

solid state

Three Software Editing Programs

By Gary Galo,
Regular Contributor

Sound Forge Audio Studio V. 7.0b. Sony Media Software, 1617 Sherman Ave., Madison, WI 53704, 608-256-3133; <http://mediasoftware.sonypictures.com>. List price: \$69.95. Street price: \$52.60 from www.ecost.com. Requires Windows 2000 or XP.

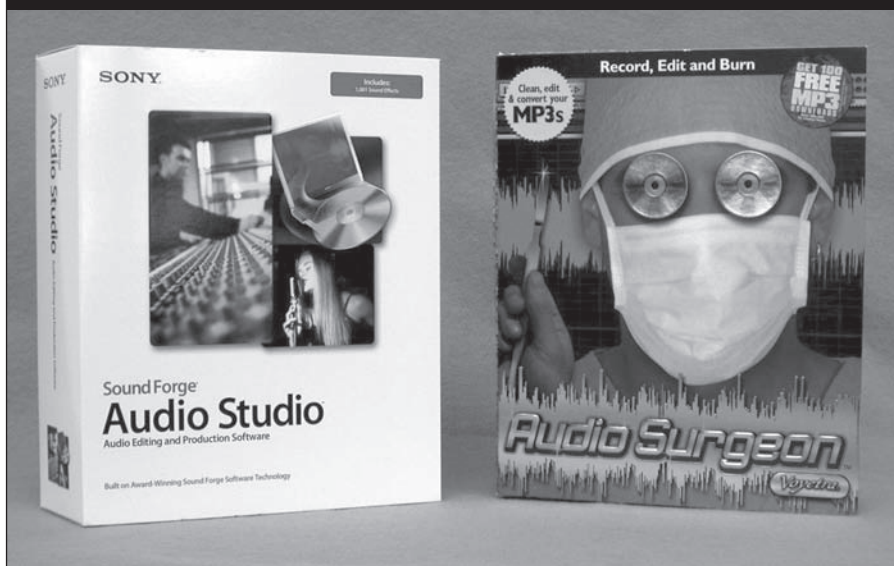
AudioSurgeon V. 6. Voyetra Music Software, Voyetra Turtle Beach, 5 Odell Plaza, Yonkers, NY 10701-1406; <http://www.voyetra.com>; 800-233-9377 (sales, in US), 914-966-0600 (sales, non US), 914-966-1102 (Fax); e-mail: sales@voyetra.com; support: support@voyetra.com. Download price: \$29.95. Requires Windows 98 or higher.

DC Six 6.14. Enhanced Audio, Inc., 3600 Board Road, York, PA 17402, 717-764-9240, 866-260-6376 (toll-free), 717-764-9254 (Fax); www.enhancedaudio.com; info@enhancedaudio.com (e-mail). \$199 (\$99 upgrade from DC Five). Requires Windows 98SE or higher.

For some time I have been using Sony Sound Forge 7.0 digital audio editing software (henceforth referred to as Sound Forge), which I use along with their Noise Reduction 2.0 and CD Architect 5.0 packages. Noise Reduction 2.0 consists of four DirectX audio restoration plug-ins—Vinyl Restoration, Noise Reduction (for hiss

and other continuous noise reduction), Clipped Peak Restoration, and Click and Crackle Removal. All four operate within the Sound Forge editing environment. CD Architect 5.0 is a stand-alone program for Red Book CD mastering with disc-at-once burning. These are full-featured programs intended for professional use.

PHOTO 1: Two low-cost digital audio editing programs. Sony Sound Forge Audio Studio offers the speed and user-friendly editing environment of their professional Sound Forge program. Voyetra's AudioSurgeon offers basic editing functions and professional-style disc-at-once CD burning, but CD drive support needs improvement.



SOUND FORGE AUDIO STUDIO

Sound Forge Audio Studio 7.0b (henceforth referred to as Audio Studio) is Sony's newest consumer version of Sound Forge, replacing Screenblast Sound Forge 7.0 (*Photo 1*). Audio Studio offers many of the features of Sound Forge at a fraction of the price. You can purchase the program either packaged or as a download from the Sony Media Software website. You can also download a fully-functional 30-day trial version.

