



NUTS and BOLTS

PART 15

The Short Delay, Part II— Flange and Chorus

BY ALEX CASE

This month's Nuts and Bolts column wraps up our three-month look at delay. Your writer hopes that by the end of this column you'll have renewed interest in using the humble delay, a simple effect with powerful sonic capability.

In the preceding two-month discussion on delays—long and short—we've spoken almost entirely about fixed delays (i.e. setting the signal processor to a single unchanging delay time). Things really get interesting as you start to change the delay time as part of the effect. Many effects are built on varying delays.

Figure 1 reiterates the controls on a standard digital delay device (we looked at this some in our two earlier columns on delay). This month we focus on the modulation section of this delay unit. These controls let us change the delay time in controlled, clever ways.

Figure 2a describes a fixed delay time of 100 milliseconds. It's a slap echo as discussed last month. The delay unit takes whatever signal you send it, holds it for the delay time you set (100 ms), then sends it out. That's it. Throughout the song, all session long, the delay time remains exactly 100 milliseconds; all signals sent to it—guitar, vocal, or didgeridoo—experience the exact same amount of delay.

That's a delay without modulation.

Some great effects begin when you start using some of the delay modulation controls. Usually three basic controls are found: Rate, Depth, and Shape.

Rate controls how quickly the delay time is changed. Figure 2b gives a graphic representation of what happens when this control is changed. You'll find cases when you'll want to sweep the delay time imperceptibly slowly (the dashed line), and other times where you dial in a fast, very audible rate (the solid line).

Depth controls how much the delay is modulated. Figure 2c graphically contrasts two different settings. That fixed delay time might be increased and decreased by 5 milliseconds (the dashed line), 50 milliseconds (the solid line), or more.

The third control, Shape, describes how the device moves from one delay setting to the next.

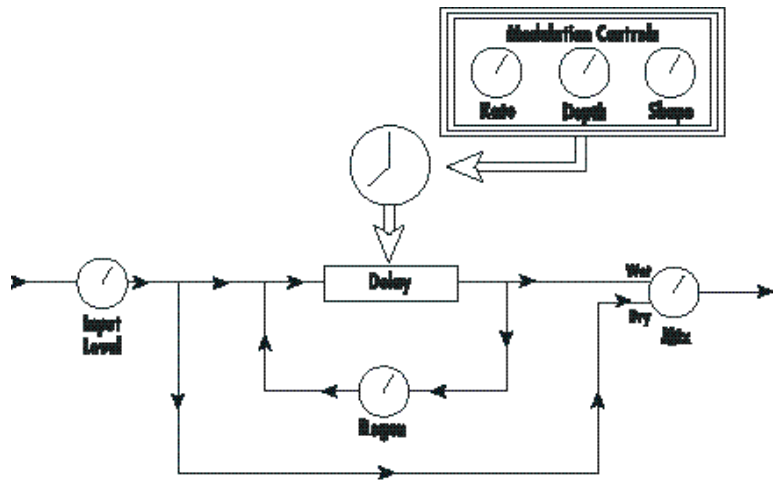
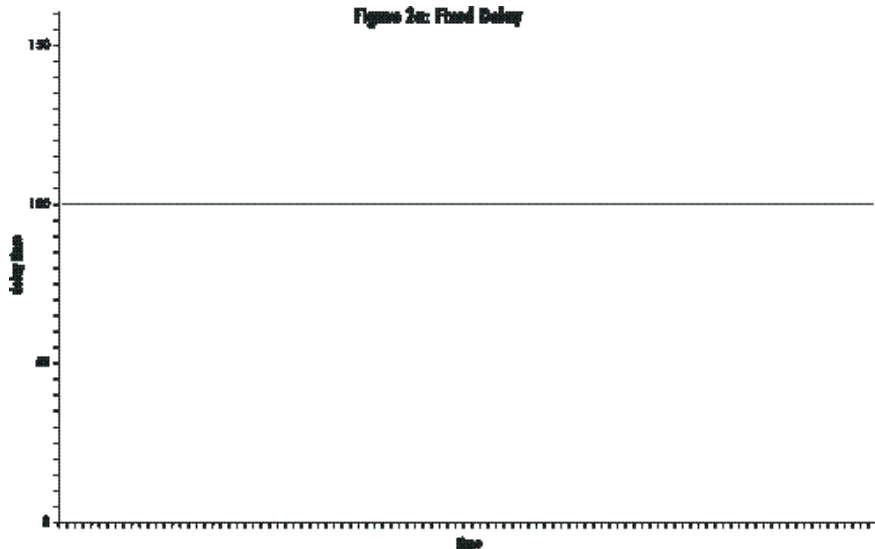


Figure 1: Signal Flow Through a Delay Unit. What's up with those Modulation Controls?

