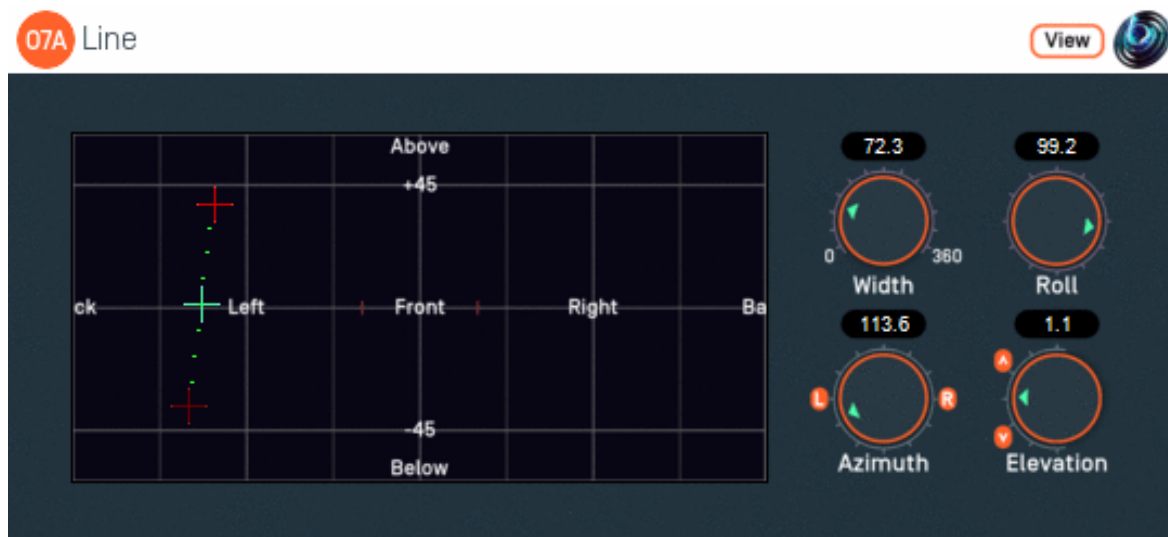
3.2.7 Presets

Presets are available for this plugin:

- Cube
- Octagon
- Square
- Stage

3.3 O7A Line

3.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.3.2 Audio

	Channels	Content
Input	1	Mono
Output	64	O7A

3.3.3 Controls

- Width
- Azimuth
- Elevation
- Roll

3.3.4 Description

This plugin takes a mono stream and converts it to seventh order ambisonics (O7A), spreading the sound out in a line.

The centre and "left" directions of the line can be set using the control surface, where the directions are indicated by crosshairs. The "right" direction is shown but cannot be controlled directly this way.

There are labels on the control surface to help you find left, right, above etc. However, if this still does not make any sense, you might want to see our page on the O7A Visualiser which lays out its viewing region in the same way.
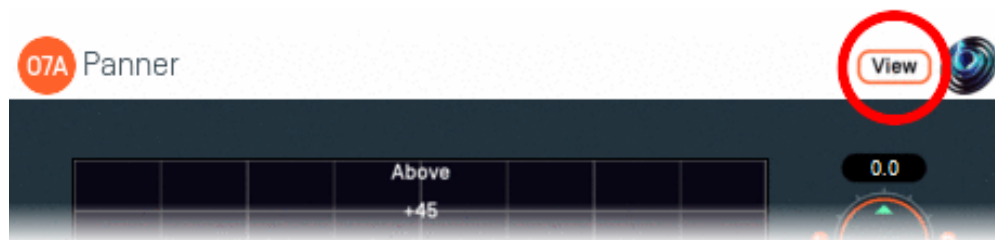
In acoustics terms, this plugin emulates a one-dimensional emitter where all points are the same distance from the centre of the coordinate system. In 3D space, strictly this is an arc rather than a line. The arc appears as a line in perspective views.

This plugin emulates a quite unusual acoustic soundfield. If you find it sounds unnatural you may wish to apply other processing to make it less regular, for instance the O7A Diffuser.

3.3.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current centre and left side directions are shown using green/blue and red crosses, similarly to the plugin display. A dotted line connects the left and right extent of the stereo image. Point at the centre or left side cross and hold the left mouse button to select it. Then, drag to set its azimuth and elevation.	The current centre and left side directions are shown using green/blue and red beams and crosses, similarly to the plugin display. A dotted line connects the left and right extent of the stereo image. Each VR controller moves one of the centre and left side directions and the controllers show short green/blue and red beams to indicate which is which. Hold a VR controller trigger to set an azimuth and elevation.