The Audio Studio interface looks and operates exactly like the professional Sound Forge (*Photo 2*). One of the nicest features of Sound Forge is its lightning-fast speed. On an up-to-date computer you can copy an entire CD worth of data—80 minutes—to the clipboard and then paste it into a new editing window, all in the time it takes to click your mouse.

Audio Studio retains all of the speed of Sound Forge—there's no waiting for normal cut- or copy-and-paste editing operations. Audio Studio allows you to have multiple editing windows open, copying or cutting and pasting between them quickly and easily. You can also resize each editing window at will. Navigating Audio Studio is easy, with intuitive toolbars for accessing the program's various features. The transport toolbar offers a full array of controls for playback of your file, most of which are duplicated in the editing window.

Zooming is an essential part of precision editing. Like Sound Forge, Audio Studio provides mouse wheel support for zooming, in addition to normal menu choices. Once you've become accustomed to mouse-wheel zooming, you'll probably be intolerant of any program that doesn't support it. Audio Studio comes with an array of menu-selected processes, including Bit-Depth Conversion (choices are 8 or 16 bits), DC Offset Correction, simple and complex Graphic EQ, Fade-In and Fade-Out (in-

cluding Graphic Fade), Insert Silence (with adjustable length), Invert/Flip (polarity inversion), Mute, Normalize, Pan, Resample (to any sample rate between 2000 and 48,000Hz), Smooth/Enhance, Swap Channels, Time Stretch, and Volume (manual adjustment of level).

A large array of effects is also supplied, including amplitude modulation, chorus, delay, distortion, dynamics, envelope, flange wah-wah, noise gate, pitch bend, reverb, and stutter. Looping features are also included, and you can produce music loops in Audio Studio for Sony's ACID looping programs (either the full, professional ACID or the consumer ACID Music Studio). Audio Studio is not intended as an audio restoration program, but it is supplied with Sony ExpressFX Vinyl Restoration module, which I have found to be a very effective tool for removing clicks and pops from LPs (Photo 3). Vinyl Restoration actually removed some nasty clicks on the Ives LP (Table 1) that Groove Mechanic (reviewed in *aX* April 2005) could not take out.

Audio Studio allows you to insert markers and regions into a sound file. Normally, a CD authoring/mastering program such as CD Architect will convert regions into CD tracks and markers into index points. Indexing never became very popular on CDs, and few players support access to them these days. Normally, markers are inserted in the file where each CD track is to occur, plus one at the end.

The professional Sound Forge allows you to automatically convert markers to regions. Marker and region information is embedded into Wave files, which CD authoring/mas-

tering programs can read. Audio Studio does not do the automatic conversion, but you can produce each region manually by marking the beginning and the end of each region (Mark In and Mark Out), and then producing a region. The Regions List window makes the Mark In and Mark Out process fairly easy.

Audio Studio has full recording capability via your sound card's inputs. One essential function of Sound Forge retained in Audio Studio is Extract Audio from CD, which allows you to extract an entire CD and select tracks or a range of data you specify by start and end time. If you extract an entire CD, or specify a range by time, the entire extraction appears in one editing window. The program will insert a marker for each index (or track), a region for each track, or both.

I master all of our concert recordings on DAT. The sound cards on my

PHOTO 2: The Sound Forge Audio Studio editing environment. The program looks and operates just like the professional Sound Forge, with mouse-wheel support for zooming and easy, intuitive operation.

