Azimuth correction – as easy as *AZ-1*

Developing further units from their powerful computer-based system, CEDAR Audio have released a stand-alone azimuth corrector. Dave Foister gets things straight

It is a sobering thought that, in these digital days, there must be many perfectly competent audio people who do not know what azimuth is, never mind what sort of problems can be caused by its misalignment. The effects of incorrect azimuth—the angle between the vertical line of the gap in the head of an analogue tape machine and the direction of tape travel (which must be exactly 90° for proper operation) are nowadays almost exclusively the domain of the mastering or remastering specialist; they need only enter the consciousness of the rest of the industry where the lowly cassette is involved, and even then most prefer to throw up their hands and blame the medium rather than do anything about it.

The fact remains, however, that analogue tape is still in regular use, and that correct azimuth alignment is vital for it to perform properly. The effects of its being misaligned are readily identifiable—a poorly-defined stereo soundstage, lack of presence of central images (bad news for vocalists), loss of HF (particularly in mono) and a general phasy, shifting muddiness. Since these phenomena are due to a more or less constant time offset between the two channels caused by the head, they are, perhaps, ideal fodder for correction using digital signal processing. Given this premise, it comes as no surprise that the first people to come up with a stand-alone unit for correcting azimuth errors are CEDAR Audio.

If one has access to the original master tape, of course, azimuth misadjustment is not a problem. Any suitable replay machine can have its repro head azimuth aligned to that of the originating record head using the original calibration tones; even if these are missing, a

close approximation can be achieved by ear, particularly by monitoring in mono, and the assistance of a phase meter or a vectorscope can make it simpler still.

The difficulties arise when an analogue original has been transcribed to another medium using misaligned equipment. Once a tape has been copied with incorrect azimuth (azimuth not matching that of the originating record head, whether 'correct' or not) then the problems become embedded in the new medium—be it another analogue tape, vinyl, or a digital format. Bring on the CEDAR *AZ-1*.

The *AZ-1* joins the existing family of stand-alone CEDAR processors, the *DC-1 DeClicker* and *CR-1 DeCrackler*, which it resembles almost identically. The few visible differences arise because CEDAR have taken the opportunity of the new model to rethink some of the basics, notably the front panel construction, which now does a better job of keeping the DSP RF nasties inside the box, and the PCBs, which are now designed and sourced by new sub-contractors to meet CEDAR's ever more stringent demands.

The overall package remains very similar, with a full complement of analogue and digital I-Os and 40-bit internal architecture, with the familiar panel and set of in-out level controls and meters, four dedicated push-button switches, and the large central display with five soft keys underneath and continuous rotary encoder-data wheel.

These CEDAR boxes have also been notable for being extremely easy to operate, and this tradition too has been upheld in the *AZ-1*. There are only four pages on the display screen, two of which handle I-O configurations and MIDI control, so setting the unit up and making it do its job could hardly be simpler. In fact, having selected the required input format, the whole operation is controlled and monitored from one main screen.

Input options cover the usual selection of analogue (with choice of 44.1kHz or 48kHz sampling rates), SPDIF and AES-EBU, with the added refinement of using the analogue inputs with the digital output synchronised to an external SPDIF source. The analogue inputs are internally jumper-selectable as either fixed gain at nominal line level (giving a claimed range of 103dB) or variable via the front-panel control, while output level is handled by a digital output attenuator.

When the digital input is in use, the associated LED can be set to indicate one of four levels of error in the input data, ranging from a complete loss of usable signal to the slightest deviation from the relevant specification. This in itself is a useful diagnostic tool rarely found elsewhere—however professional the kit claims to be.

Operation

The main operation screen provides control and display of five central functions—accessed via the five soft keys and the main control wheel—and a sophisticated central display showing the end result in a particularly useful form. Two of the control functions are for basic setting up and checking of the unit's effects; one is a phase reverse of either or both of the channels, while the other gives an output signal which is normal stereo, summed mono (which can show in a more exaggerated way the problems present in the original signal and provide a clear indication of the efficacy of the process) or a mono difference signal which can further point up subtle problems and make their solutions significantly easier to find.