3.3.6 Controls

3.3.6.1 Control: Width

The width controls the length of the line, from 0 degrees to 360 degrees. At 0 degrees, this plugin has much the same behaviour as the standard O7A Panner. At 360 degrees, the line forms a complete circle around the listener.

3.3.6.2 Controls: Azimuth and Elevation

Azimuth and Elevation control the centre of the line. Effectively, this allows the line to be moved around.

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

3.3.6.3 Control: Roll

The line is centred around the point given by the azimuth and elevation controls and with a length given by the width control. The roll control sets the *angle* of the line and can be used to rotate it around the centre point.

This control has an angle between -180 and +180 degrees. Increasing the value rotates the line clockwise.

4 "A-Format" Support

4.1 O7A A60->B Converter and O7A B->A60 Converter
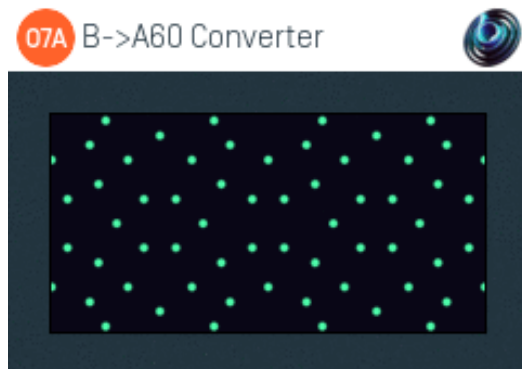
4.1.1 Host Support

4.1.1.1 O7A B->A60 Converter

Host Type	Support
AAX	No
VST2	Yes

4.1.1.2 O7A A60->B Converter

Host Type	Support
AAX	No
VST2	Yes

4.1.2 Audio

4.1.2.1 O7A B->A60 Converter

	Channels	Content
Input	64	O7A (B-Format)
Output	60	A60 (A-Format)

4.1.2.2 O7A A60->B Converter

	Channels	Content
Input	60	A60 (A-Format)
Output	64	O7A (B-Format)

4.1.3 Description

These plugins translate from 64 channel O7A B-Format to a 60 channel "A-Format" and back again.

4.1.4 What do we mean by A-Format Here?

When working with seventh order ambisonics (O7A) streams, it is often not obvious what the 64 channels of audio within the streams actually 'mean'. It is also often difficult to apply conventional processing directly to the streams without disrupting the 3D.

The terms "A-Format" and "B-Format" strictly relate to microphone techniques, where A-Format is the direct output of a number of directional microphone capsules (typically four cardioids) and B-Format is the full ambisonic stream. For our purposes here, by B-Format we mean the full O7A stream and by A-Format we mean a breakdown of the stream into a collection of channels corresponding to individual directions (although with a sharper response than cardioid). These two plugins translate between these two formats.

We convert to A-Format because some processing is more naturally applied there. This approach was pioneered by Joseph Anderson.

For our A-Format breakdown we use 60 fairly evenly distributed directions set out so some are above and below. You can think of the channels of the A-Format as being similar to narrow microphone responses in these directions.

This 60 channel A-Format is *not* compatible with the 4 channel A-Format produced by first order ambisonic microphones. It is similar to, but not the same as, Spatial PCM.

4.1.5 How can we use A-Format?

You can convert freely between normal O7A B-Format and this special 60 channel A-Format.

Once you have your audio in A-Format, you can modify the individual channels of the A-Format and only affect audio in a particular direction (subject to some overlap). For instance, you might want to apply a distortion effect to an O7A mix. Applying distortion to B-Format directly will produce very strange spatial results, but applying it to A-Format will probably give you what you were expecting!