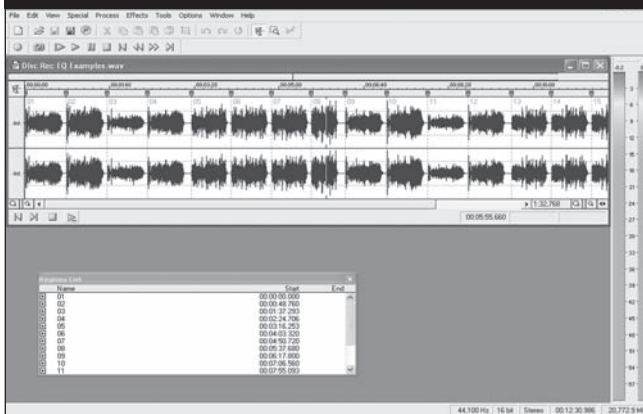
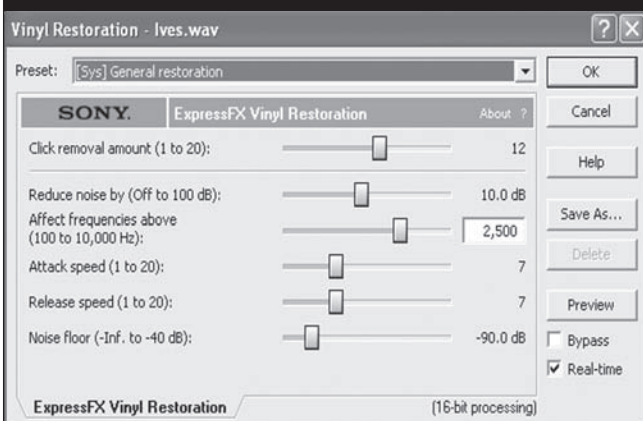
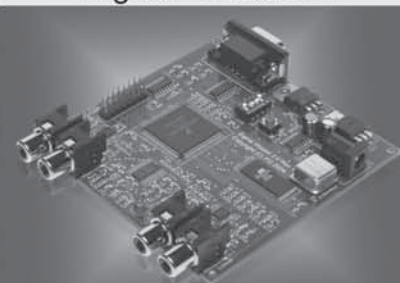


PHOTO 3: Sony ExpressFX Vinyl Restoration program is one of the best on the market and is supplied with Sound Forge Audio Studio. Six adjustments are included, and the default settings normally yield excellent results.



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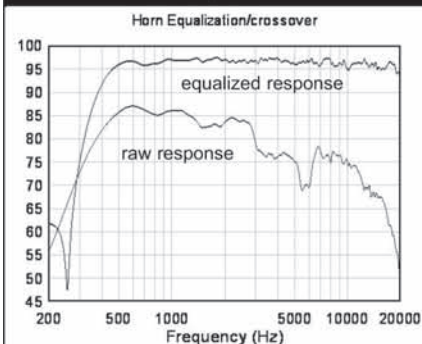
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computers do not have digital inputs, so I normally make a digital copy of my DAT master on a CD recorder. I can then extract the audio from this CD to load it into my editor. This way, the transfer process stays in the digital domain.

There are a number of programs—some of them free—that will extract the contents of a CD, but the ones I've seen store each track as a separate Wave file. This is useless if you need to extract a long piece that has multiple tracks within continuous music. Sony has done it right.

often involves inserting CD tracks in the middle of continuous music, which can be problematic. Track-at-once burners, the most common type, usually insert a 2-second pause between CD tracks, though some allow you to override this.

A seamless joining of multiple Wave files may or may not work, depending on your software and CD burner. Some burning programs support disc-at-once burning, but normally from separate files. Again, I have found achieving seamless joining of files to be a hit-or-miss proposition.

Studio. Both support only track-at-once CD burning. I urge Sony to reconsider this and include disc-at-once burning in these programs.

I also wish that Sony would include a system volume control that would stay “on top” of the program. As it stands, you must use the Windows Volume Control, which hides in the background when you are working in the editor. If you wish to change playback or recording level, you must click on the taskbar to bring up the volume control, which disappears as soon as you go back to editing.

There are a number of other Sound Forge features not included with Audio Studio. Audio Studio does not support DirectX plug-ins, so it is not compatible with Sony Noise Reduction 2.0 package or any other DirectX programs. It doesn't have a playlist/cue list, time display window, effects chainer, clipped peak detection and marking, automated time-based recording, and audio threshold record triggering. Audio Studio has only peak-reading meters; Sound Forge allows you to also choose VU and PPM types.

Sound Forge allows normalizing by the peak or RMS method; Audio Studio uses the peak method only. There's no undo/redo history in Audio Studio, even prior to closing a file. Sound Forge supports digital audio formats up to 32-bit and 192kHz; Audio Studio supports 8 or 16-bit digital audio at sampling rates as high as 48kHz. There are other differences between them, shown in a comparison chart on the Sony Media Software website at:

<http://mediasoftware.sonymovies.com/Products/showproduct.asp?PID=945&FeatureID=7874>.

Any “light” version of a professional software package is going to eliminate some features found in the full-blown version. Sony, which has generally made sensible choices in designing Audio Studio, is to be applauded for retaining the speed and user-friendly operation of the professional Sound Forge. The boxed package includes a CD-ROM and a 66-page, spiral-bound Quick-Start Manual. You can download a detailed manual that covers both Audio Studio and professional Sound Forge in PDF format from the Sony Media Software website.