Figure 2a: Fixed Delay



As Figure 2d shows, it can sweep in a perfect sinusoidal shape (the dashed line) back and forth between the upper limit and the lower limit you set (those upper and lower limits you set with the Depth control). Or you might want a square wave sort of trajectory between delay times, in which the delay time snaps—instead of sweeps—from one setting to the other.

Figure 2d highlights a common feature of the Shape control: it lets you use a shape that is some mixture of the two—part sinusoid, part square. Your delay may also have a random setting in which the delay time moves less orderly between the two delay extremes.

Finally, some delay units let you use a combination of all the above, for example varying the delay time in a slightly random, mostly sinusoidal general pattern. The Shape control lets you mix these options and set a contour for how the delay moves between its highest and lowest settings.

These three controls let you take control of the delay and play it like a musical instrument. You set how fast the delay moves (rate). You set the limits on the range of delay times allowed (depth). And you determine how the delay moves from its shortest to its longest time (shape). Flanging, chorusing, doubling, and related effects are now yours for the taking.

Flange

Dialing in a very short delay time and modulating it via these three controls lets you create flanging. The only rule is that the delay time needs to be less than about 20 milliseconds—in fact I recommend starting with a delay time of 10 milliseconds or less. This ensures that audible comb filtering will occur. Set the delay modulation controls to taste.

The flanger's ringing, whooshing, ear tickling sound comes from the comb filter effect we discussed last month in combination with the modulation controls we just went over.

Recall from last month what happens when you combine a signal with a delayed version of itself. When the delay time is below about 20 milliseconds, certain frequencies are constructively reinforced. Other frequencies oppose each other, attenuating or even canceling each other out. That's good old comb filtering.

Those peaks and valleys in the frequency spectrum introduced by a short delay offer a distinct sound. The specific frequencies where spectral boosts and cuts occur depend on the specific short delay time we use. One delay setting causes the peaks and valleys to occur at one set of frequencies. A different delay setting results in a different set of peaks and valleys (see Figure 3).

The way cool effect comes from modulating the delay time. As your modulated delay sweeps from one delay time to another, the comb filter bumps and notches sweep also. Figure 3 shows the result: flanging.

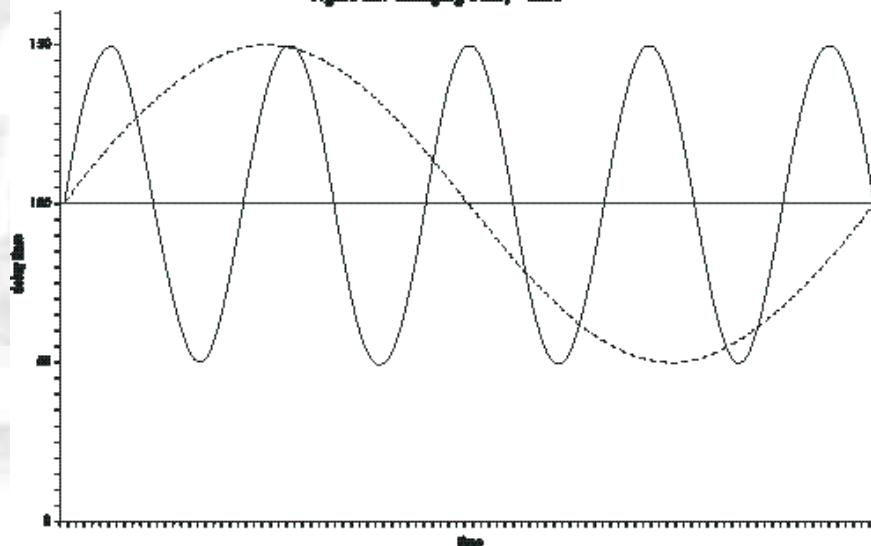
Sometimes you don't hold back: the entire mix gets flanged. Other times you might apply the effect to a single instrument, like the drum kit. You might flange just a single track. Or you might limit the effect to just one section of that track (e.g. only on the bridge). Flange to taste.