If this does not make any sense yet, it might help to see this output from the O7A Visualiser where only channel 30 of the A-Format has been kept (i.e. the others are silent). This channel is to the left, slightly towards the front.
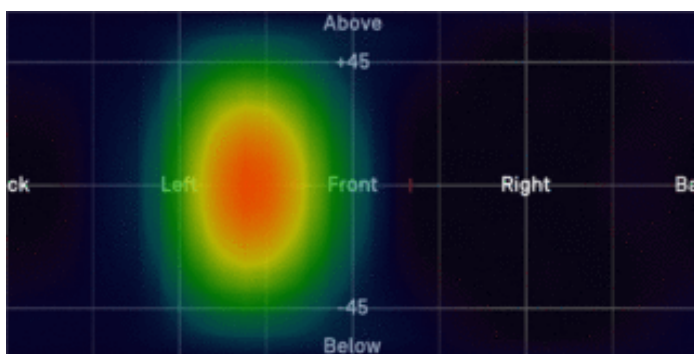
When converting from B-Format to A-Format, this shape can be thought of as an imaginary microphone response pattern. There are 60 such responses, overlapping each other. When converting from A-Format to B-Format, this shape can be thought of as the location at which the A-Format channel audio will be placed. The shape is nearly, but not quite, circular around its main direction. (There are some mathematical reasons why it is not actually circular which relate to some somewhat mind-bending topics. Contact us if you are really interested!)

The A-Format used here has slightly fewer channels (60) than the B-Format (64). If you convert from B-Format to this A-Format and then straight back again, your signal will be essentially as it

started, but a little spatial information will be lost.

4.1.6 Directions

Using the ambisonic convention (X is forward, Y is left and Z is up) the directions, as unit vectors, are:

| Number	X	Y	Z
1	0	0.357	0.934
2	0	-0.357	0.934
3	-0.577	0.577	0.577
4	0.577	0.577	0.577
5	0.577	-0.577	0.577
6	-0.577	-0.577	0.577
7	-0.934	0	0.357
8	0.934	0	0.357
9	-0.357	0.934	0
10	0.357	0.934	0
11	0.357	-0.934	0
12	-0.357	-0.934	0
13	-0.934	0	-0.357
14	0.934	0	-0.357
15	-0.577	0.577	-0.577
16	0.577	0.577	-0.577
17	0.577	-0.577	-0.577
18	-0.577	-0.577	-0.577
19	0	0.357	-0.934
60	0	-0.357	-0.934

4.1.7 Working with A-Format in Reaper

If you are working in Reaper, current versions do not make it particularly easy to set up processing of the A-format channels, but it is possible if you are prepared to use some advanced features and do some rather tedious set-up. For instance, you can save an "FX Chain" in which 60 mono compressor plugins are "routed" correctly and in which controls are linked by "parameter modulation" so that one set of controls operates the others. Once the FX Chain is saved, you can load it into other projects.

5 Split and Join

5.1 O7A Spatial Mask Split
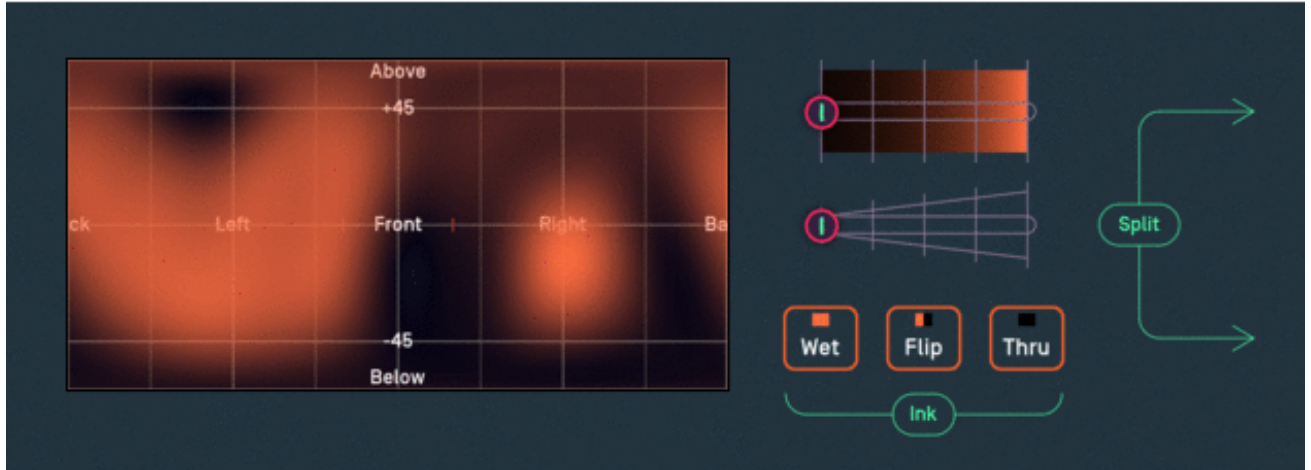
5.1.1 Host Support

Host Type	Support
AAX	No
VST2	Extreme channel count excludes most hosts

5.1.2 Audio

	Channels	Content
Input	64	O7A
Output	128	Two split O7A mixes

5.1.3 Controls

- Ink Control
- Thru Button
- Wet Button
- Flip Button
- ACN00 - ACN63 Elements

5.1.4 Description

This plugin has an extreme channel count and will not work in most hosts.