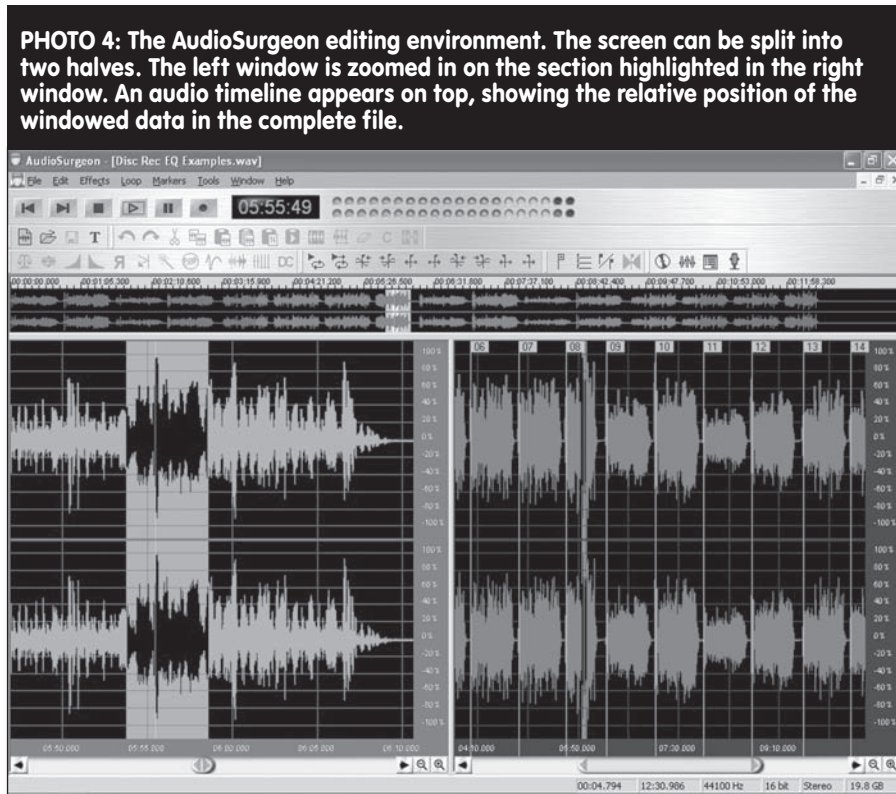


PHOTO 4: The AudioSurgeon editing environment. The screen can be split into two halves. The left window is zoomed in on the section highlighted in the right window. An audio timeline appears on top, showing the relative position of the windowed data in the complete file.

Unlike Sound Forge, which lets you save your editing projects in a proprietary .FRG format, Audio Studio does not support non-destructive editing. You can undo and re-do editing operations as long as your file is open. Once saved, your work is cast in stone. Audio Studio allows you to save your work in 22 different file formats, including .WAV and .MP3.

Most CD-burning programs supplied with computers will not recognize markers or regions inserted into Wave files. You need to save each CD track as a separate Wave file, load each file into your burning program, and then burn the disc using the “track-at-once” method. Classical music—especially opera—

Another problem with joining separate Wave files is a doubling of the amount of data on your hard drive. You may choose to keep your original Wave file, with markers and regions in place, plus the separate Wave files you've extracted for each track. This senseless redundancy will bloat your hard drive.

One limitation with Audio Studio is that it doesn't allow you to automatically extract the regions in your file to separate Wave files (Sound Forge does). You'll need to do it manually, by copying and pasting each region to a new editing window, and saving the individual file, a definite inconvenience. I have two other criticisms that apply to both Sound Forge and Audio

AUDIOSURGEON

AudioSurgeon is a really inexpensive digital audio editor, which you can buy as a download or as a boxed package from many Internet dealers (*Photo 1*). The interface has a very slick, professional-looking appearance (*Photo 4*). Editing is done with normal cut- or copy-and-paste operations, and there's also a Mix Paste function for blending two audio clips. Zooming is done by clicking the + or - buttons in the lower right corner of the screen, but there's no support for mouse-wheel zooming.

