



Field Test: CEDAR Audio Cambridge Restoration System

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EQUALLY AT HOME IN FORENSIC, MASTERING AND POST PROJECTS

My first introduction to the miracles wrought by CEDAR equipment happened more than a decade ago at a Nashville AES meeting. It was the golden age of Masterfonics, and mastering engineer Glenn Meadows had brought his PC-driven “CEDAR for DOS with SADiE cards” to the meeting. Jaws dropped when he played the “before” and “after” of Patsy Cline's “Walkin' After Midnight” from a transcription disc of the Arthur Godfrey show. Gone were many of the gritty artifacts we had long associated with needle-scraping vinyl or lacquer, and in its place was the stunning power of Cline's voice. We realized that we were hearing something that only had been heard by the control room engineers long ago.

THE BASICS

CEDAR's new turnkey system offers 8-channel processing and arrives in a 4U rackmount chassis containing the dual-processor “host” running Windows XP Pro and I/O cards with another 1U rackmount “Timecode Automation Controller,” which also serves as a hardware key for the system. The system is a tour-de-force, fully automated, scalable noise-reduction toolbox. The simplest version comes with 64-bit floating-point processing, 24-bit/96k digital I/O, 2-channel tools including M/S encode/decode, dither and noise shaping, gain module, metering module and the excellent Spectrum Analyzer, with its resolution of 0.02 Hz (totaling about \$15,000).

The full-blown system adds DNS, a dynamic noise suppressor; Dehiss-3, a

hiss removal module; NR-4, advanced noise-reduction module; EQ-L, linear phase equalization module; EQ-P, precision equalization module; Declickle, impulsive noise-removal module; Debuzz, buzz and hum removal module; Declip, de-clipping module; phase corrector; adaptive filter package; dynamics processor; limiter; and internal sample rate selector (more than \$60,000).

It's difficult to compare the Cambridge to other noise-removal and equalization systems because there is nothing else in its class with regard to the range of processes or the excellent final result. The system is equally at home in post, broadcast and forensic facilities. Latencies vary with the number of processes launched, their order, the I/O card used and the ASIO buffer size, but the precise number is always available by the Cambridge system in use. Although the original Cambridge system was real time — only, Version 2 adds “disk-to-disk” and “disk-to-world” file-processing capabilities. Complex event and scene-based processing of .WAV and .AIFF files, with morphing, are available via automation.

SYSTEM MANAGEMENT

The core of CEDAR Cambridge is the Process Manager. It calls up tools, setup pages and processing modules. Engaged modules or processes are bright turquoise when enabled, and you can drag and drop them for positioning. Equally important are the text windows at the bottom of the Process Manager's screen that report channel I/O, incoming sample rate, bit depth and latency.

The Spectrum Analyzer is not your mom's pokey old FFT with frequency bins of equal width (and poor resolution for bass frequencies). CEDAR's analyzer is about 5,000 times more accurate and, among other things, allows you to display the average amplitude at each frequency, the peak value at each frequency or the minimum value at each frequency, each calculated from the moment you select the mode until it is cancelled.

Dither offers five bit depths (off, 16, 18, 20 and 24), four dither sources (off, tpdf, gpdf and htpdf) and five noise-shaping curves (off, first order, curve A, curve B1 and curve B2).

Two-channel tools allow you to apply the meters and tools to any two

channels from the system's eight. There's a Lissajous figure with a balance meter that has a range of 30 dB in either direction. You can specify the gain differential between the two selected channels with the balance control and auto-balance automatically centers the output signal. Output modes include normal, mono sum and mono difference. You can invoke two instances of M/S encode and decode and place processing modules between them for a wide range of effects.

The Metering module is an 8-channel meter that provides simultaneous amplitude metering of all channels selected in the channel selector. Information for each channel includes RMS metering, peak metering, peak hold with a hold time of one second and peak hold from the most recent reset.

The Dedicated Gain module works as an input gain control, output “makeup” gain or a gain boost anywhere in the processing chain.

RESTORATION MODULES

When you need “quick-and-clean” noise reduction for hiss and simple broadband noise, Dehiss-3 — with threshold, attenuation and brightness controls — allows you to dial in noise suppression with a minimum of fuss (and skill). Although operating Dehiss-3 is straightforward (you “locate” the noise level with the threshold control and then “remove” it with attenuation), it's important to note that brightness is not a tone control but a “noise character” control used to compromise between various side effects.

The more complex NR-4 allows more attention to detail and provides a sophisticated set of parameters for the delicate tweezing necessary in CD remastering, soundtrack restoration, post and audio analysis. I used NR-4 on a surround solo cello recording that suffered from a large, low HVAC rumble and poorly placed air returns. The results were simply stunning. The four separate NR-4 areas (noise fingerprint, noise reduction, noise-free/wanted signal EQ and modeling/brightness) allow you to make an intelligent compromise between reducing noise to an acceptable level while leaving the program material as pristine as possible.