This plugins separates the content of an O7A stream into two that can be joined together later. The separation is controlled by painting regions.

This plugin is a variant of the O7A Spatial Mask plugin. Whereas that plugin produces 64 channels of output containing a single O7A scene, this plugin produces 128 channels of output, containing two O7A scenes.

The first 64 channels of output contain the masked scene as before, but the second 64 channels contain the rest of the original scene. These two sets of channels can be added back together to reconstruct the original input mix with the O7A Join plugin.

This can be useful when you want to apply processing just to the masked region, leaving the rest of the original scene intact. This can all then be joined back together.

5.1.5 Controls

5.1.5.1 Control: Ink Control

The first horizontal slider selects the colour of the "ink" that will be used when the panel is painted on. The grey tick marks are 6dB points.

5.1.5.2 Control: Thru Button

This instantly paints the entire canvas dark ("Thru"). This means that all sound directions are then passed to the *second* O7A mix.

5.1.5.3 Control: Wet Button

This instantly paints the entire canvas light ("Wet"). This means that all sound directions are then passed to the *first* O7A mix.

5.1.5.4 Control: Flip Button

This instantly converts the parts of the canvas that were light to dark and the parts that were dark to light and so on. This has the effect of switching which O7A output sounds are sent to.

### 5.1.5.5 Controls: ACN00 - ACN63 Elements

These controls are not shown on screen as numbers but are available for automation. They capture an internal representation of what is on the canvas and they can be used to automate the canvas. If you are recording them, make sure you record them all together!

We recommend that you do not attempt to interpret these numbers. However, it may be worth knowing that fading them together (linearly) will result in a natural (linear) fade of the canvas image.

Technically, these elements contain a spherical harmonic decomposition of the gain function, defined as a function mapping the surface of the unit sphere to values broadly between 0 and 1, where the spherical harmonics are encoded using the SN3D convention.