AudioSurgeon doesn't boast the lightning speed of Audio Studio. On my home computer, a 2.8GHz Dell Dimension 4600 with 1GB of RAM, loading a 12 1/2-minute file takes about 20 seconds. Deleting 45 seconds of music from that file takes 7 seconds, and restoring it with Undo takes about 2 seconds. On my office computer, which is a 2.4GHz Gateway E-Series, with 384MB of RAM, loading, cutting, and undoing took 20, 20, and 10 seconds, respectively. These processes happen virtually instantaneously with Sound Forge or Audio Studio, on either computer.

Navigating the AudioSurgeon editor is quite easy, and I'm surprised that such an inexpensive program works so well. Only one editing window is available, but you can have several files open at once, cutting or copying and pasting between them. Once each file is opened, you simply go to the Window menu to select the one you wish to view.

Switching between them is fast, once each has been opened. You can split the screen horizontally to show two different portions of the same file, which is also quite useful. The program also has an overview display above the waveform displays that always shows the entire file and highlights the section that is visible in the main waveform display.

AudioSurgeon has an Insert Silence function, which is rather strange, and should really be called "Replace with Silence." With Sound Forge and Audio Studio, you simply put the cursor where you want the silence placed, select the length of the silence in the dialog box, and click the mouse. With AudioSurgeon, the Insert Silence is grayed out until you highlight a portion of the waveform. Then it replaces the portion

you've selected with silence. Everyone doing digital editing will need a conventional Insert Silence function.

Here's a trick: Record one minute of silence with the AudioSurgeon Record Wizard (more on that later). Simply let the recorder run with the mixer levels all the way down. Save this file as Silence.wav. If you wish to insert 5 seconds of silence into your file, open Silence.wav, highlight 5 seconds of it, and copy it to the clipboard. Change the window to the file you're editing, put the cursor where you want the silence, and select Paste. You now have 5 seconds of silence added to your file, right where you want it, rather than replacing a section you wanted to keep.

AudioSurgeon features a basic menu of effects, including scale (manual level adjustment), normalize, fade-in, fade-out, reverse (L & R channels), and echo (reverb). AudioSurgeon also has basic audio restoration tools, including click and pop removal, hiss removal, low pass filtering, and DC offset adjustment. The program has default settings and an automatic mode for each, but you can override these and adjust the parameters manually. Toolbars allow easy access to these functions, in addition to pull-down menu selection.

I didn't find the click and pop removal as effective as Groove Mechanic or Sony's Vinyl Restoration. In general, I also preferred Groove Mechanic's hiss reduction to AudioSurgeon's, but the latter has a sliding noise floor threshold control that is occasionally more useful than Groove Mechanic's three fixed choices. All of these effects run rather slowly.

AudioSurgeon has a Record Wizard that makes recording via your sound card extremely easy. Transport playback controls are available on the toolbar. You can save files in three formats, .WAV, .MP3, and .WMA (Windows Media File). AudioSurgeon supports resolutions up to 16-bit, with sample rates as high as 48kHz. Markers that are stored with the Wave file are easy to insert—for later conversion to CD tracks—and are easy to move around or delete. The program won't extract the contents of a CD.

DISC-AT-ONCE BURNING

AudioSurgeon has one feature that

makes it unique among affordable editors: it is the only low-cost editor I've seen that supports disc-at-once CD burning. It recognizes the markers you have inserted (and saved) into its own stored Wave files or Sound Forge/Audio Studio Wave files, and turns them into CD tracks when you burn your disc. Some disc-at-once CD burning programs still require you to save each track as a separate Wave file. You must then produce a "play list" or "cue list" of the tracks you want to burn. If everything is working right, the individual files will be joined together properly when the CD is burned.

AudioSurgeon burns a disc from the single, marked file in the editing window, without having to produce a "cue list," a very professional way of operating. Once you've tried real disc-at-once burning, you'll find the old track-at-once method—or any method that requires you to save each track as a separate file—decidedly awkward. Even if you don't use any of the other functions, disc-at-once burning from within the editor is easily worth the \$30 price. You can use Audio Studio as your

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There is one caveat: AudioSurgeon is unusually finicky regarding the recordable CD drives it will support. I ran into a problem when the drive in my office computer failed. AudioSurgeon had worked fine with the old drive, but not with the replacement supplied by Gateway, a GCC 4481B. Voyetra has a list of supported CD-R and DVD-R drives at: <http://www.voyetra.com/site/products/audiosurgeon/supported.asp>. Unfortunately, this list is very out of date, and the specific model numbers are normally not current.

