Mid/Side Audio Processing

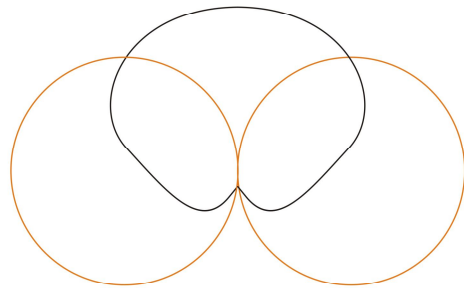## White Paper

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Introduction

Audio recording using mid/side techniques has been around for many years, especially in recording live performances as shown below.

Mid/Side recording has three main advantages.

- It guarantees mono compatibility of a stereo production

- The stereo width of the recording can be easily changed during the post production stage.

- Stereo imaging is very good without the need for a matched pair of microphones.

The mathematics are simple!

Left = Mid + Side

Right = Mid - Side

Using simple audio combining techniques (in either hardware or software) it is very easy to derive a Left/Right stereo image from the original Mid and Side recording.

But what happens if you do it in reverse and derive Mid and Side from a 'normal' Left/Right stereo signal?
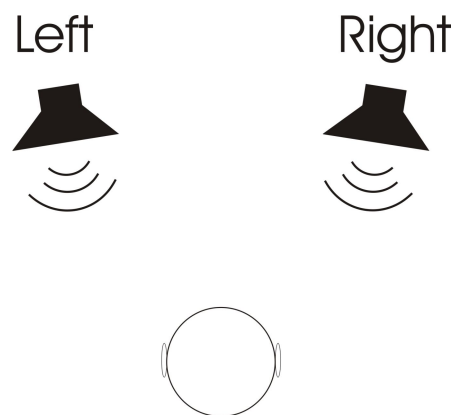
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Mid/Side during Post Production

Again mathematics are simple

Mid = Left + Right

Side = Left - Right

And again it's relatively straightforward to derive Mid and Side audio signals from stereo left and right either 'in or out of the box'.

In normal stereo (think about two loudspeakers), the stereo audio signal is fed as left (to the LH speaker) and right (to the RH speaker). You listen in the central position and hear a full stereo spatial representation derived from the two discrete audio signals.
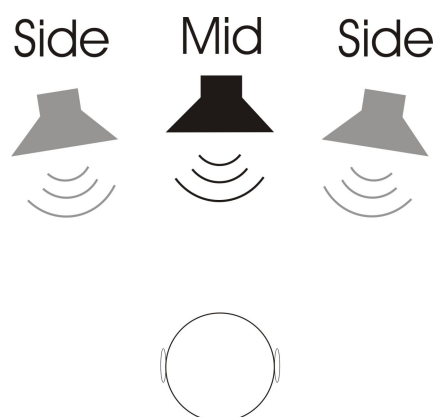
In M/S (which is still a representation of stereo audio), the two audio signals describe the centre (M or mid), and both sides together (S or sides).

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The **mid** channel handles those elements which are mostly panned centre, whereas **side** handles these signals which are mostly panned away from centre (so side might be thought of as the stereo content of the audio).

It's important to remember that, when using Mid/Side signals during music production, the mid/side elements are converted back into left/right at the end of the chain. So it's left/right in and left/right out, as shown below.


So now we have stereo audio available in Mid/Side format what kind of audio processing can be applied?

Stereo Width Control

By changing the relative levels of the mid and side signals the stereo width of the audio can be changed all the way to mono (turn down the side signal to zero), through the default stereo width (just like it sounded in the original left/right audio) all the way to extra wide (turn down the mono signal and increase the side signal).

In the Safe Sound Stereo Toolbox this is conveniently done on a single rotary control (1) which operates a bit like a balance control. So when you sweep from mono through normal stereo to extra wide the overall loudness of the stereo signal is unchanged. You could achieve the same effect by using separate gain controls for Mid and Side (2 and 3) which the Stereo Toolbox also provides for other reasons, but it would just less convenient to maintain the same overall level.

Stereo width control is used by mastering engineers working on the full stereo audio mix but it's also useful in the final mixdown stage especially when working on stereo subgroups (sometimes called stereo stems). Let's have a look and a listen to the impact of varying the stereo width on a drum submix.