Those familiar with single-ended noise-reduction schemes will recognize the noise fingerprint as the sample-capture routine that makes a mathematical

model of the noise to be removed. Unlike simpler systems, NR-4 allows you to edit the fingerprint manually or create one with drawing tools. For those of us who receive material to master where the mix engineer has decided to do tight head and tail edits, this control can mean the difference between success or failure on a troublesome track.

NR-4's modeling/brightness control resembles the brightness control for Dehiss-3, but offers three models to choose from for balancing artifacts against noise reduction. Noise reduction determines how much attenuation to apply to the signal's noise content, while noise-free EQ is an 8-band parametric EQ, plus two high and two low shelves that allow you to EQ the signal without EQ'ing noise.

The Declickle module is the logical combination of De-Click and De-Crackle that have long been CEDAR's flagship and industry standard against which other systems are usually compared. The combined algorithm offers better detection and interpolation than the earlier separate processes. I found an old, abused album in my collection, *Sharkey's Southern Comfort*, which apparently had been used as the coaster for a large potted plant in someone's college dormitory room before being returned to its shabby, tattered cardboard jacket. Declickle brought the material back from the dead so that I could once again hear Sharkey Bonano and his Sharks of Rhythm play non-gritty Dixieland.

Debuzz greatly benefits from previewing the problem material in the aforementioned spectrum analyzer. As buzz often involves low fundamental frequencies with ancillary harmonics, the spectrum analyzer, with its 0.02Hz resolution, is just the ticket for targeting problem areas. Controls include Detection Channels (you can select which channel or group of channels to use to track the dominant frequency nearest the fundamental frequency), Buzz Bandwidth, Fundamental Frequency (with associated markers), Tracking (follows jittery fundamentals within a two-percent range), Confidence Meter, Threshold and Reduction.

Declip is a graphically oriented module that provides essential rescue for signals that have punched through the digital ceiling and left a hideous plateau of full-scale samples. Engineers who record live performances know that no matter how judicious the soundcheck and no matter how vast the headroom left on the digital recording medium, there is usually one point in

which the performer overshoots the expected volume shortly before the engineer dives for the volume control. It's especially disconcerting to hear clipped material in the context of an otherwise well-recorded acoustic program, and Declip is a welcome solution to an often vexing problem. Here, again, the help manual provides excellent advice.

The Phase Correction module revs up an old standby, taking it from the mundane use for azimuth correction tweaking and Sony PCM-F1 half-sample delay problem repair to a full-blown surround image tweezer and sound design kit. It will correct timing errors to within 0.2 samples on-the-fly; in Manual mode, it can shift a signal by 0.01 samples (1 microsecond at 96k). Master Channel selects the reference channel against which timing errors of all other channels are compared. With Phase Invert, you can flip any channel or group of channels 180 degrees. There's an eye-catching timing error display and you can select any channel or group of channels to be corrected with the Auto-Mode selectors, as well as manually shift the remaining channels that *were not selected* by using Applied Shift. Detected Error shows the applied time shift for channels in Auto mode.

NOISE SUPPRESSION AND EQ

Dialog Noise Suppression splits the audio spectrum into several bands, analyzes each band with a digital filter and then suppresses the noise in each band. It's a simple tool to use, with astounding results for (especially mono) dialog.

Linear Phase EQ has eight parametric filters, two high-shelving filters and two low-shelving filters. It offers linear and logarithmic displays and markers that let you transfer frequency information among CEDAR processes. Precision EQ offers the same parametric control with total automation but is more suited to brickwall filtering and tweezing constant tones.

FORENSIC SYSTEMS

The Forensic Systems include single-channel and cross-channel filters and a time-align module for fixing the azimuth problems often found in recordings of this type. Single-channel filters identify the rate of change of components within the overall signal to separate speech from background noise. Cross-channel filters compare the signal of a reference track to the target (noisy

track). They attempt to determine the elements of the reference content so that the elements that do not match the reference in the target track may be discarded. This gobbles up a lot of processing power and is best to limit the internal sample rate to 8 kHz. Here, again, the time-align module comes into play because the reference signal and the target signal must be time-aligned for optimum performance.

The single-channel lattice filter is similar in operation to the single-channel filter, but its powerful algorithm is capable of extracting more fricatives and consonants buried in broadband noise and adapts more quickly to new tones invading and disappearing from the signal. There are two outputs — the predicted signal and the filtered signal — that can be mixed with the original audio for the final result. There's also a cross-channel lattice filter. Once you have set up reference and parameters, you can process eight tracks at once. This is a great way to work on long-going investigations with large volumes of content.

KUDOS AND A FEW SUGGESTIONS

While I hesitate to propose any additions to an already overwhelmingly complete and excellent set of tools, I would like to be able to label meters. I'd also like to have a manual de-click and I wish Retouch were available for Cambridge. CEDAR has already implemented my most fervent request: disk-to-disk processing (and the file processor is a free upgrade!). With V. 2, the company has also added a limiter, a compressor, and an upward and downward expander.

My only other wish is that I had the entire system back at my studio, JamSync. It's money well-spent for a system that offers the best quality in a set of tools used daily by pro audio engineers. Yes, it's a bit on the expensive side, with prices starting at \$15,000, but it's worth it.

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