NUTS and BOLTS

PART 8

EQUALIZATION, PART 2

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To EQ, or Not to EQ, That Is the Question

"I hear they used a Spasmatron 2000 equalizer on that kazoo track."

"No Waaaay."

"Yup, and that album went triple platinum."

"No Waaaay."

"And I saw on a web site that they raised it 4 dB in the lower highs."

"Wait a second. Get me a pencil...What was that killer EQ move again?"

Last month we discussed the operation and theory of eq. Now let's roll up our sleeves and look at the nuts and bolts of using it.

The technique

The number one approach to dialing in an eq setting is quite intuitive: boost, search, and then set the equalizer. Boost by a clearly audible amount, maybe 12 dB or more. Search by sweeping for the frequency select knob until you find the sound you are looking for. And finally set the eq to the desired sound—either cutting the frequency if you don't like it or finding just the right amount of boost (and bandwidth) if you do.

It's that simple. Over time, through experience and eartraining, you can skip the boost and search steps and instead reach immediately for the frequency range you wish to manipulate. But until then there's nothing wrong with this approach. And even the famous, expensive engineers resort to the boost, search and set approach on occasion.

So when do we boost, search, and set? What are we listening for? Why and when do we equalize? Eq is simple in concept but not necessarily in application.

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But before giving in to despair, realize that all engineers have a lot to learn about eq. Apprentices, hobbyists, veterans, and Grammy winners... all are still exploring the sonic variety and musical capability of equalization. Eq offers a huge range of possibilities and options. Critical listening skills are developed over a lifetime and require careful concentration, good equipment, and a good monitoring environment. No one learned the difference between 1 kHz and 1.2 kHz overnight.

Interfering with this challenging learning process is the temptation to imitate others or repeat equalization moves that worked for us on the last song.“Magic” settings that make every mix sound great simply don’t exist. If you got the chance to write down the equalizer settings used on, say, Jimi Hendrix’s guitar track on ‘The Wind Cries Mary,’ it might be tempting to apply it to some other guitar track, thinking that the equalizer goes a long way toward improving the tone.

Beware the urge to imitate others or repeat eq moves that worked on the last song...

But the fact is, the tone of Jimi’s guitar is a result of countless factors: the playing, the tuning, the type of strings, the kind of guitar, the amp, the amp settings, the placement of the amp within the room, the room, the microphones used, the microphone placement chosen, et cetera et cetera. The equalizer alone doesn’t create the tone. In fact, it plays a relatively minor role in the development of the tone in the scheme of things.

The way to get ahead of this infinitely variable, difficult to hear thing called eq is to develop a process that helps you strategize on when and how to equalize a sound. Armed with this organized approach, you can pursue a more complete understanding of eq.

The audio needs and desires that motivate an engineer to reach for some equalization fall into four categories: The Fix, The Feature, The Fit, and The Special Effect.

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The Fix

A big motivation for engaging an equalizer is to clean things up and get rid of problems that lie within specific frequency ranges. For example, outboard equalizers, consoles, microphone preamplifiers, and even microphones themselves often have low frequency roll-off filters. Why is this kind of eq on all these devices and what is it used for?

These devices remove low frequency energy less for creative "this'll sound awesome" reasons and more to fix the common problems of rumble, hum, buzz, pops, and excessive proximity effect.

In many recording situations, we find the microphone picks up a very low frequency (40 Hz and below) rumble. This low-end energy comes from such culprits as the building's temperature control system or the vibration of the traffic on nearby highways and train tracks (note to self: don't build studio next door to Amtrak and Interstate 10).

This is really low stuff that singers and most musical instruments are incapable of creating. Since very little music happens at such low frequencies, it is often appropriate to insert a highpass (i.e. low cut) filter that removes all the super low lows entirely.

That's rumble. A slightly different problem is hum. Hum is the interference from our power lines and power supplies that is based on 60 Hertz AC power (50 Hertz for many of our friends in other countries).

