

BPan3 - Third Order Ambisonic Encoder

Original code by [Dave Malham](#)

When BPan3 is selected from the surround menu, clicking on the plug to open the editor window brings up the host's standard style of parameter display'

There are both a lot of parameters and a lot (16)! of outputs but only two inputs. The panner is basically a stereo in, third order B format output device. The first four outputs are grouped together and are the standard first order outputs in W,X,Y,Z order, exactly as in the first order plugs. The next five outputs are the second order outputs in the order R,S,T,U,V and these channels correspond to the [Furse-Malham standard](#) for second order. The final seven outputs are third order, designated K,L,M,N,O,P,Q. These channels form a logical extension to the definitions given in the Furse-Malham set and follow the convention called MaxN, (Maximum Normalisation), as given in [Jérôme Daniel's](#) doctoral thesis (see Table 3.1 on page 151 and Table 3.3 on page 156). This standard is not ideal from the mathematical point-of-view but is best from the engineering standpoint since it sets gains so that each channel has a maximum signal level of ± 1.0 , ie, it won't clip but it does make the optimum use of dynamic range. Note that this is slightly different, because of a change in weighting factors, from what I [previously published](#). The plugin can be used in first order only, second order or third order modes, simply by using only those outputs which are appropriate for the order in use.

The parameters and what they mean....

"Left Az"	Azimuth of left channel from centre front in degrees anticlockwise. (default 0)
"Left El"	Elevation of left channel from horizontal. +90 is due up, -90 is due down. (default 0)
"Left Centre"	Size of the centre region of left channel on an arbitrary 0.01 to 10 scale (default 1.0)
"Left Vol"	Volume of left channel (default -6dB)
"Left Dist"	Distance of left channel from the centre on an arbitrary 0 to 10 scale (default 1.0)
"Left DFact"	Distance factor of left channel - sets volume decrease with distance (default -4.5dB)
"Left Zero"	Level of the zero order spherical harmonic (W) of the left channel (default 70.7%)
"Left First"	Level of the first spherical harmonics (XYZ) of the left channel (default 100%)
"Left Second"	Level of the second order spherical harmonics (RSTUV) of the left channel (default 100%)
"Left Third"	Level of the third order spherical harmonics (KLMNOPQ) of the left channel (default 100%)

The parameters all have right channel versions which are not shown in this table.

The following gives more detail on some of parameters.

Distance, centre and distance factor

Distance, centre and distance factor all interact to determine the amplitude-distance profile. When distance and centre are equal, the sound is panned 'on the surface of the unit sphere' which means that, on decode, the sound will seem to come from the distance of the speakers (unless, of course, you alter things with reverberation). In this state - and if the Zero, First, Second and Third order parameters are set to their defaults - the amplitudes of the signals in the B format outputs follow the Ambisonic laws exactly, changing only with settings of the azimuth and elevation controls for the particular channel. If the set distance is less than the value of Centre, then the first order components (X,Y and Z) start to drop off, reaching zero at the centre, but the zero order component (W) continues to rise to a peak at the centre so that the sound seems to come from everywhere (or nowhere) and is louder. As distance increases beyond the central zone, levels of all the components start to drop, as would the loudness of a real sounding object moving away from the listener. If it were a point source of sound, this drop off would be at the rate of 6dB per doubling of distance, but real objects are not point sources, so the factor can be set in the range 0 to -6dB per doubling. For instance, if Centre is set to 1.0, the distance factor to -3dB and the distance to 2.0, the overall level will be 3dB down on the level on the 'unit sphere', at distance = 2.0, the level would be 6dB down and so on. The Centre is made variable to allow the user to choose precision for close sounds (with high settings of Centre) or greater range of distance

setting (with Centre set small).

Spherical harmonics controls

The normal Ambisonic rules set W at a gain of 0.707 with respect to the first order spherical harmonic components, X,Y and Z. It should usually be left at that. However, by breaking the rules and decreasing the first order components a little, the source can be made to seem more diffuse or, in other words, a little larger than the nominal point source. This is not a perfect object modelling system, but it is provided to allow flexibility. The same applies to the second and third order levels. Normally one would want to lower second more than first, third more than second in order to window off the components smoothly thus blurring the image in a sensible way, but by breaking this rule, wierd shapes and strange effects can be created.

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Bdec3 Programmable Third Order Ambisonic decoder

Original code by [Dave Malham](#)

The deoder is designed to take up to third order Ambisonic B format signals and decode to a reasonably regular array of up to sixteen speakers. Note that by using the [diametric pairs approach](#), this can be extended to 32 if you have spare output channel (and a suitable external mixer) available to send out W separately without sending it to BDec3. Later versions will feature more control over the per-speaker decoding equations so that you can at least attempt to get irregular arrays to work better. It currently has controls for the azimuth (in degrees anticlockwise from due left) and elevation (in degrees up or down from the median horizontal plane) for each speaker and overall controls for the amounts of zero, first, second and third order spherical harmonic signals being fed to the decoder. It has no controls for setting delays or gains either individually or jointly, since these can be provided by externall by other devices. They will be included in future versions.

The first four inputs are grouped together and are the standard first order inputs in W,X,Y,Z order, exactly as in the first order plugs. The next five inputs are the second order inputs in the order R,S,T,U,V and these channels correspond to the [Furse-Malham standard](#) for second order. The final seven inputs are third order, designated K,L,M,N,O,P,Q. These channels form a logical extension to the definitions given in the Furse-Malham set and follow the convention called MaxN, (Maximum Normalisation), as given in [Jérôme Daniel's](#) doctoral thesis (see Table 3.1 on page 151 and Table 3.3 on page 156). This standard is not ideal from the mathematical point-of-view but is best from the engineering standpoint since it sets gains so that each channel has a maximum signal level of +/- 1.0, ie, it won't clip but it does make the optimum use of dynamic range. Note that this is slightly different, because of a change in weighting factors, from what I [previously published](#). The plugin can be used in first order only, second order or third order modes, simply by using only those inputs which are appropriate for the order in use. The input ordering corresponds exactly to that used in the [BPan3](#) panner so interconnection is relatively easy.

Setting levels of the differing components...

I'm afraid this is where you are going to have to experiment to find the appropriate levels for your speaker array. I did say this is early days, hence the Alpha status. Do let me know what you come up with. Note, the following, though;

- The more speakers you have, in general, the less W you will want.
- In general, Third will be less than Second which will be less than First which will, however, be more than Zero. For instance, with all 16 speakers in a horizontal ring, something like ;
 - Zero =0.825
 - First = 1.0
 - Second = 0.46
 - Third = 0.095

might be a good starting point.

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