There are then two main parameters for adjustment. One is the inter-channel balance in terms of straightforward amplitude; CEDAR have identified problems which can be caused by factors other than tape heads (errant RC networks in particular) which can include level imbalances as well as the time differences typical of out-of-whack azimuth. The other is the crucial function of correcting inter-channel time differences—to a resolution of 1/20 of a sample—which can be carried out manually but will generally be done automatically, hence the fifth soft key to switch between Manual and Auto.

In Auto mode the time compensation is glitchlessly adjusted 44 times per second in order to re-align the dominant common signals present on the two channels, within limits which are carefully defined to cover the range of errors likely to be caused by misaligned heads. Continuous monitoring and re-correction is necessary because even a correctly-aligned transport has difficulty maintaining constant perfect azimuth—try recording a stereo signal across tracks 1 and 24 of even the best analogue multitrack.

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This combination of finding the best fit of the common signals and limiting the correction range should avoid the danger of the system misinterpreting deliberate timing differences, such as those produced by a spaced pair of omnis or a dummy head. CEDAR acknowledge the possibility of certain conditions fooling the software—a particular trial track had such a tight stereo ADT that the system thought it was an error, hence the manual over-ride.

The display screen carries bar-graph displays and numeric readouts for the current level and time offsets, but is dominated in the middle by a real-time graphic display of the stereo soundstage. This produces something akin to the kind of Lissajous figures familiar from vectorscopes and oscilloscopes configured in X-Y mode, but the result is rendered far more meaningful by having a logarithmic amplitude response, giving a more consistent, legible pattern. Obviously a centre mono signal gives a vertical straight line, left mono points North-West and right North-East, while out-of-phase mono gives a side-to-side straight line. Healthy normal stereo gives something between a circle and a vertically-elongated ellipse, usually with noticeable bunching of the signal, shown by a more dense pattern, at the top and bottom. An ellipse which is wider than it is tall suggests the existence of a problem since it means the side, or difference, signal is greater than the central sum signal, and this is commonly the display produced by the phase errors inherent in faulty azimuth. Switching the unit into operation shows an immediate modification of the display's shape to the ideal, and this is reflected in the audible result.

This result can be quite remarkable. As already mentioned, and as old analogue hands will be only too aware, misaligned azimuth can produce an unpleasantly indistinct stereo image, with individual sources hard to localise and a general lack of clarity and focus, and these effects are made even worse by the all-too-common fluctuations in the inter-channel relationships as the tape weaves its erratic way across its misaligned path. The *AZ-1* can immediately lock everything into place, providing a stable image, restoring the presence and perspective of the component sounds and keeping everything steady even when the extent of the underlying problem is continually varying. It even restores mono compatibility, which is always the first casualty of even the smallest azimuth error.

My own worst azimuth horror story involved a track I contributed to an album, the majority of which was recorded elsewhere. I still believe mine was recorded with a correct machine line-up, but when the record was cut the replay machine was lined up to the tones attached to the other tracks; these were sufficiently different from mine to leave my contribution sounding muffled and indistinct. It would have been unreasonable to expect the cutting engineer to have corrected this on the fly with nothing more than the big knurled knob on his repro head azimuth screw to help him, but the *AZ-1* would have sorted it out on the spot, as I proved to myself by playing a dub of the finished album track—off vinyl—through it.

What it won't do is correct the problems created within each of the stereo tracks by a head with incorrect azimuth. Each track will suffer a degree of comb filtering and consequent HF loss caused by the angle of the head gap across the recorded flux patterns, and while this may be theoretically correctable it would require a knowledge or a calculation of the width of the track, the amount of azimuth error, the spacing between tracks and similar factors. What I heard, however, was enough to convince me that these problems are secondary to the time offsets the system does address, and that at least the comb filter effects generated across the two tracks were improved by the process, resulting in a real increase in HF information.

There will, I imagine, be plenty of people who find it hard to appreciate the problems the *AZ-1* sets out to solve, still less why anyone would want to spend the *AZ-1*'s asking price (which, once again, puts it squarely in the specialist bracket) to solve them. I am equally sure that there are a significant number of potential users who have fallen over these problems only too often, and who will see the *AZ-1* as a magic wand they might once have thought impossible.■

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