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Centre of stereo image
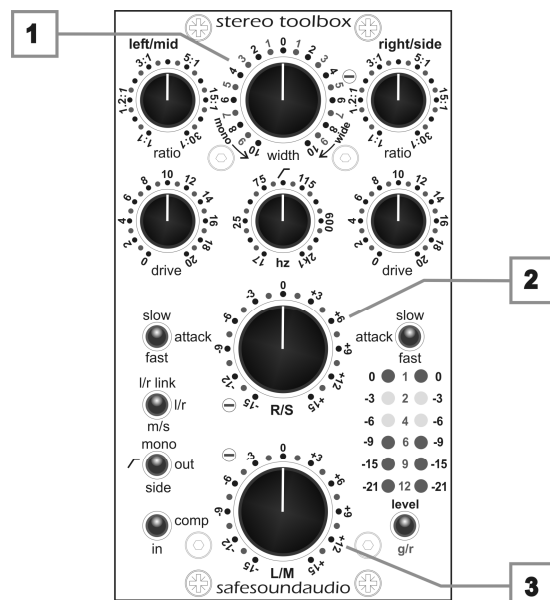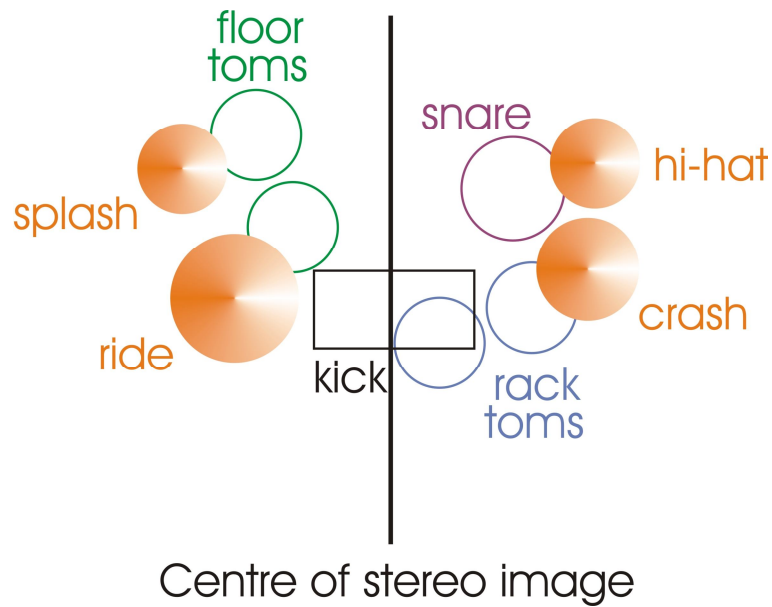
Visually you might imagine a typical stereo drum submix to look like above. This has probably been constructed by panning a number of mono microphones within the submix but quite often a stereo overhead pair has also been used to record the drums in stereo during tracking.

Centre of stereo image
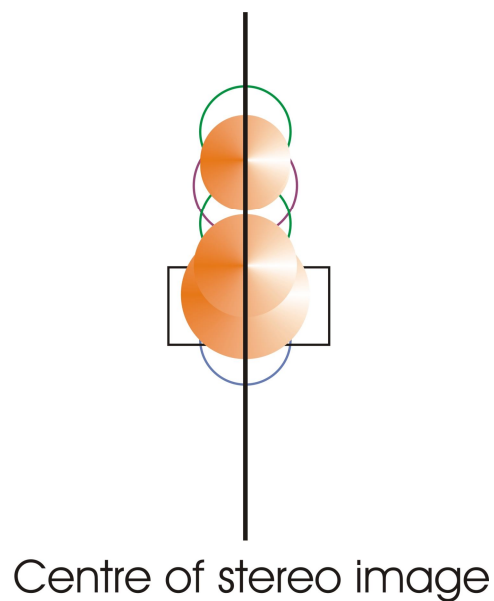
If we imagine turning the stereo width control to full mono, then it has the effect of bringing all the elements of the drum mix to the exact centre of the sound stage as shown above.

Centre of stereo image
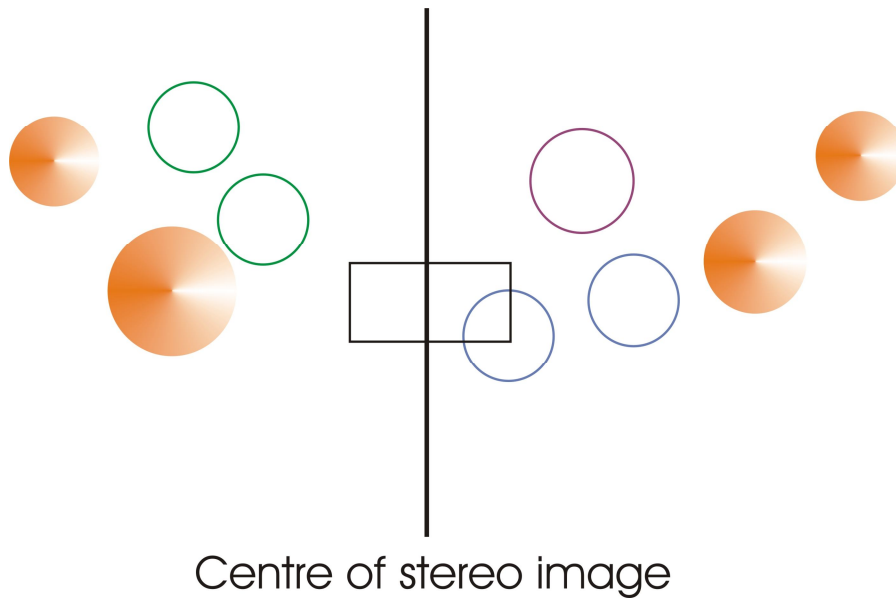
Now if we turn the stereo width control to extra wide, see what happens above. Those sources like the kick drum stay exactly centre stage and are unaffected. However those elements which were left of centre now stretch leftwards, and those elements which were right of centre now stretch rightwards.