The alternating current in the power provided by the utility company often leaks into our audio through damaged,poorly designed, or failing power supplies. It can also be induced into our audio through proximity to electromagnetic radiation of other power lines, transformers, electric motors, light dimmers, and such.

As more harmonics appear—120 Hz, 180 Hz, and 240 Hz—the hum blossoms into a full-grown buzz. Buzz finds its way into almost every old guitar amp, helped out a fair amount by florescent lighting and single coil guitar pickups.

Again, a low pass filter helps. To remove hum, we need to roll-off at a frequency just above 60 Hertz or perhaps an octave above, 120 Hertz.

This is high enough in frequency that it can audibly affect the musical quality of the sound. Exercise care and listen carefully when filtering out hum. Many instruments (e.g. some vocals, most saxophones, a lot of percussion, to name a few) aren't changed much sonically by such a filter. But low frequency-based instruments (e.g. kick drum, bass guitar) aren't gonna tolerate this kind of equalization.

Fortunately, the hum might be less noticeable on these instruments anyway as their music can mask a low level hum. Buzz is more challenging. The additional harmonics of buzz make removing it only more musically destructive. Drive carefully.

Other low frequency problems fixed by a highpass filter are the woofer-straining pops of a breath of air hitting the mic whenever the singer hits a "P" or a "B" in a word. Or if you are working outside (doing live sound or collecting natural sounds in the field), you've no doubt discovered that any breeze across the mic leads to low-end garbage. If you can't keep the wind off the microphone, then filter the low frequencies out.

When the instrument you are recording is very close to a directional microphone, proximity effect appears. Sometimes this bassy effect that increases with proximity to a directional mic is good. Radio DJs love it—makes them sound larger than life. Sometimes proximity effect is bad. Poorly miked acoustic guitars have a pulsing low frequency sound that masks the rest of the tone of the instrument with each strum of the guitar. Roll off the low end to lose it.

Equalizers are employed to fix other sounds. Ever had a snare with an annoying ring? Find the frequency range (boost, search....) most responsible for the ring and try attenuating it at a narrow bandwidth. Often, turning down that ring reveals an exciting snare sound underneath.

Ever track a singer with a cold? It's difficult to get a great sounding performance out of a congested crooner, but such a problem might be fixable. Find the dominant muddying frequency (probably somewhere between 200 and 500 Hertz) and cut it a bit. Compensate with some helpful midrange boost and you might find a vocal sound that you and the singer didn't think was there.

Ever track a guitar with old strings? Dull and lifeless. This is unlikely to be fixable (because eq can't generate missing frequencies), but don't rule it out until you've tried a bit of a boost somewhere up between 6 kHz and 12 kHz.

Sometimes a gorgeous spectral element of a sound is hidden by another, much less appealing frequency component. A good example of this can be found in drums.

Does it never sound right when you go searching for the right frequency to boost for that punchy big budget drum sound? The low frequency stuff that makes a drum sound punchy often lives just a few Hertz lower than some rather muddy junk. And boosting the lows invariably boosts some of the mud.

Search at narrow bandwidth instead for the ugliest, muddiest component of the drum sound (between about 180 and maybe 400 Hertz) and cut it. As you cut this problematic frequency, listen to the low end. Often this approach reveals plenty of low end punchiness that just wasn't audible before the well-placed cut was applied.

Want a richer tone to the voice? Manipulate the vowel range. Having trouble understanding the words? Manipulate the consonant range. Watch out for overly sizzling "S" sounds, but don't be afraid to emphasize some of the human expressiveness of the singer taking a big breath right before a screaming chorus.

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The Feature

A natural application of equalization is to enhance a particular part of a sound, to bring out components of the sound you like. Here are a few ideas and starting points.

The voice:It might be fair to think of voice as sustained vowels and transient consonants. The vowels happen at lower mid frequencies (200 to 1000 Hz) and the consonants happen at the upper mids (2 kHz on up).

The snare:It's a burst of noise. This one is tough to eq, as it reacts to almost any spectral change. One approach is to divide the sound into two parts. One is the low frequency energy coming from the drum itself. Second is the mid-to-high frequency energy up to 10 kHz and beyond due to the rattling snares underneath. Narrow the possibilities; look for power in the drum-based lows, and exciting raucous emotion in the noisy snares.

