Binaural Surround Plugins

v2.2.1

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1 Introduction

This is a set of plugins designed to convert a multichannel surround mix into binaural 3D stereo for playback on headphones.

These plugins can be used with surround mixes in 5.1, 6.1, 7.1, 7.1.2 (Dolby Atmos), 7.1.4, 22.2 and Auro-3D and use Blue Ripple Sound's ground-breaking "Amber" HRTF and Projected Panning technologies.

The documentation also covers a Stereo Crosstalk Cancellation plugin which, under highly controlled conditions, can be used with the stereo output from these plugins to produce 3D sound using stereo speakers.

1.1 Compatibility

Note that some of these plugins need quite a few channels (for instance, 7.1.2 needs 10) and so *will not work correctly* in many Digital Audio Workstations, which may even crash if these plugins are used.

1.1.1 AAX

Most of these plugins exist as AAX versions which are compatible with Pro Tools Ultimate or Pro Tools HD 12.8.2 and 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 ensure plugins are used in the right places. However, where formats are not available in Pro Tools (e.g. 22.2), corresponding plugins are generally not available. To avoid this in some cases, some plugins "misuse" stem formats with matching channel counts. For instance, the ten-channel "Auro3D 9.1" format is unavailable in Pro Tools, so the "Binaural Surround - Auro3D 9.1" plugin expects audio as ten-channel 7.1.2 (Dolby Atmos). Cases like this are described for individual plugins below in the text.

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 VST 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.

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

These 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 Technical Notes

The Blue Ripple Sound Amber HRTF uses data from the IRCAM LISTEN HRTF data set, available at http://recherche.ircam.fr/equipes/salles/listen/index.html.

The HRTF data for each head in the data set is cleaned and converted into a suitable parameterised model. The parameter space is explored to find an "average" head model which works on a wide range of heads.

This HRTF head model can be used to present virtual speakers to the listener ("Virtual" mode). Alternatively, Blue Ripple Sound's Projected Panning technology can be used ("Inferred" mode). This is designed to work with material that has been panned using conventional pan pots and effectively uses the results of the panning to infer the pan pot settings approximately. This can result in reduced "gaps" between the directions of the virtual speakers.

Processing is "passive" and does not suffer from the material-dependent processing artefacts that occur with some other techniques.

2 Using the Plugins

2.1 What do these plugins do?

These plugins take multichannel mixes (such as 5.1) and convert them to stereo designed to be played in 3D on headphones. The sound is processed with "HRTF" data to make a binaural recording, so that sounds can be heard in 3D.

Generally, the output sounds natural on speakers, although the 3D effect is lessened. It can be strengthened through use of our Stereo Crosstalk Cancellation plugin in some circumstances.

The processing uses our Amber HRTF technology. It also uses our Higher Order Ambisonic (HOA) technology internally, but you don't need to think about that while using it.

2.2 Processing

There are two modes supported. In "Virtual" mode, each channel is panned into place, as if coming from a virtual speaker. Alternatively, "Inferred" mode uses a patented technique to help fill in the gaps between speakers.

Either way, we use passive processing techniques, so we don't mess with the character of the sound. You won't hear any DFT processing artefacts. Instead, the image produced is spacious and natural.

These plugins do *not* apply a room model or add any reverberation to what is originally in the mix.

2.3 Technical Requirements

2.3.1 Operating System

Supported versions of Microsoft Windows are Windows 7, Windows 8 and Windows 10. Supported versions of Apple macOS X are 10.7 or later, Intel only. VST plugins are generally available in 32bit or 64bit forms on both platforms (packaged as a Universal Binary on macOS). The AAX plugins are 64bit only.

2.3.2 VST Host

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

These plugins do not work with all VST 2 hosts. They are multichannel plugins and so will not work on VST hosts that only handle stereo. Also, note that some of the plugins need large numbers of channels on each track. For instance, the "Binaural Surround - 22.2" plugin needs 24 channels of input. Check the individual plugins for the channel counts they need. Also note that not all VST 2 hosts can use shell plugins. In particular, at the time of writing shell plugins are not supported in Nuendo or Cubase.

2.3.3 AAX Host

The AAX plugins require Pro Tools Ultimate, or Pro Tools HD v12.8.2 or later.

