



## 2D Sound in a 1D System

By Multicellular

Most humans live in three-dimensional space - up/down, left/right, front/back. Typical audio systems have two channels - left/right. And you can think of our ears as being two left and right inputs.

But if we only have one dimensional hearing, how can we hear in two dimensions? If you were in a completely anechoic space, a space with no reflections, it would be hard. (Interestingly, artificial rooms like this make people anxious and even hallucinate- see "[Anechoic Orfield Labs](#)").

In natural spaces, however, we do perceive additional dimensions. Left/right is easy. Tap something to your left, the sound reaches your left ear before your right ear. Your brain makes a calculation based on this.

Near/far is more complicated. In short, we perceive it through environmental clues. (We can actually perceive above and below from outer ear vibrations, but that is not practical to do in stereo recording tech.)

If you have ever looked at a reverb pedal or plugin, you may know the terms pre-delay, dampening, mix, time. But let's examine where those come from. Many people turn these knobs and aren't clear on how they relate to perception of distance. Understanding this can help you use these effects yourself or in critically listening when working with an engineer.

But where did those terms/knobs come from? Humans long enjoyed the natural reverb characteristics of caves, cathedrals, and dungeons. Our first artificial 'analog' reverb units ran electricity through springs or plates. Spring reverbs are still quite popular in guitar amps; think of the iconic surf reverb sound. Digital reverbs have come much closer to simulating natural spaces. These developments are especially helpful to many of us in metropolitan areas where room space is at a premium, but are relevant considerations any time your recording includes overdubs, direct ins, or close micing.

All those parameters thus, were based on an understanding of how sound works naturally in space; even if some of the early analog and digital attempts didn't sound very natural.

I think of using reverb in two ways - to simulate a natural room or as a special effect. As a special effect, I might use a huge wash of reverb on guitar in place of a synthesizer pad. Or I

might use a reverse reverb - a sound that doesn't occur in nature.

With special effects, there are absolutely no rules. Use sizes of spaces you'd never record in. Get wild, twist the knobs blindly!

But this article is about simulating a *natural* space. So some understanding of the parameters is helpful.

First, of course, you want to consider *how* you will record things. Do you even need to add reverb through effects?

One way to get a natural reverb that sounds like it was recorded in a real room is...surprise!....record in a real room with the mics farther away.

But that is a luxury we don't all have and recording in a noisy or poorly shaped room can be worse than faking it in the box.

Even if you have a nice room, sometimes you want to close mic things for isolation, e.g. drums, mouths in a vocal booth. Or you might have elements that, for efficiency, are easier to record direct. Or sometimes sound better direct, e.g. sometimes I want my Moog Minitaur's unaffected direct sound versus it going through a tube amp. Or maybe there are things you didn't record, at all like samples.

So it is useful to have the freedom to add similar reverb to each element to 'glue' the mix later.

Granted, you can have some room mics on the drums and dial in reverb on the overdubs that matches it, but this is hard to get perfect. Even in my treated home studio, I usually record drums very close and dry because I get a better end result.

With that beginning of 'when' and 'why', here are the key parameters that help us perceive distance, our second D:

## **Panning**

The farther something is from you, the smaller the difference is between any left or right signals. Image a room 20-meter-long room. You are facing the drums. The low tom is on the left, hi hat on the right. If you are at the far end, the angles to your ears may only be a few degrees. If you move the drums to a meter in front of you, they may be at 45-degree angles to your ears, making it much more obvious which is to the left and right.

So anything intended to be far away should be panned more to the center. Close items can be panned anywhere, those are just perceived as being to your left or right.

## **Pre-Delay**

Imagine again you are in the back of a room, a singer is in the middle. When they sing, the sound of their voice will go straight to your head. That is the 'dry' signal. Their voice is also radiating in multiple directions, off the walls, the ceiling, and the bass player's vinyl onesie.

The pre-delay parameter adjusts the delay between the dry signal hitting you and the wall or ceiling reflections. If the singer is farther back in the room, some of the reflections would hit you much closer in time to the dry signal. If a guitar/synth amp intended to be at the far wall, you might use a pre-delay of zero.

If you are trying to match overdubs or a specific hypothetical room, note that three milliseconds is about 1 meter. We are talking about short reverbs usually to glue things.

## **Equalization or Damping**

All things being equal, high frequencies get absorbed more easily than low frequencies. So things that are farther away will have a high frequency cut or added dampening. It is difficult to give a default starting point here as what works is very dependent on the source and volume it is meant to be. Reverb aside, you also have mix/arrangement muddiness issues to consider.

But I may use anything from 1000Hz to 6000Hz, but that is as much subjective taste as near-far positioning as different surfaces absorb frequencies at different rates.

At the other end of the frequency spectrum, you tend to have a tighter window of what is cut. A roll off up to 200Hz is not unusual.

## **Decay Time or Room Size**

Things will tend to be perceived as farther away if the virtual room is larger. This one is more obvious, but note that if you are trying to glue your mix, having a long decay on some tracks and a short one on another will sound unnatural. A slight variation though just makes the room sound irregularly shaped. Remembering regarding pre-delay that three milliseconds is about a meter, note that huge concert halls may have just 2 seconds of decay. For a studio sounding recordings, I am usually using .5 seconds at most.

## **Reverb Mix or Wet/Dry**

Far away sources tend to have more reverb overall. There is more opportunity for more reflections on the way from the source to you. In some scenarios it can even overwhelm the dry signal - remember the way it sounded when you locked your accordion player in the basement? Raise the reverb mix to move items farther away.

## How much reverb overall? What kind of reverb?

This is related to the mix, wet dry but also in a way decay time. Overall, be clear here, for a natural gluing reverb, we are talking about something that is very subtle. If I played you some of the mixes I used this approach on, you might think, 'but I don't even hear any reverb?' You shouldn't, not overtly unless you are critically listening. Rather you should be able to close your eyes and picture that the drums are in the back middle of the room, singer is in front, etc.

What kind? This matters less than you might think because it is so subtle. Sure, you probably don't want to use a spring reverb, they sound awesome, but not realistic. 'Hall' 'room' even 'plate' simulations can work. Using convolution reverbs is also a great way to get something natural. I was actually using a few impulses I made of my home studio for a while, but I usually use algorithmic reverbs because they are more easily tweakable.

## How do I do this in my DAW?

The usually thing I will do here is set up three to five busses. Usually

- far verb
- near left
- near right

I might have a middle verb or middle left right, but I find I usually get a nice depth just with far and near left / right.

Then, I usually start with the far verb tweaking. That is of course going to be the most prominent. Then I copy that to the near busses and make small adjustments, based on the parameters above. For left and right, I just make them a little different, *but* I do sends from everything, the amount you send is a way of controlling reverb mix. And sending to near left and right as well as adjusting pans on the tracks themselves, completes the process.

Having hopefully gained some understanding of these psychoacoustics, my advice: Pay attention to these factors in your natural environment; Listen to the depth in recordings you love; and go out and make some 2 dimensional music (with 3 dimensional lyrics).

Perceived distance quick reference.

Parameter	Near	Far
Panning	Wide is okay	Narrow
Decay Time AKA Room Size	Down	Up
Mix/Wet Level	Dry up	Wet up
Pre Delay	Up	Down
EQ	Do nothing	Lower highs & very lows (usu. over 2000Hz and under 200Hz)