Pop music is full of examples of flanging. "Then She Appeared" from XTC's last effort as a band on the album *Nonesuch* offers a good case study of a gently sweeping flange. Each time the words "Then she appeared" occur, a bit of your traditional flange begins courtesy of a short vocal delay being slowly modulated.

In this example the flange comes and goes throughout the song, offering us a good chance to hear the vocals with and without the delay treatment. Feel free to take a more subtle approach, as on Michael Penn's "Cover Up" from the album *Resigned*. A wacky flange appears on the vocal for the single word 'guests' near the end of the second verse. That's it. No more flange on the vocal for the rest of the tune. It's just a pop mix detail to make the arrangement that much more interesting.

The flange effect actually softens the rather hard sounding, sibilant, and difficult to sing 'sts' at the end of the word 'guests.' And it makes me smile every time I hear it. The simple effect that comes from mixing in a short, modulated delay offers a broad range of audio effects. Flanging invites your creative exploration.

Figure 2b: Changing Delay - Rate



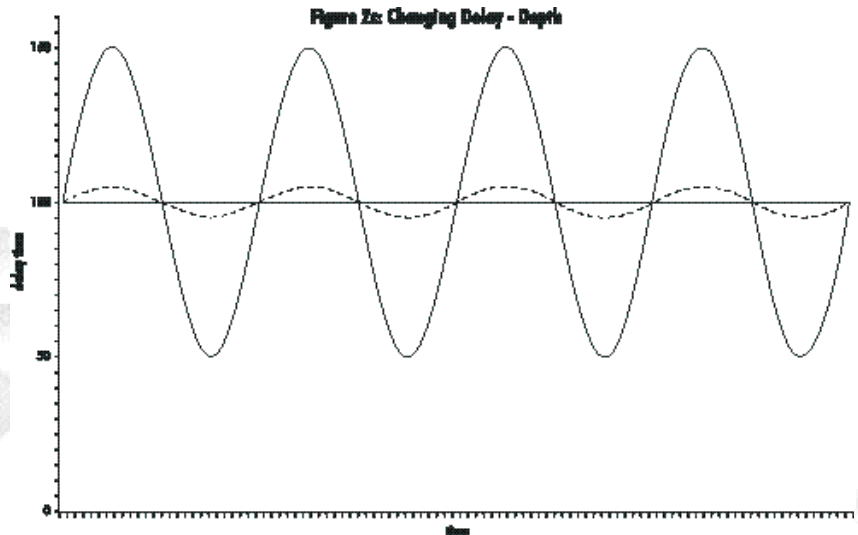
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Double

The first Nuts & Bolts of Delay column (July 2000) focused on long delays—those greater than about 50 milliseconds. We saw how long delays are used for a broad range of echo-based effects.

The result is neither an echo nor a flange. The delay is too short to be perceived as an echo. It happens too fast. But the delay is too long to lead to audible comb filtering.

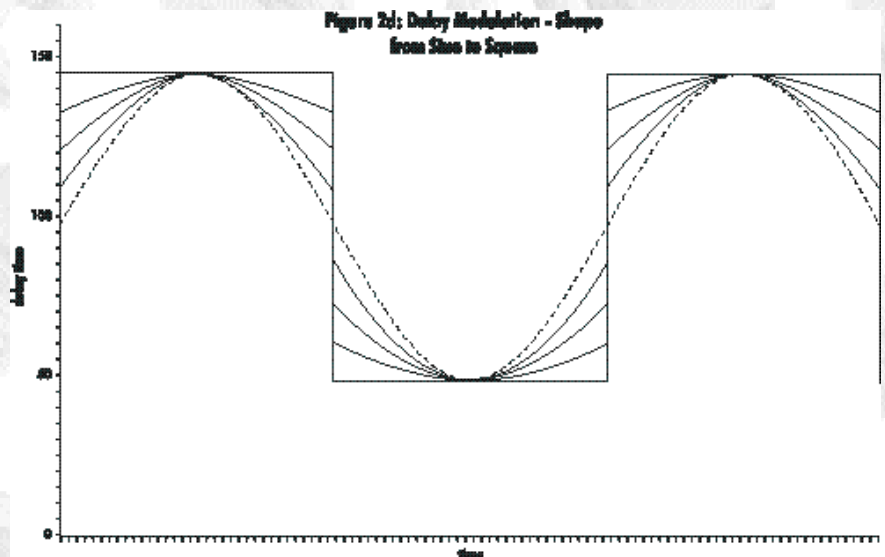
What do these medium delays do? Try a 30 millisecond delay on a vocal