5.2 O7A Spotlight Split
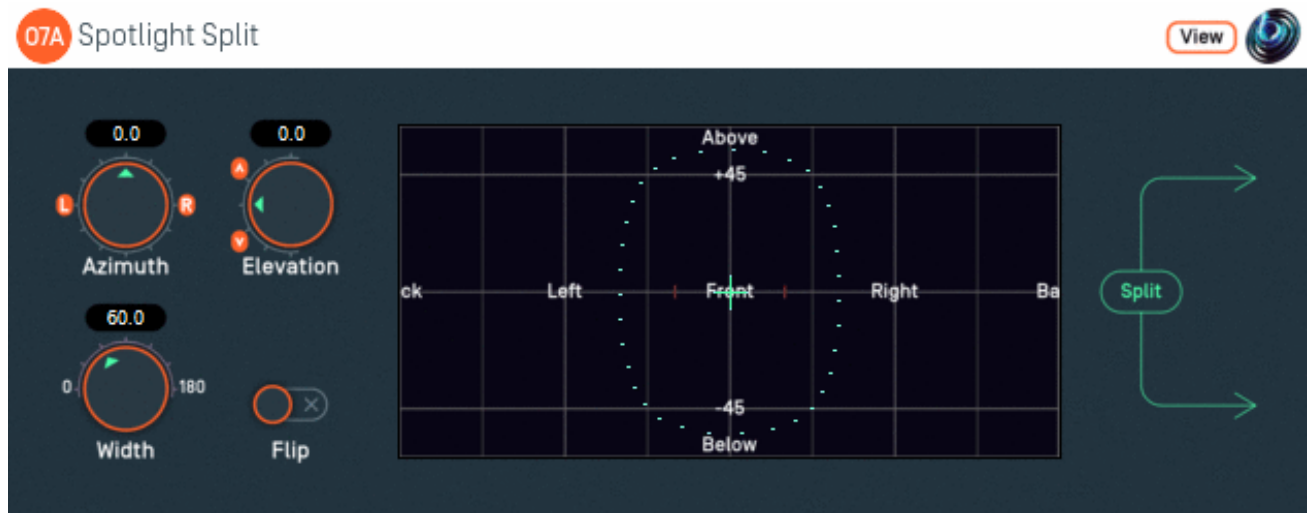
5.2.1 Host Support

Host Type	Support
AAX	No
VST2	Extreme channel count excludes most hosts

5.2.2 Audio

	Channels	Content
Input	64	O7A
Output	128	Two split O7A mixes

5.2.3 Controls

- Azimuth
- Elevation
- Width
- Flip

5.2.4 Description

This plugin has an extreme channel count and will not work in most hosts.

This plugin is a variant of the O7A Spotlight plugin. Whereas that plugin produces 64 channels of output containing a single O7A scene, this plugin produces 128 channels of output, containing two O7A scenes.
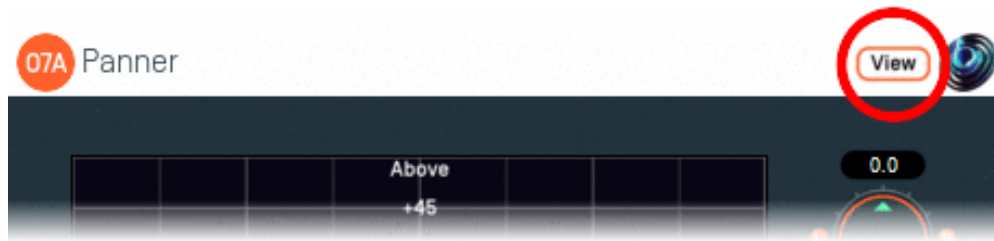
The first 64 channels of the output contain the spotlit scene as before, but the others contain the rest of the original scene. These two sets of channels can be mixed back together to reconstruct the original input mix with the O7A Join plugin.

This can be useful when you want to apply processing just to the spotlit region, leaving the rest of the original scene intact. These can then be joined back together.

5.2.5 View Support

When used with O7A View Sync from the O7A View library, this plugin can be connected to the separate View or ViewVR applications.

When this option is available, a 'View' button appears at the top right of the plugin's user interface.

When this is pressed, the plugin is connected to the View or ViewVR application and is displayed there.

View Support	ViewVR Support
The current direction is shown using a cross. Hold the left mouse button to set the azimuth and elevation.	The current direction is shown using a beam and cross. Hold a VR controller trigger to set the azimuth and elevation.

5.2.6 Controls

5.2.6.1 Controls: Azimuth and Elevation

Azimuth and Elevation control the direction to be kept in the first audio scene (the rest is passed to the second).

Azimuth is the horizontal angle, between -180 to +180 degrees, measured anticlockwise (left) from the front. Elevation is a vertical angle between -90 and +90 degrees, measured with positive upwards and 0 on the horizontal.

For instance, the direction for azimuth +90 and elevation +45 can be found by turning 90 degrees to the left and then looking up by 45 degrees.

5.2.6.2 Control: Width

Width is an angle, between 0 and 180 degrees, indicating how wide the beam of the spotlight should be. An angle of 0 indicates a narrow beam and an angle of 180 encompasses the whole scene.

Angles are measured from the spotlight direction to the sound direction. When the angle is less than the width setting, the sound is in the lit region and should be kept. Other sounds are in the unlit region and should be attenuated. In practice, the transition from the lit to unlit region is a gradual slope rather than a hard transition.

5.2.6.3 Control: Flip

Enabling this switch flips the meaning of the lit and unlit regions.

5.3 O7A Swap

5.3.1 Host Support

Host Type	Support
AAX	No
VST2	Extreme channel count excludes most hosts

5.3.2 Audio

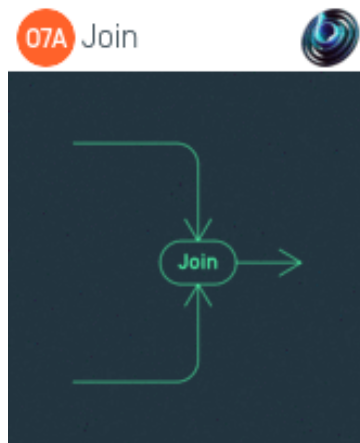|	Channels	Content
Input	128	Two split O7A mixes
Output	128	Two split O7A mixes

5.3.3 Description

This plugin has an extreme channel count and will not work in most hosts.

