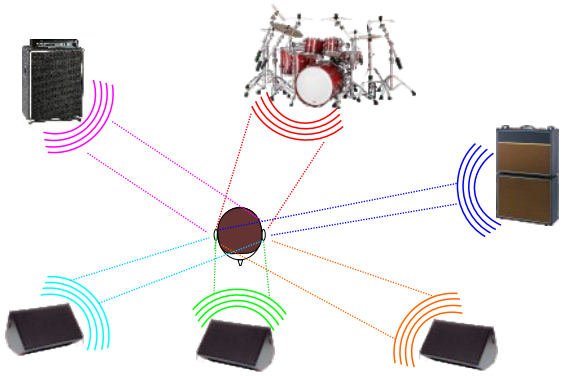
Going to In-Ear-Monitors requires a 3D mix

Introduction

There are several good reasons for looking into using in ear monitors, like: increasing the overall sound quality by reducing stage volume (getting rid of monitor speakers), introducing hearing protection for the individual musicians, the need to have a precise monitor mix to play in tune with backing tracks
and many more. This paper explains some psycho acoustical basics and why monitor speakers cannot simply be replaced with a pair of IEMs. For a positive IEM experience it is absolutely important to use a three-dimensional mix, mono mixes don't work for IEMs.

How we hear with monitor speakers

Our hearing is a powerful and extremely precise mechanism. We are able to detect and localize items or persons around us. We notice whether something is approaching or leaving, its position in the room and many other details; much more than we can differentiate with our sight. We live in a three-dimensional world and our brain uses the level and arrival time difference of a sound between the two ears as well as the ratio of direct to reverberant sound to project a full 3-D sound image. This is the same for a musician on a stage. The sound quality might not be what we want, but it is three- dimensional. The sound from all the monitor speakers in the front, left, right, the sound from the backline and instruments– based on their position, plus reflections from the room and the stage, etc... While some of these signals might not be wanted or appreciated, the brain still recognizes a 3-D sound image.



Pic 1: We hear the individual instruments with level and time differences according their poistion: a 3D sound image.

Why In-Ear Monitors are so different

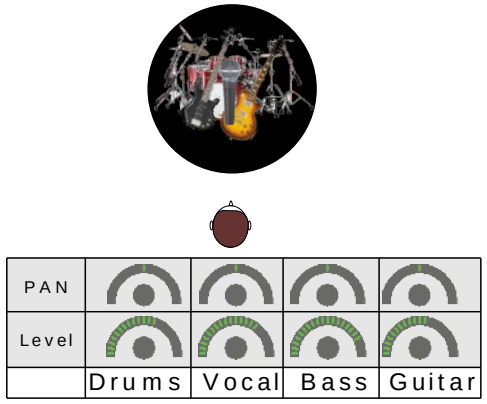
Inserting the in-ear monitors in our ears will reduce the surrounding sound by 20 to 26 dB on average. What we now hear is mainly what's in the IEM mix. The great advantage is that we can now adjust which signals will apply to the ear and which not... but that's also where the problem begins.
Close miking

In most cases all instruments are either picked up with a close microphone (about one inch from the sound source) or they are brought in via DI boxes. While we hear the original sound sources as they are positioned in the room, the electrical signals arriving at the mixing console all within the same time, with little to no room information. The drums overhead mics are usually the only ones that keep some room ambience. That's not an issue as long as we are listening with “free ears” through speakers, which will always include all other sound sources from the room as well.

The mono trap

It is absolutely common to use a mono mix for the monitor speakers on stage; a stereo set-up for five or more musicians would simply be over the top. As long as the listener has "open ears" the room information will be added and the musician will hear a 3D sound image.

This changes completely when the ears are isolated from the acoustical environment by inserting in-ear monitors: the natural sound of the room is gone, the sound image depends on what's being feed as a signal into the ears. What happens if a mono mix is used with in-ear monitors is dramatic. Mono means that the signals for both ears are 100% identical. Our brain, which is designed to utilize differences ina signal between both ears, no longer gets such information. Everything, all instruments and voices come from the same spot, with no spatial differentiation. Instead of a 3-D sound image the brain recognizes everything in one dimension. This has quite some consequences.



Pic 2: a mono mix means feeding the exact same signal to booth ears. This results in a one dimensional sound image with no spatial resolution.