Short delays of about 20 milliseconds or less create the radical comb filtered effect that, especially when modulated, we call flanging. What goes on in between 20 and 50 milliseconds? Naturally, the best way to answer that question is to listen to the effect of combining a signal with a medium delay somewhere between about 20 and 50 milliseconds.

track for a good clue. This kind of medium delay sounds a little bit like a double track—like two tracks of the same singer singing the same part.

It is a common multitrack production technique to have the singer double a track. You record a killer take, then have the singer record the part again on a separate track along with him or herself. The resulting sound is stronger and richer. It even shimmers a little.



If you are unfamiliar with the sound of doubled vocal tracks, a clean example can be found at the beginning of "You Never Give Me Your Money" on the Beatles' Abbey Road. Verse One begins with solo vocal. On the words "funny paper" the doubling begins. The vocal remains doubled for the next line and then the harmonies commence.

Speaking of harmonies, among other things Roy Thomas Baker is famous for taking doubling to the hilt. Check out the harmonies, doubled and tripled (probably much more), throughout The Cars' first album. For example, listen to the first harmonies on the first song "Good Times Roll," when they sing the hook "good times roll." It sounds deep and immense; the vocals take on a slick, hyped sound.

This layering of tracks borrows from the tradition of forming instrumental sections in orchestras and choirs. The value of having multiple instruments play the same musical part is indescribably magic. Adding more players doesn't just create more volume—the combined sound is rich and ethereal. It transports the listener.

A contemporary application of doubling can be found on Macy Gray's "I Try" from the album *On How Life Is*. Typically, double tracks support the vocal, adding their inexplicable extra bit of polish. They are generally mixed in a little lower in level than the lead vocal, reinforcing the principal track from the center or panned off to each side.

The Macy Gray tune turns this on its head. At the chorus, where you need a good strong vocal, the vocal track panned dead center does something quite brave: it all but disappears. The chorus is sung by double tracks panned hard left and right.

It's brilliantly done. Rather than supporting the vocal, they become the vocal. The chorus doesn't lose strength and the tune doesn't sag or lose energy one bit. The doubled tracks—panned hard but mixed aggressively forward—offer a contagious hook that invites the listeners to sing along.

Pop vocals—especially background vocals—are the instrument most often doubled, followed fairly closely by the rhythm electric guitar. The same part is recorded on two different tracks. On mixdown, they appear panned to opposite sides of the stereo field.

The two parts are nearly identical. Sometimes you switch to a different guitar, a different amp, a different microphone or slightly change the tone

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of the doubling track in some other way. Maybe the only difference between the tracks is the performance.

Even rock and roll guitar legends are human (mostly), leading to a pair of guitar tracks that vary slightly in timing. The 'chugga chugga' of the left guitar track is slightly early in one bar, slightly late in the next.

Through the interaction of the two guitar tracks, our ears seem to pick up on these subtle delay changes. At times the two tracks are so similar they fuse into one meta instrument. Then one track pulls ahead and we notice it. Then the other track pulls ahead in time and temporarily draws our attention.

Doubled guitars are part audio illusion, part audio roller coaster. They are an audio treat, plain and simple.

Layering and doubling tracks can be simulated through the use of a medium delay. If it isn't convenient, affordable, or physically possible to have the singer double the track, just run it through a medium delay. Modulate the delay so that the doubled track moves a little. This helps it sound more organic, not like a clone copy of the original track.

The result is the beginning of a slick, multitrack effect. Add a bit of regeneration (the lower control in Figure 1), and you'll create a few layers of the track underneath the primary one.

Some delay units have the ability to offer several delay times simultaneously (called a multitap delay). Dial in several slightly different delay times in the 20 to 50 millisecond area and you are synthesizing the richness of many layered vocals. Spread them out to different pan positions for a wide wall of vocal sound.

Fun stuff. Just make sure the sound is appropriate to the song. The solo folk singer doesn't usually benefit from this treatment. Neither does the jazz trumpet solo. But many pop tunes welcome this as a special effect on lead vocals, backing vocals, keys, strings, pads, bass, and so on.