The O7A Spatial Mask Split and O7A Spotlight Split plugins separate the contents of an O7A mix into two separate O7A mixes, each using 64 channels. This audio can be reassembled into one mix using O7A Join or by just mixing the audio back together.

This plugin swaps the two O7A mixes over.

5.4 O7A Join

5.4.1 Host Support

Host Type	Support
AAX	No
VST2	Extreme channel count excludes most hosts

5.4.2 Audio

	Channels	Content
Input	128	Two split O7A mixes
Output	64	O7A

5.4.3 Description

This plugin has an extreme channel count and will not work in most hosts.

The O7A Spatial Mask Split and O7A Spotlight Split plugins separate the contents of an O7A mix into two separate O7A mixes, each using 64 channels. In total, this gives 128 channels of audio. This is typically done so that two spatial regions of an initial mix can be processed separately.

This plugin joins these two O7A mixes back together, by simply mixing the audio from the two scenes back into one.

6 Appendix: O7A Streams

6.1 What is an O7A Stream?

A seventh order ambisonic (O7A) stream is made up of 64 individual channels of audio which together represent a 3D soundfield. Into this "audio scene" can be placed individual sound sources, reverberation and complex spatial textures.

These 64 channels can be quite confusing to understand conceptually. For instance, they do not relate to particular speaker directions, or to individual sound sources in the soundfield. You do *not* need to understand them to use them! But, it doesn't hurt to know the basics.

Each channel adds spatial detail to a sound scene. With just the first channel, you have a basically omnidirectional (mono) sound image. The second channel adds some basic detail left/right, the third up/down and the fourth front/back; these four channels make up first order ambisonics. The first and second channels together provide essentially the spatial detail available with the Mid/Side (M/S) stereo recording technique, which captures a sound image with left/right width. But with the further two channels the detail is available in all directions, not just left/right.

That covers the first 4 channels. The other 60 add further detail to make the image sharper. If you are interested in what exactly is in these channels (which is not so easy to describe) you may want to read up on Higher Order Ambisonics (HOA) and the mathematics of the Spherical Wave Equation and Spherical Harmonics. But you should *not* need to read up to *use* the techniques described here. If you want to make sense of what is going on spatially in an O7A stream, we find that it is normally best to use an O7A Visualiser or O7A Flare plugin.

6.2 What processing can I apply to an O7A stream?

As well as processing designed specifically for O7A streams, it is possible to mix streams together in the expected way. It is also possible to run conventional mono DSP algorithms on them directly by applying the algorithm to all 64 channels individually, subject to some rules. Failing to follow these rules is likely to shred the spatial imaging, so be careful! Specifically:

- If you process an O7A stream with a conventional mono DSP algorithm you *must apply the same processing to all 64 channels identically*.
- Only *linear* processing can be used (e.g. not distortion or compression). Also, be aware that time-variant processing can cause issues.

If you are working in Reaper, current versions do not make it particularly easy to set up this sort of processing, but it is possible if you are prepared to use some advanced features and do some rather tedious set-up. For instance, you can save an "FX Chain" in which a number of equalization plugins are "routed" correctly and in which controls are linked by "parameter modulation" so that one set of controls operates the others. Once the FX Chain is saved, you can load it into other projects.

6.3 Encoding

There are a number of ways in which the channels can be defined in HOA. To a large extent it does not matter which is chosen, as long as *everything uses the same convention*. This is critical and horrible things will happen to the spatial image if this is not the case. However, if you follow the convention, or convert explicitly where you need to, you will be able to pass audio around between different software packages.

These plugins use the "SN3D" ambisonic convention. As is usually the case, we order the channels using "ACN" ordering.

This encoding is used in the "AmbiX" file format and YouTube. It is supported directly by Rapture3D Universal.

6.4 How does O7A SN3D relate to FuMa and Classic Ambisonics?

The ambisonic format used (SN3D) is not directly compatible with classic 1970s four channel "WXYZ" B-Format, or the extension (FuMa) which was used by versions of these plugins prior to version 2.0.

However, conversion is straightforward. The O7A Core pack includes plugins to do this: O7A Decoder - FuMa and O7A Injector - FuMa.