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

2.3.4 PC Hardware

Please check your PC meets the following requirements:

- Intel Pentium D CPU or better.
- 200MB of free disk space.
- Internal network card.

2.3.5 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.

2.3.6 Permissions

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

3 Binaural Surround Plugins

3.1 Binaural Surround - 5.1

3.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.1.2 Audio

	Channels	Content
Input	6	5.1 Surround
Output	2	Binaural Stereo

3.1.3 Controls

- Corners
- Mode

3.1.4 Description

This plugin takes a surround mix prepared for a 5.1 system and converts it to 3D stereo to be listened to on headphones.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.1.4.1 Channels

The channel ordering used is:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Left Surround	LFE
5	Right Surround	Side Left
6	LFE	Side Right

The low frequency effect channel is *not* used.

3.1.5 Controls

3.1.5.1 Control: Corners

The corner layout lets you tell the processor how the 5.1 mix was prepared, as this can help the accuracy of the spatial imaging. ITU is the most common option.

Corner Layout	Description
ITU	In principle, the speakers of a 5.1 system should be set out using ITU angles. From front centre, this recommends front left and right speakers be at +30 or -30 degrees and side speakers be at +110 or -110 degrees. ITU layouts are common in studios and are a common way to mix 5.1.
Square	In practice, many 5.1 speaker systems are set up with the corner speakers set out in what is roughly a square and some mixes are put together on this basis. If you know that's the case, switch the corner layout to Square.

3.1.5.2 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.2 Binaural Surround - 6.1

3.2.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.2.2 Audio

	Channels	Content
Input	7	6.1 Surround
Output	2	Binaural Stereo

3.2.3 Controls

- Mode

3.2.4 Description

This plugin takes a surround mix prepared for a 6.1 system and converts it to 3D stereo to be listened to on headphones.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.2.4.1 Channels

The channel ordering used is:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Surround Left	LFE
5	Surround Centre	Side Left
6	Surround Right	Side Right
7	LFE	Back Centre

The low frequency effect channel is *not* used.

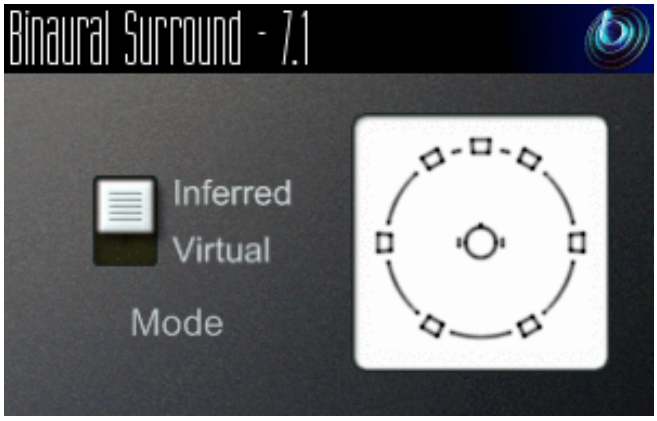
3.2.5 Controls

3.2.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.3 Binaural Surround - 7.1



3.3.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.3.2 Audio

	Channels	Content
Input	8	7.1 Surround
Output	2	Binaural Stereo

3.3.3 Controls

- Mode

3.3.4 Description

This plugin takes a surround mix prepared for a 7.1 system and converts it to 3D stereo to be listened to on headphones.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.3.4.1 Channels

The channel ordering used is:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Left Surround Side	LFE
5	Right Surround Side	Back Left
6	Left Surround Rear	Back Right
7	Right Surround Rear	Side Left
8	LFE	Side Right

The low frequency effect channel is *not* used.

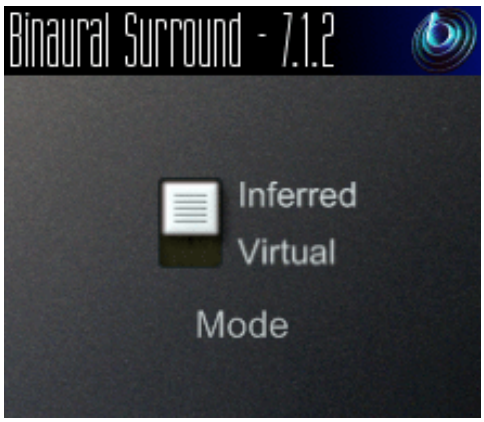
3.3.5 Controls

3.3.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.4 Binaural Surround - 7.1.2 (Dolby Atmos)



3.4.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

3.4.2 Audio

	Channels	Content
Input	10	7.1.2 (Dolby Atmos)
Output	2	Binaural Stereo

3.4.3 Controls

- Mode

3.4.4 Description

This plugin takes a surround mix prepared for a 7.1.2 system and converts it to 3D stereo to be listened to on headphones.