For example, the list includes the Teac CD-W552E and CD-W552EL, but neither model is made anymore. AudioSurgeon won't recognize the replacement CD-W552G as an external USB2 drive on my office computer. Both the Teac and GCC drives work fine with Sony CD Architect 5.0, the trial version of Adobe Audition 1.5 (which also does disc-at-once burning without splitting up your file), Roxio E-Z CD Creator, and the OEM version of Nero Express 6 (Nero came free with the Teac drive).

I raised this issue with Voyetra's tech support folks, and was simply told that if the drive is not on this list "it won't burn." They won't answer any questions about newer drive models not on this list, nor about what is specifically required of a drive in order to work with the program.

In answer to one of my inquiries, Voyetra tech support noted that since all computers come with burning software, the fact that AudioSurgeon's burner did work should not be an issue. They really seem clueless regarding the importance of their disc-at-once burning for some customers. This is very frustrating, so I strongly suggest downloading the trial version to see whether it is compatible with your drive. If your current drive fails, you will likely be out of luck.

If, for some reason, you choose to store each CD track as a separate file, AudioSurgeon supports this. Simply select Split Markers Into Files to display a dialog box that allows you to select as many or as few tracks as you like. If you're unsure which tracks you

want, you can select a track for listening within this dialog box. This is another extremely useful feature, rare in such an inexpensive product.

Another nice feature of AudioSurgeon is the Voyetra Mixer, which you can use instead of the Windows Volume Control. It has many customizable options, including an "Always On Top" choice that puts it on top of your editing application. It also works fine with Sound Forge and Audio Studio.

If you download asurgeon.exe, you will get AudioSurgeon version 6.20, but this version will not accept product ID codes supplied with the boxed product. Most Internet computer dealers selling the boxed product are still shipping version 5, which is out of date. In order to update this version to version 6 for free, go to Voyetra's FTP site <ftp://ftp.voyetra.com/pub/voy/asurgeon>. Download the file dr_50enc.exe, which, contrary to the filename, is really version 6.01.2172.

The Voyetra website notes: "If you already have the previous version 6.01.2172 of December 23, 2003, do NOT update to the newer version, as there are NO new features except for Copyright/Licensing changes. You need to make sure that you are using the correct Product ID to unlock the appropriate version."

Voyetra has added further confusion to the version issue with its installer, which tells you that version 5 is being installed, even though it is really installing version 6. Once installed, you can go to "Help" and "About AudioSurgeon" to verify installation of the correct version. I see no need to order the boxed version, which is actually a couple of dollars more than the download, and won't allow you the benefit of a free trial. The 20-page manual supplied with the boxed version is the same one you can download as a .PDF file, but the download version has color screenshots (the printed manual is black and white).

DC SIX

DC Six is an audio restoration, audio editing, and audio enhancement software package selling for under \$200 (Photo 5). DC stands for Diamond Cut Productions, Inc., the designer of this package and its predecessors, DC Five

and DC 32 (www.enhancedaudio.com). Enhanced Audio, distributor of DC Six, is a partnership between Diamond Cut Productions and Tracer Technologies (www.tracertek.com). Tracer sells a variety of audio gear including sound cards, phono preamps, record cleaning products, microphones, and mixers.

Diamond Cut audio restoration software was written by Craig Meyer and Rick Carlson, two engineers working on the restoration of old sound recordings at the Edison National Historical Site in West Orange, N.J. A companion product, DC Live/Forensics, is intended for forensic audio uses, and allows live "on the fly" audio processing. One manual covers both programs, but I did not evaluate the Live/Forensics package. DC Six version 6.14 is the most recent upgrade, containing a number of bug fixes for users of earlier versions. Registered users can download the 6.14 patch at <http://www.tracertek.com/software1.htm>.

Enhanced Audio claims that DC Six is "the world's most powerful audio restoration software." Tracer Technologies calls it "the world's best audio restoration/enhancement and editing product," and further notes "You won't find a better audio editor, audio restoration and audio enhancement package anywhere in the world. Period."