Using IEMs in MONO – consequences and side-effects

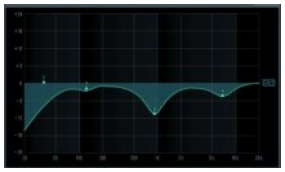
So why shall this be an issue? The monitor should help the musicians control their playing not pleasing them, right? A monitor mix on a wedge is usually in mono, so replacing the speaker with an IEM should do the job… Now, most of the issues musicians run into with IEMs are caused by a mono mix, and most musicians have no idea about how and why.

Fatiguing

Our brain has no mono switch. So when it receives identical signals with no differences, it starts analyzing even harder. The brain can detect arrival time differences below 1ms and tiny differences in early reflections, but this job can't be solved. Our brain is “spinning in circles” trying to find differences, because that's the way it is programmed. The longer this situation lasts the more the brain will fatigue, creative energy will suffer and after hours there can be even dizziness or headaches. So no wonder certain musicians have a constraints against IEMs.

Heavy EQ-ing needed

Most instruments and voices have very wide overlapping frequency bands. Without the possibility to locate them in a three-dimensional room, they easily cover up each other. If there are many instruments and voices the only way around is to cut out certain frequency bands to create some space for the other instruments. Besides the fact that cutting also means losing things, it is also about the how and who. Precise cutting of frequencies needs the right tools, like a multi-band fully-parametric eq in each channel; and if you happen to have the equipment, you still need the person who knows how to operate the equipment.



Mono mix = continuously redialing

And even with “perfectly cut” signals, it will only work within small boundaries. A change of the guitar sound, a different song – and all of a sudden the detailed sound is gone. The keyboard, perfectly balanced with the guitar when using a piano sound, all of a sudden covers the guitar completely when switching to a fat string sound. The eq-ing that was perfect just a second ago needs now massive redialing; in fact the whole mix needs redialing, and the usual solution is increasing the level of the missing instrument. Something many musicians are familiar with, but they don't know why.

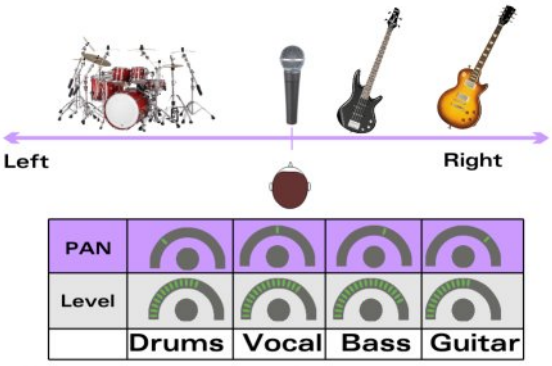
Mono for IEMs is not working

Using IEMs and feeding them with a mono mix is a very unsatisfying situation, and the reason why there are plenty of musicians that have concerns with in-ear monitors. So musicians would feel “forced” to use IEMs. The assumption to simply replace the monitor speaker with a pair of IEMs using the same aux send from the console is wrong. One can live with a mediocre monitor mix on a wedge – because the brain still receives a 3D sound image, but if this mono mix is all you can hear, because you have ear plugs, it's simply unbearable. That doesn't change whether the mix is done by an engineer or the musicians themselves using a wireless app for a remote level control.

Going Stereo is almost the solution

So, the solution seems simple: just use a stereo mix for your IEMs and all will be good. It's a start in the right direction and a huge improvement over mono. The signals to both ears are not identical any more. The brain can find level differences and can position them along a line.

Advantage: the individual instruments and voices can be differentiated now much better, less eq-ing and redialing is needed and fatiguing won't happen as fast. It is a step in the right direction but the signals used for that mix are picked up within an inch or less from the source - spatial information is still not in the mix, it is a 2D and the musicians will still feel " isolated" from the room.



Pic 3: using a stereo mix for the in-ear systems allows to position the signals within the stereo image.