7.1.2 is a standard mix format for beds in Dolby Atmos. It adds two ceiling channels to standard 7.1. **Please note that this plugin does not process Dolby Atmos bitstreams directly.**

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.4.4.1 Channels

The channel ordering used is:

Channel	AAX	VST
1	Front Left	Front Left
2	Front Centre	Front Right
3	Front Right	Front Centre
4	Left Surround Side	LFE
5	Right Surround Side	Left Surround Rear
6	Left Surround Rear	Right Surround Rear
7	Right Surround Rear	Left Surround Side
8	LFE	Right Surround Side
9	Left Top Surround	Left Top Surround
10	Right Top Surround	Right Top Surround

Please note that the channel ordering used by Dolby's Atmos RMU may differ.

The low frequency effect channel is *not* used.

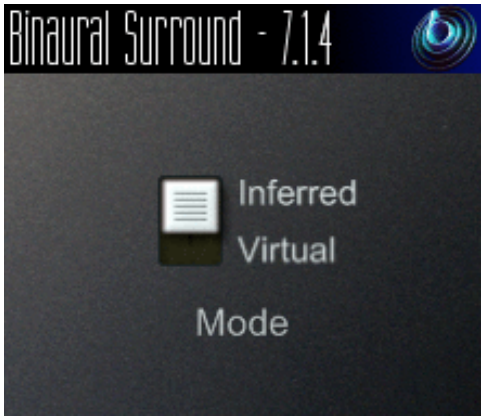
3.4.5 Controls

3.4.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.5 Binaural Surround - 7.1.4



3.5.1 Host Support

Host Type	Support
AAX	No
VST2	Yes

3.5.2 Audio

	Channels	Content
Input	12	7.1.4
Output	2	Binaural Stereo

3.5.3 Controls

- Mode

3.5.4 Description

This plugin takes a surround mix prepared for a 7.1.4 system and converts it to 3D stereo to be listened to on headphones.

7.1.4 adds four ceiling channels to standard 7.1.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.5.4.1 Channels

The channel ordering used is:

Channel	VST
1	Front Left
2	Front Right
3	Front Centre
4	LFE
5	Left Surround Rear
6	Right Surround Rear
7	Left Surround Side
8	Right Surround Side
9	Left Top Front
10	Right Top Front
11	Left Top Rear
12	Right Top Rear

The low frequency effect channel is *not* used.

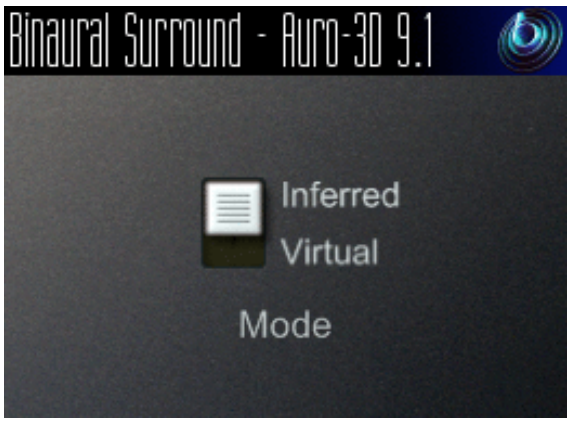
3.5.5 Controls

3.5.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.6 Binaural Surround - Auro-3D 9.1, 10.1, 11.1 and 13.1



3.6.1 Host Support

3.6.1.1 Binaural Surround - Auro-3D 9.1

Host Type	Support
AAX	Yes, input mapped to 7.1.2 (Dolby Atmos) stem
VST2	Yes

3.6.1.2 Binaural Surround - Auro-3D 10.1

Host Type	Support
AAX	No
VST2	Yes

3.6.1.3 Binaural Surround - Auro-3D 11.1

Host Type	Support
AAX	No
VST2	Yes

3.6.1.4 Binaural Surround - Auro-3D 13.1

Host Type	Support
AAX	No
VST2	Yes

3.6.2 Audio

3.6.2.1 Binaural Surround - Auro-3D 9.1

	Channels	Content
Input	10	Auro-3D 9.1 (mapped to 7.1.2 for AAX)
Output	2	Binaural Stereo