If you reading this on screen and have a sound system connected to your computer then click below to listen to the effect on a stereo drum submix.

http://www.safe-sound-audio.co.uk/AUDIO/msaudio1.mp3

Whilst it's easier in the example above to hear the effect in isolation, it's more usual that you would want to vary the stereo width of the stereo submix (drums in this case) whilst listening to the overall mix.

Here's another example of a stereo drum mix but this time we'll alter the stereo width from it's default stereo width down to mono and back through default width to extra wide. We'll bring the other sources down and up in level so you can get a feel for the impact of the effect.

http://www.safe-sound-audio.co.uk/AUDIO/msaudio2.mp3

Stereo width processing can also be applied to a whole stereo mix and we'll have a look at a few examples later in this paper.

Used in moderation, stereo width can be a very powerful way to sit the elements of a mix within the stereo sound stage but that's just the beginning of what can be achieved through Mid/Side processing.

Other forms of audio processing in Mid/Side

With the stereo signal in Mid/Side format it's possible to process the mid and side signals separately, so EQ, compression, reverb, in fact any audio processing you can

think of, can be applied only to one element (either mid or side) or to both but in different amounts.

The Safe Sound Stereo Toolbox includes a stereo mix buss compressor so we're going to focus on that application to begin to explore the other possibilities.

Compressing in mid/side

Inserting a stereo compressor across a stereo drum buss is a fairly common technique during mixdown as a way to achieve a fuller or fatter sound. Compressing the entire drum mix together often gives a more natural affect and helps glue the individual elements together. The compromises arise due to the very different energy envelops of the individual drum elements and it's very easy to compromise the transient dynamics of the drum kit whilst looking for that gritty fat sound. Side-chain filtering of the compressor can help but it can eat away at the very effect you are trying to achieve.

And yes it's possible to spend a couple of hours getting the perfect kick drum sound before spending another happy hour or two working on the snare but yes the <u>drum set</u> is called that for a reason!

Working in mid/side allows buss compression to be approached with a whole new sound pallet. In the case of a stereo drum mix, it allows those parts of the kit centre stage, primarily the kick drum but also elements of the snare and toms, to be compressed differently from the those elements spread towards the edges of the sound field, usually cymbals. You might dive back to the individual tracks again but if you're using stereo overheads then you already have a mixed element to the drum sound.

Let's have a look and a listen to a stereo drum buss which needs some work and start to explore what Mid/Side compression can offer.

In this example the kick and snare are quite flat sounding and lacking in depth and ambiance. We might reach for gating and reverb, but let's have a look at mid compression as an option. The objective here is to impact on the centre sound field without affecting the panned high hat and cymbals which are already a little too loud.

A traditional left/right stereo compressor would succeed in adding some grit and depth to the kick and snare but as the post compression gain make-up is applied the hi-hat and cymbals would be brought up in level as well and the balance of the kit would be lost.

We've set the mid channel compressor attack to fast, ratio to 5:1 and we're hitting the compressor at about 12db peak compression, some of which we'll get back using the mid channel gain make-up control. We'll also insert a mid sidechain high pass filter so the compressor doesn't hit too much on the low end of the kick sound.

First we'll have a listen to the uncompressed drum mix. Then we'll fade down the other sources so you can hear the mid compression being dialled in, after which we'll

fade back up the other sources so you can hear the affect within the whole stereo mix.

http://www.safe-sound-audio.co.uk/AUDIO/msaudio3.mp3

In addition to the improvement which compression has brought to the kick and snare drums, gain make-up has brought up the centre element of the stereo overheads which contain a lower level kick and snare element which is much more ambient than the separately recorded kick drum. This would have been very difficult to achieve with traditional left/right stereo compression.

And it's been possible to tackle what was needed in the mid channel without any compression in the wider stereo field at all. This is really useful when you don't want a related 'pick-up' on panned elements (in this case hi-hat and cymbals).