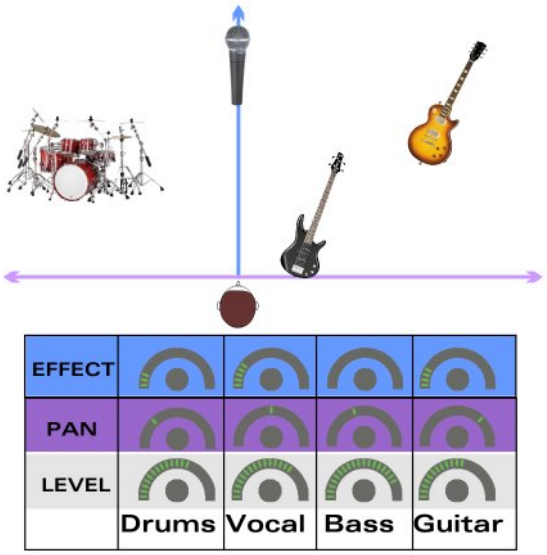
Creating a 3-D monitor mix

Ambience microphones?

There are two reasons for the "isolated" feeling: the very low feedback level from anything (wanted or unwanted) in the environment and the absences of any spatial information in the mix; it is still a two-dimensional sound image. Ambience mics can help to get some feedback, and because they contain some room information they help a bit overcoming the isolation. Ambient mics that provide a good capture need to be placed correctly and adjusted in level in between songs. That's something better done by an engineer. However, adding one, or even several ambient mics won't get the missing third dimension to the mix. It's mainly the two-dimensional sound image that causes the “strange isolated feeling”.

Stereo-Effects- adjustable per channel for a 3D sound image

The solution to recreate the third dimension is to be able to add stereo room or reverberation effects to the individual signals in the mix. That's where myMix with its built-in stereo effects scores double: three presets for rooms, three for reverbs and an adjustable (time and feedback) delay. Each channel has an effect send - post pan- so the instrument or voice will get its ambience resulting on the positioning in the stereo image: a three dimensional sound image for the listener, like "without earplugs" but now with the desired level in the mix.



Pic4: Adding more or less of effect to an instrument or a voice is like moving it more or less "deep" in the room, creating a 3D sound image.

More good news

The 3D sound image also helps with all the other issues that cause so much trouble in the mono mix. Because there is a distinct position now for each source, the brain uses that to deal with overlapping frequency bands and even volume changes. Once a 3D mix is created the amount of redialing and eq-ing is greatly reduced.

Use the internal auto-mixer

We all use it, but most people aren't even aware we do: our built-in auto mixer. When listening to a crowd of people and we want to emphasize and focus on one particular person, we can do that. What's impossible in any mixed stereo signal: adjusting the level of a single source (that's why multi-track recording was invented), our brain can do. It needs the spatial information of the sound sources and uses them to bring up the source we focus on versus the surrounding signals. Of course there are some limits, but within a certain range this auto mixer does a good job.

Stereo-Mix with Effects is a must for IEMs

If one decides to use IEM's, the success of implementing them is heavily dependent on the ability to create three dimensional sound images for the listeners to maintain a three-dimensional hearing. This will not only overcome the "strange, isolated sound" many musicians complain about, it will also reduce the amount of eq-ing and redialing to a minimum and let musicians listen easily. The whole creative energy can be put into the music, nothing disturbs, musicians get in the flow!

While a mono aux send works for a monitor speaker, it doesn't work for IEMs. That doesn't change whether it is mixed by an engineer or controlled with a wireless app from the musician. If your budget doesn't allow having a large monitor console with plenty of stereo busses and as many stereo effects, operated by a very skilled engineer who knows exactly the desires of all the musicians, the solution is to use a personal monitor mixing system with adjustable stereo-effects per channel.

The smart solution

myMix is easy and intuitive to use and travels very light. Besides an outstanding audio quality it features built-in stereo effects that can be added to each channel individually. Musicians can create a full 3-D sound image for their IEMs, recreating their own little sound world. And it's not a secret that musicians who hear what they want, the way how they want it, not only feel and but also perform better.

Note: a stereo set-up will also improves the listening situation when using speakers for monitor. A stereo set of speakers fed by a myMix (with a 3D mix) helps to get a much more differentiated sound than any mono set up. It sounds like a contradiction, but the second speaker will allow to keep the overall volume much lower than on a single wedge.

myMix allows each person to create a stereo mix with 3D sound. In addition it also allows each person to determine which signals to use for that mix. I

Each unit can select up to 16 channels from all available network channels (depending on your set up that can be a few hundred) to use detailed channels where important and submixes where convenient. See www.mymixaudio.com/webinars for more info.

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