3.6.2.2 Binaural Surround - Auro-3D 10.1

	Channels	Content
Input	11	Auro-3D 10.1
Output	2	Binaural Stereo

3.6.2.3 Binaural Surround - Auro-3D 11.1

	Channels	Content
Input	12	Auro-3D 11.1
Output	2	Binaural Stereo

3.6.2.4 Binaural Surround - Auro-3D 13.1

	Channels	Content
Input	14	Auro-3D 13.1
Output	2	Binaural Stereo

3.6.3 Controls

- Mode

3.6.4 Description

There are four Binaural Surround plugins for processing Auro-3D surround mixes. These correspond to each of the Auro-3D 9.1, Auro-3D 10.1, Auro-3D 11.1 and Auro-3D 13.1 speaker layouts. They convert the mixes to 3D stereo to be listened to on headphones.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.6.4.1 Channels

The channel orderings used for the Auro-3D formats are:

Auro-3D 9.1	Auro-3D 10.1	Auro-3D 11.1	Auro-3D 13.1	Channel Name
1	1	1	1	Front Left
2	2	2	2	Front Right
3	3	3	3	Front Centre
4	4	4	4	LFE
5	5	5	5	Surround Left
6	6	6	6	Surround Right
-	-	-	7	Back Left
-	-	-	8	Back Right
7	7	7	9	Height Front Left
8	8	8	10	Height Front Right
9	9	9	11	Height Surround Left
10	10	10	12	Height Surround Right
-	-	11	13	Height Front Centre
-	11	12	14	Top Ceiling

Please note that when Auro-3D 9.1 is mapped to 7.1.2 (Dolby Atmos) for AAX, no attempt is made to map to channels where they correspond. The channels simply appear in the order above.

The low frequency effect channels are *not* used.

If you are using the recommended "Inferred" mode, make sure you are using the right plugin for your content, rather than just patching to some of the channels of 13.1. This will give better results.

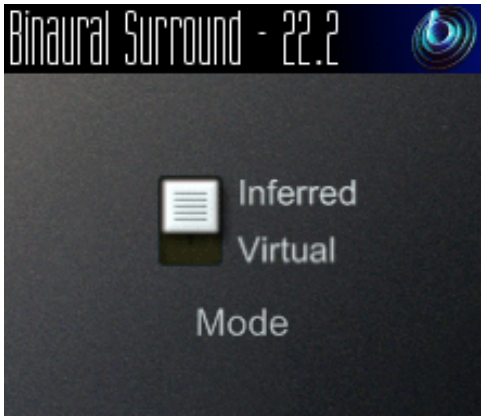
3.6.5 Controls

3.6.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

3.7 Binaural Surround - 22.2



3.7.1 Host Support

Host Type	Support
AAX	No
VST2	Yes

3.7.2 Audio

	Channels	Content
Input	24	Hamasaki 22.2
Output	2	Binaural Stereo

3.7.3 Controls

- Mode

3.7.4 Description

This plugin takes a surround mix prepared for a Hamasaki 22.2 system and converts it to 3D stereo to be listened to on headphones.

The 3D aspects of the stereo are synthesised using HRTF data. This models how sound from different directions is changed as it passes around the head.

3.7.4.1 Channels

The channel ordering used is:

Channel	VST
1	Front Left
2	Front Right
3	Front Centre
4	LFE Left
5	Back Left
6	Back Right
7	Front Left/Centre
8	Front Right/Centre
9	Back Centre
10	LFE Right
11	Side Left
12	Side Right
13	Top Front Left
14	Top Front Right
15	Top Front Centre
16	Top Centre
17	Top Back Left
18	Top Back Right
19	Top Side Left
20	Top Side Right
21	Top Back Centre
22	Bottom Front Centre
23	Bottom Front Left
24	Bottom Front Right

The low frequency effect channels are *not* used.