During this evaluation I did considerable comparison with my reference editing and restoration programs, Sony Sound Forge 7.0 and Noise Reduction 2.0 packages. Street price for these two programs is around \$550, nearly three times what DC Six costs (remember that Sound Forge comes bundled with CD Architect 5.0). But, in view of the manufacturer's claims for DC Six, the comparisons seem fair.

Their claims also seem to invite comparisons with five-figure editing and restoration programs such as Sadie, Cedar, and Sonic Solutions. The Sadie Disc Editor combined with Cedar audio restoration software is considered the state-of-the-art in audio editing and restoration for the Windows platform; Sonic Solutions holds that same position in the Macintosh world. Several of my friends in the recording and restoration business use both of these products.

DC Six comes with a full array of

programs for click, crackle, and hiss removal, equalization, and a host of effects (*Photo 6*). It was designed for restoring every conceivable type of recording, including cylinders, lateral and vertical 78s, 45s, broadcast transcriptions, LPs, and tapes.

Noise reduction modules include EZ Clean, EZ Impulse Noise, Expert Impulse Noise, Continuous Noise (Hiss), Harmonic Reject Filter, and a Dynamic Noise Filter. The Impulse Noise filters are intended for click and crackle removal. The EZ versions are for novice use. EZ Impulse noise has only two sliding controls—one for scratch and one for crackle.

The Expert version has separate slider adjustments for threshold, size, and tracking. EZ Clean has three controls, for scratch, crackle, and hiss. All of these programs include many presets (a few dozen on some) for various types of source material, including specific types of 78-rpm and LP records, and a variety of tape sources.

Most affordable hiss removal programs use the spectral subtraction method. The DC Six Continuous Noise

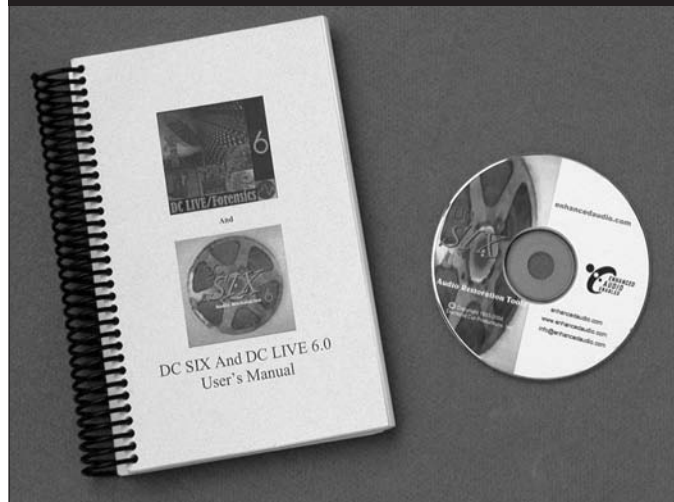
processor also has two other choices—Normal CNF and Audio Spectrum CNF. The Audio Spectrum CNF mode works “on-the-fly” and doesn’t require sampling the noise first. Every module included with DC Six allows previewing, so you can play the file and adjust the controls to hear the effects. Once you’re satisfied, you can process the entire file.

DC Six also has a variety of filters, including Lowpass, Bandpass, and Highpass, all with adjustable slopes and a choice between Butterworth and Chebyshev (their spelling). There’s also a Notch Filter with adjustable bandwidth and “Q,” plus median and averaging filters. Three equalizers

are also included: 10-Band Graphic, 20-Band Graphic, and a terrific Paragraphic equalizer, which allows you to literally draw the filter shape. All of these filters have a multitude of presets and a preview mode.

One of the Paragraphic presets is an RIAA de-emphasis curve. Tracer Tech-

PHOTO 5: DC Six packs a toolbox of audio editing, restoration, and effects programs at an affordable price. The program comes with a 400-page manual that requires considerable study in order to master its operation.



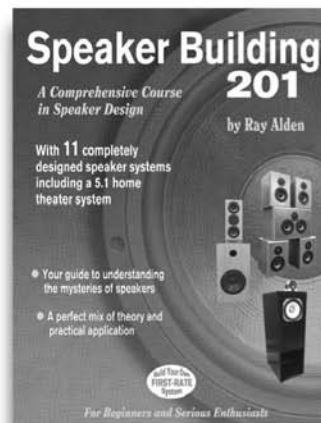
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nologies sells two flat phono preamplifiers (which don't compensate for the RIAA curve). After making a flat transfer of an LP to your computer, you can use the Paragraphic's RIAA setting to add RIAA playback EQ in the digital domain. Enhanced Audio believes that this is a more precise method than conven-

tional analog RIAA phono preamps.

