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TV TechCheck



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A New Technique for Audio Restoration

One part of the broadcast industry that always presents particular challenges is archival restoration. Many broadcasters will, on occasion, need to dip into the vaults for some old material – and some may have to do it rather frequently. Putting this material on the air, especially when directly juxtaposed against contemporary content, often calls attention to the reduced quality of the archival elements.

Over the years, numerous audio processing tools have been developed to address the problems of legacy audio recording. Most of these processors attempt to mask common artifacts like tape hiss and the pops and clicks of analog disc recording. Often, however, these cures are worse than the disease, causing artifacts of their own such as gating or variable high- or low-frequency rolloffs, which can substantially alter the natural sound of the original recordings.

So it comes as some surprise when such a process is generally hailed as fixing a common problem of archival recordings without introducing any downside. Such seems to be the case with a new solution that virtually eliminates wow-and-flutter (and other time-related artifacts) in archival audio tape recordings. To date, the technique is only known by the company that developed it, called *Plangent Processes*, an audio and soundtrack restoration firm owned by Jamie Howarth, an Emmy- and Grammy-winning television and film composer and musical director, who has worked in the recording studio and broadcast industries since the 1980s.

The Plangent solution is based on a deceptively simple concept, but its execution requires precision in both its hardware and software components. First, specialized head stacks and amplifiers are required to playback analog audio tapes. The heads and signal path are designed to provide extremely wide-range frequency in playback (flat to 1 MHz), such that the audio output signal will include the bias signal found on the tape. The system also includes DSP control for fine tuning of playback equalization curves, to compensate for recording equalization at the various standards used in various regions and periods (NAB, IEC or other), and which may or may not have been correctly aligned to the standard on the recorder.

Note that the typical analog audio recorder's bias frequency is at least 5 to 10x higher than the highest audio frequency, so most bias signals found on recordings are at 100 kHz or higher. While it is often assumed that bias signals are not retained by the recording tape, this is only because typical *playback* heads cannot resolve such high frequencies. In fact, the signal is indeed recorded and retained on most recordings, and this can be verified by playing back any such recording at very low speed (wherein the bias signal can be heard as an audible tone). To recover the original bias signal at regular playback speed, however (as the Plangent technique requires), specialized playback heads with the ability to resolve such high frequencies are needed. The bias signal is also applied to the tape at 5 to 10x the *level* of the audio signal, so if the playback head has adequately wide frequency response, resolving the bias signal is typically not a problem, since its signal-to-noise ratio is typically high.

Because the original bias signal applied to the tape was a continuous sine-wave oscillation, any deviation from the stable frequency that is recovered by Plangent's wide-band playback will be an excellent representation of the time-domain errors introduced during the original recording by the tape transport. The entire wide-band audio signal from the tape is then converted to the digital domain, and the recovered bias waveform is used as a time base for a servo that drives a digital pitch-shifting process intended to stabilize the bias frequency, restoring to its original constant waveform. (Think of it like "Autotune for bias.") Of course, doing this also removes the wow and flutter from the audio signal on the recording. The processed audio is then stored to a new digital audio file in the preferred archival format.

The removal of time-domain artifacts in analog tape recordings produces some unexpectedly beneficial results. Not only is the typical wow and flutter removed – which is evidenced respectively as slow and fast modulation of pitch in the original sound (i.e., “vibrato” or “beating” in musical terms) – but the effects of *scrape flutter* are also reduced or removed. Scrape flutter is a less obvious artifact that results from the resonances that build up in unsupported sections of the tape as it passes with some degree of friction through the transport during recording and playback. These generally high-frequency components cause a type of FM intermodulation distortion to be added to the recording, meaning that undesirable (and non-musically related) sum and difference products are added to the original audio signal’s spectrum. Subjectively, the removal of scrape flutter effects via the temporal correction of the Plangent Process often adds general clarity to the recordings, described by some as “lifting a veil from the sound.”

Interestingly, the latter process may also improve some early digital recordings in which the ringing of poorly designed anti-aliasing filters and other conversion artifacts also added FM intermodulation products to the recordings. As a result, new digital playback systems with high temporal resolution correct for such time-domain variations in early digital recordings, and often remove some of the characteristic harshness found in them.

The greatest benefit from the Plangent Processes’ system would seem to accrue to current and future digital re-masters of analog music recordings. In fact, a recently released 73-disc box set of the Grateful Dead’s complete “Europe 72” recordings were run through the Plangent Process, as were a number of other re-masters and reissues of catalog recordings. As this technology proliferates, it may find its way into broadcast archive restorations, which, like any such collections, are subject to periodic re-recording and migration to new storage formats. During such transitions, application of the Plangent Process could audibly improve the quality of many analog audio recordings found in these archives. For those involved in broadcast archival work, this development has been seen as a welcome addition to the ever-growing arsenal of artifact-mitigation tools. For further information about this technology, go to <http://www.plangentprocesses.com/>.

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