3.7.5 Controls

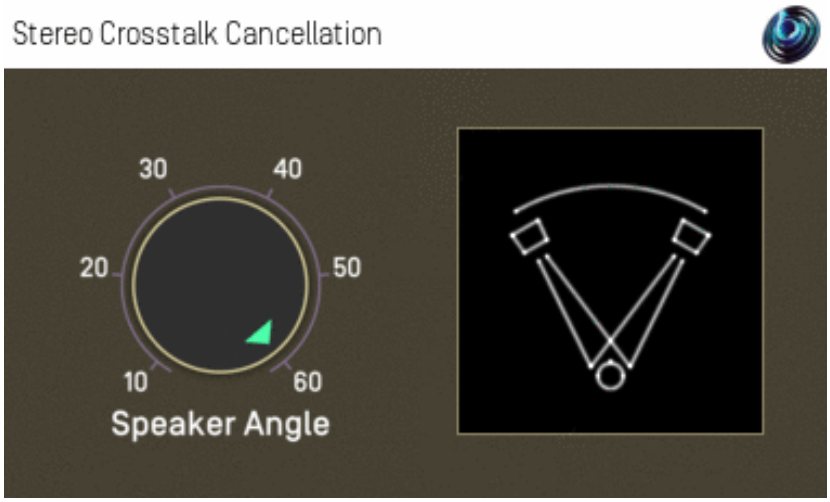
3.7.5.1 Control: Mode

Two modes are supported, "Inferred" and "Virtual". Generally, "Inferred" is recommended.

Mode	Description
Inferred	This mode is optimised for use with material that has been mixed using conventional panning techniques, such as equal-power panning or VBAP. The approach produces smooth transitions when sounds pass between speaker locations.
Virtual	This mode simply places each of the main (non-LFE) audio channels in their appropriate speaker direction. This can be worth trying when the mix has not been put together by conventional panning and the channels have a complex phase relationship.

4 Crosstalk Cancellation

4.1 Stereo Crosstalk Cancellation



4.1.1 Host Support

Host Type	Support
AAX	Yes
VST2	Yes

4.1.2 Audio

	Channels	Content
Input	2	Stereo
Output	2	Stereo

4.1.3 Controls

- Angle

4.1.4 Description

When you listen to stereo using normal stereo speakers (rather than headphones), the sound coming from the left speaker reaches both of your ears, not just the left one. Similarly for the right speaker. The sound that travels from the left speaker to the right ear and the sound that travels from the right speaker to the left ear is known as "crosstalk".

This plugin modifies a stereo signal to cancel out some of this effect, although this only works well under highly controlled conditions. This is known as "crosstalk cancellation" (CTC).

4.1.4.1 Why would I want to do that?

Mostly, you would not. Usually, stereo material is intended to be played on stereo speakers and this crosstalk is normal.

However, it can be useful when you have binaural 3D stereo material that is intended to be listened to on headphones (where crosstalk does not occur naturally) and you want to play it on stereo

speakers. With this processing it is possible to produce 3D sound using just two speakers.

Binaural 3D stereo recordings can be made with microphones mounted in real or modelled heads, or by software such as Blue Ripple Sound's Binaural Surround processors or O3A Decoder for Headphones.

4.1.5 Severe Warnings!

There are things about this plugin that you should be aware of:

- Unlike ambisonic decoding methods, this sort of crosstalk cancellation processing is *extremely* sensitive to listener location. It has a *tiny* sweet spot and a head rotation or a head movement of a few centimetres can be enough to ruin the image. The tiny sweet spot also means that this technique normally will not work for more than one listener at once.
- Errors in speaker angle can ruin the image.
- Acoustically reflective surfaces can ruin the image.
- When the image does not work for any reason, the processing used here can result in strong sound colouration.

So, if you are considering using this effect on material that may be hear somewhere that is not set up correctly, be really careful to listen to the results from different angles and ideally on different speakers and on headphones. It's a great effect when it works, but setting everything up correctly can be difficult and a lot can go wrong.

4.1.6 Controls

4.1.6.1 Control: Angle

This plugin has just one control, the angle between the two stereo speakers. For a normal stereo set-up this should be 60 degrees. Desktop and laptop computer speakers tend to be narrower than this, typically 20 or 30 degrees.

Values from 10 to 60 degrees can be selected, in 5 degree steps.