Moving on to vocals

So far we've concentrated on the stereo drum buss but what about other sources? Let's concentrate on the vocal buss in the previous example and have a look at what mid side compression can achieve during mixdown.

The vocal buss comprises of three elements;

The main lead vocal panned centre
A doubled tracked lead vocal with reverb and panned 30% right
Double tracked backing vocals panned 80% left and right (right channel with 90ms delay)

The main vocal is sitting a little bit too much on top of the mix and will probably benefit from low ratio compression.

The 'stereo' backing vocals are still quite flat and there's little sense of breadth.

So we have an example where compressing the mid and side channels differently should be helpful.

We'll apply compression at a 1.3:1 ratio to the centre channel and hit the compressor at a slowish attack for about 6 to 9dB of compression. This will help sit the lead vocal into the mix. As the double tracked lead vocal is panned right it will be less effected by both the mid channel compression and make-up gain which is what we want.

On the side channel we'll go more aggressive and hit the compressor on a fast attack, 5:1 ratio and aim for a maximum of 6dB compression. We'll also widen out the stereo width a little to help tease out the limited width we've created in the backing vocals by using delay on the right backing vocal.

Let's have a listen to the effect of these different mid and side compression settings.

http://www.safe-sound-audio.co.uk/AUDIO/msaudio4.mp3

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The lead vocal now sits much better in the mix and the backing vocals have gained some much needed width. Even with gain make-up applied to the centre channel after compression, the overall level of the mix has fallen by over a dB. This would allow the entire mix level to be raised by a dB during mastering without any additional compression across the final stereo mix.

M/S processing across the whole mix and into mastering

There's an ongoing debate about whether processing should be applied across the stereo buss during mixdown or whether this should be left to the mastering engineer. In either case, mid/side processing, as part of the final mixing and mastering processes, offers some unique tools which are difficult to achieve purely in the left/right domain.

Let's look at an example where we want to improve how the main elements of a mix sit together and where their spatial separation within the stereo sound field may be utilised in the mid/side domain.

In this example we have:

A female vocal panned centre
Bass and drums, with the low frequency elements panned centre
Double tracked guitars panned left and right
Stereo Keys
Stereo Piano
Sax, panned right of centre

We'll use mid/side compression to work on two issues;

The female vocal is a little strident at times so we'll compress the mid channel using a fast attack, 3:1 ratio and aim for around 6dB of peak compression. A high pass filter has been inserted into the mid sidechain to prevent the bass guitar from triggering the compressor.

The side has been compressed at a low ratio of 1.5:1 on a slow attack and again aiming for around 6dB of peak compression. The idea here is to gently sit the guitar and sax into the mix without any pumping effects.

The main advantage of mid/side compression in this application is to allow different attack speeds and ratios to be applied to different elements of the mix.

A small amount of stereo widening has been applied to bring the stereo piano and strings a little forward in the mix without any significant level increase.

You can hear the unprocessed and processed versions of the audio clip at

http://www.safe-sound-audio.co.uk/AUDIO/msaudio5.mp3

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The second example is a rock mix which has already got a pretty busy stereo sound field. Here we're aiming to re-establish the mid channel element of the mix just a bit as it's maybe struggling to compete with the panned affects.

Have a listen to the unprocessed mix
http://www.safe-sound-audio.co.uk/AUDIO/msaudio6.mp3

For the mid channel we'll use a compressor set to slow attack, a fairly aggressive 4:1 ratio and we'll be aiming to hit the compressor at between 4 and 6dB of gain reduction at the loudest part of the mix.

The side channel contains panned guitar, some panned vocals and unusually, some low frequency elements which do work well in this particular mix. Even though these elements are already panned, we're going to use a small amount of stereo widening to generate a little more space for the centre panned elements. As an example of another mid/side technique, we're going to use the stereo width control to drive the side compressor. So as we push the panned elements a little further out to the edges of the soundfield, we'll prevent any resultant increase in the side level by hitting the side compressor threshold as we widen. Again we'll use a slow attack on the compressor but with a lower ratio of around 2:1 as the side elements have already been compressed during mixdown, aiming to peak between 3 and 6dB of gain reduction.

Here's the processed version of the mix;

http://www.safe-sound-audio.co.uk/AUDIO/msaudio7.mp3

In conclusion

Having the option to work with audio in the mid/side domain opens up a whole new sound palette of audio processing techniques. Mid/Side processing can be especially useful when you're working with high track counts and chose to mix down though stereo stems into your final stereo mix. Already more established in mastering, mid/side processing can also be used to fine tune elements within the stereo buss and we expect the use of mid/side processing to increase as hardware and software mid/side processors become more widely available.

Thanks and acknowledgements

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