Chorus

An alternative name for the doubling effect is chorus. The idea is that you could add this delay effect to a single vocal track to simulate

the sound of an entire choir—chorus—through the use of medium delays. Naturally, stacking up 40 medium delays of a single vocalist will not sound convincingly like a choir of 40 people. Think of it instead as a special electronic effect, not an acoustic simulation.

And it isn't just for vocals. John Scofield's trademark tone includes a strong dose of chorus (and distortion, and a sweet guitar, and brilliant playing, among other things). You'll often hear a bit of chorus on the electric bass. This medium delay concoction is a powerful tool in the creation of musical textures.

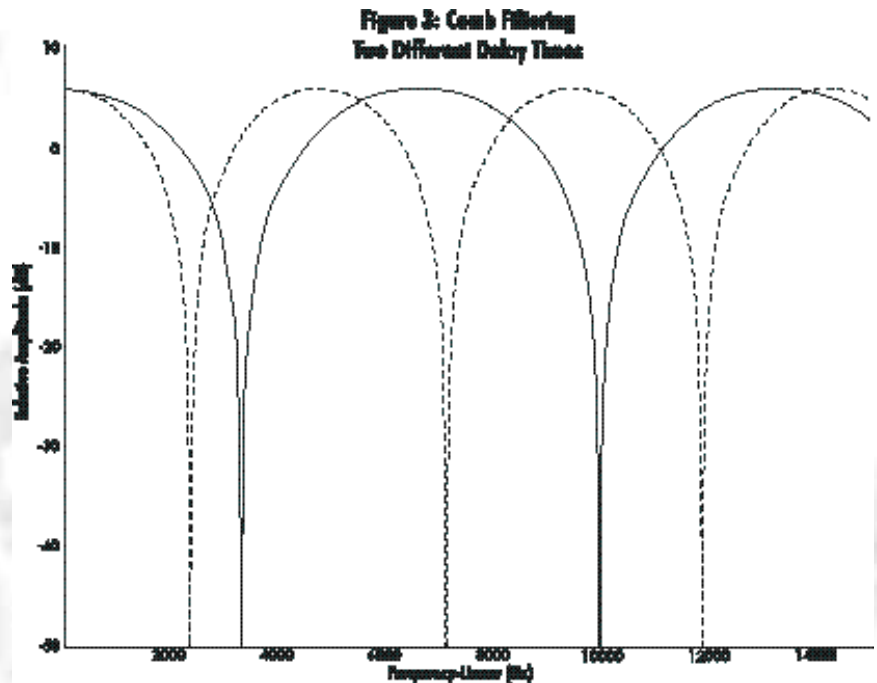
of the guitar are mixed together at similar volumes. You get a good taste of chorus. And you get great inspiration to do more with it.

A simple delay unit offers a broad range of audio opportunities, representing a nearly infinite number of patches. Short delays create that family of effects called flanging. Medium delays lead to doubling and chorusing.

We can take a quick tour of all of the above with a single album: *Kick* by INXS. To hear a terrific use of flange, listen to "Mediate." They really went for it. True doubling? Listen to "Sweat" and those hard panned questions, "How do you feel? What do you think? Whatcha gonna do?"

Finally, the same album gives us a classic application of chorus to an electric guitar. Check out the rhythm guitar in "New Sensation" and the steely cool tone the chorusing adds.

Of course, when the delay is long enough it separates from the original



To see how "out there" the effect can be made, spin *Throwing Copper* by Live and listen to the beginning of the tune "Lightning Crashes." I've no idea what kind of craziness is going on. The guitar sound includes short and medium delays, among the panning, distortion, and phase shifting effects going on. To my ear the delay is being modulated between a short flanging sort of sound (around 10 milliseconds) and up to a longer, chorus sort of delay time (around maybe 40 milliseconds).

Note especially the sound of the guitar in the second verse, when the effect and the relatively clean sound

signal and becomes its own perceptible event: an echo. Flange, chorus, and echo—three very different kinds of effects that come from a single kind of effects device: the delay.

In fact, there's more. This Nuts and Bolts series will soon discuss reverb and pitch shifting, two more classes of effects that, at their heart, are based on the delay.

Alex Case used to sing in a chorus. He hopes to one day sing in a flange.

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