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The kick drum: Like the snare, consider reducing this instrument to two components. There is the click of the beater hitting the drum followed by the low frequency pulse of the ringing drum. The attack lives up in the 3 kHz range and beyond. The tone is down around 50 Hertz and below. These are two good targets for tailoring a kick sound.

The acoustic guitar: Try separating it into its musical tone and its mechanical sounds. Listen carefully to the tone as you seek frequencies to highlight. Frustratingly, this covers quite a range from lows (100 Hertz) to highs (10 kHz).

In parallel, consider the guitar's more peculiar noises that may need emphasis or suppression: finger squeaks, fret buzz, pick noise, and the percussive sound of the box of the instrument itself, which resonates with every aggressive strum. Look for these frequency landmarks in every acoustic guitar you record and mix. Eq is a powerful way to gain control of the various elements of this challenging instrument.

For the instruments you play and often record, you owe it to yourself to spend some time examining their sounds with an equalizer. Look for defining characteristics of the instrument and their frequency range. Also look for the less desirable noises some instruments make and file those away on a 'watch-out' list.

These mental summaries of the spectral qualities of some key instruments will save you time in the heat of a session when you want more punch in the snare (aim low) and more breathiness in the vocal (aim high).

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The Fit

A key reason to equalize tracks in multitrack production is to help us fit all these different tracks together. One of the simplest ways to bring clarity to a component of a crowded mix is to get everything else out of the way—spectrally.

That is, if you want to hear the acoustic guitar while the string pad is sustaining, find a satisfyingly present midrange boost for the guitar and perform a complementary cut in the mids of the pad. This eq cut on the string pad keeps the sound from competing with or drowning out the acoustic guitar.

The trick is to find a spectral range that highlights the good qualities of the guitar without doing significant damage to the tone of the synth patch. It'll take some trial and error to get it just right, but you'll find this approach allows you to layer in several details into a mix.

Expect to apply this thinking in a few critical areas of the mix. Around the bass guitar, we encounter low frequency competition that needs addressing. If you play guitar or piano and do solo gigs as well as band sessions, you've perhaps discovered this already.

Solo, you've got low frequency responsibilities as you cover the bass line and pin down the harmony. In the band setting, on the other hand, you are free to pursue other chord voicings. You don't want to compete with the bass player musically, and the same is true spectrally.

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As an engineer, this means that you might be able to pull out a fair amount of low end from an acoustic guitar sound. Alone, it might sound too thin, but with the bass guitar playing all is well. There is spectral room for the low frequencies of the bass because the acoustic guitar no longer competes here. But the acoustic guitar still has the illusion of being a full and rich sound because the bass guitar is playing along, providing uncluttered, full bass for the song—and for the mix.

In the highs, competition appears among the obvious high frequency culprits like the cymbals and hand percussion as well as the not-so-obvious: distorted sounds. It is always tempting in rock music to add distortion to guitars, vocals, and anything that moves.

Spectrally speaking, this kind of distortion occurs through the addition of some upper harmonic energy. And this distortion will overlap with the cymbals and any other distorted tracks. Make them fit with the same complementary eq moves. Maybe the cymbals get the highs above 10 kHz, the lead guitar has emphasized distortion around 8 kHz, and the rhythm guitar hangs out at 6 kHz. Mirror image cuts on the other tracks will help ensure all these high frequency instruments are clearly audible in the mix.

The mid frequencies are definitely the most difficult region to equalize. It is very competitive space spectrally, as almost all instruments have something to say in the mids. And it is the most difficult place to hear accurately. We tend to gravitate toward the more obvious low and high frequencies areas when we reach for the equalizer.

On the road to earning golden ears, plan to focus on the middle frequencies as a key challenge and learn to hear the subtle differences that live between 500 and 6,000 Hz.

The Special Effect

If you have the sense from the discussion above that there are technical considerations behind equalization decisions, that's true. But music wouldn't be music if we didn't selectively abandon those approaches. A final reason to eq is to create special effects. This is where we are least analytical and most creative. Your imagination is the limit, but here are some starting points.

"Wah-wah" is nothing more than variable eq. If you've a parametric equalizer handy, patch it in to a guitar track already recorded. Dial in a pretty sharp midrange boost (high-Q, 1 kHz, +12 dB). As the track plays, sweep the frequency knob for fun and profit.

On automated equalizers you can program this sort of eq craziness. Without automation, you just print the wah-wah version to a spare track. Your creative challenge: explore not just middle frequencies, but low and high frequency versions; try cuts as well as boosts; and apply it to any track (acoustic guitar, piano, tambourine, anything).

Another special effect is actually used to improve realism. As sound waves travel through space, the first thing to go are the high frequencies. The farther a sound has traveled, the less high frequency content it has.

Consider the addition of a repeating echo on a vocal line. For example, the lead singer sings, "My baby's gonna get some Gouda Cheese." And the background singers sing, "Gouda!" Naturally the mix engineer feeds the background line into a digital delay that repeats at the rate of a quarter note triplet: "Gouda... Gouda... Gouda."

For maximum effect, it is traditional to equalize the signal as it is fed back to the delay for each repetition. The first "GOUDA!" is simply a delay. It then goes through a lowpass filter for some removal of high frequency energy and is fed back through the delay.

It is delayed again: "Gouda!" Once more through the same lowpass filter for still more high frequency attenuation and back through the same delay: "gouda." The result is (with a triplet feel): "GOUDA!...Gouda! ...gouda." The echoes seem to grow more distant, creating a more engaging effect.

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Obviously, this eq approach applies to signals other than echoes, and it even works on non-dairy products. In composing the stereo or surround image of your mix, you not only pan things into their horizontal position, but you push them back, away from the listener by adding a touch more reverb (obvious) and removing a bit of high end (not so obvious). This eq move is the sort of subtle detail that helps make the stereo/surround image that much more compelling.

Speaking of stereo, a boring old monophonic track can be made more interesting and more stereo-like through the use of equalization. What is a stereo signal after all? It is difficult to answer such an interesting question without writing a book, or least an entire article dedicated to the topic. But the one sentence answer is: a stereo sound is the result of sending different but related signals to each loudspeaker.

Placing two microphones on a piano and sending one mic left and the other right is a clear example of stereo. The sounds coming out of the loudspeakers are similar in that they are each recordings of the same performance on the same piano happening at the same time.

But there are subtle (and sometimes radical) differences between the sounds at each mic due to their particular location, orientation, and type of microphone. The result is an audio image of a piano that is more interesting, and hopefully more musical,than the monophonic single microphone approach would have been.

If you begin with a single mic recording of a piano and wish to create a wider, more realistic, or just plain weird piano sound in you mix, one tool at you disposal is equalization. Send the single track to two different channels on your mixer and eq them differently. If the signal on the left is made brighter than the same signal sent right, then the image will seem to come from the left, brighter side (remember distance removes high frequencies).

Consider eq differences between left and right that are more elaborate and involve several different sets of cuts and boosts so that neither side is exactly brighter than the other, just different. Then the image will widen without shifting one way or the other. The piano becomes more unusual (remember, this section of the article is called Special Effects, so anything goes....); its image is more liquid, less precise.

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Add some delays, reverbs, and other processing (topics of future Nuts & Bolts pieces) and a one-mic monophonic image takes on a rich, stereophonic life.

The End

The challenging and subtle art of equalization needn't be surrounded in mystery. Whenever you have a track with a problem to be removed or a feature to be emphasized, try to grab it with eq. If a mix is getting crowded with too many instruments fighting for too little space, carve out different spectral regions for the competing instruments using eq.

And sometimes we just want to take a sound out and make it more interesting. Again, just boost, search, and set the equalizer so that you like what you hear.

Alex Case has cornered the market on murky, dull sounding mixes. What's your eq specialty gonna be? Suggest Nuts & Bolts topics via case@recordingmag.com.