One question I posed to Enhanced Audio concerned the phase characteristics of the digital equalization. Digital filters can be designed with perfect group delay characteristics and can provide frequency equalization without the nasty phase shifts of analog filters. But, RIAA

phono preamps compensate for both the amplitude and phase characteristics of the record, as played by a magnetic (velocity-sensitive) pickup. No one ever considers the phase characteristics of the RIAA curve because with analog filters, the phase correction comes along for the ride when the correct frequency equaliza-

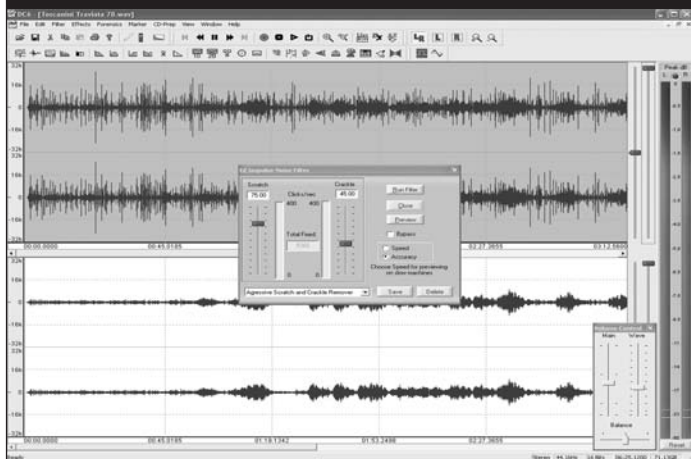
tion is achieved.

In *Fig. 1*—two graphs I generated using computer simulations—the top graph shows the familiar RIAA emphasis and deemphasis curves, i.e., the frequency response. The bottom graph is the phase response of the emphasis and deemphasis networks. In both cases, the complementary curves yield a flat response.

If RIAA de-emphasis is done in the digital domain, it must work exactly like an analog filter in order to provide correct amplitude and phase equalization. I sent several e-mails to Enhanced Audio's technical support asking whether or not the paragraphic RIAA EQ provided proper phase response, but they never answered the question (all of my other questions were answered, however). I would not do RIAA digitally unless I was certain that the phase response was correct. The RIAA filter is "phase neutral" and provides zero phase shift.

DC Six also includes an array of studio effects, including reverb, echo, a dynamics processor, a punch and crunch multi-band dynamics processor, and a channel blender. There's even a very

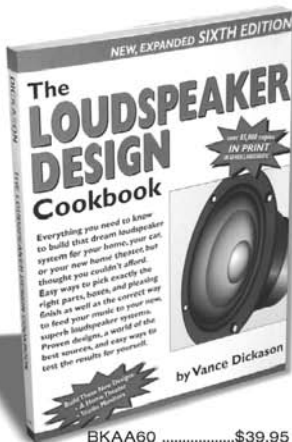
PHOTO 6: The DC Six environment. The screen shows the program in the "classic" editing mode, with the source window on top and the destination window on the bottom. Processed files appear in the destination window. The EZ impulse noise filter is open in the center of the screen, and the "always on top" volume control is in the lower right.



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flexible virtual valve amplifier for adding tube warmth or sweetness to a recording. The change speed processor allows fixed speed changes, such as an analog pitch control, over three ranges—1%, 10%, and 100%. This allows you to make any conceivable correction to an old recording that has been transferred at the wrong speed (remember that most so-called 78-rpm recordings were actually recorded at some speed “in the ballpark,” from below 70 to the mid-80s, and sometimes even higher).

You can also set this processor to adjust pitch over time, to correct “pitch creep” in a recording. There are a variety of presets, including corrections needed for fractional speed mastering. Stretch and Swish is a DJ-type feature, allowing you to change tempo while maintaining the same pitch. All of these effects allow previewing.

DC Six has an incredibly versatile file conversion feature, which is an elaborate “Stereo-Mono” switch. You can convert a mono file into stereo, with a variety of “fake” stereo settings, or a stereo file into mono L+R, mono L-R, left only, right only, stereo reverse, and also

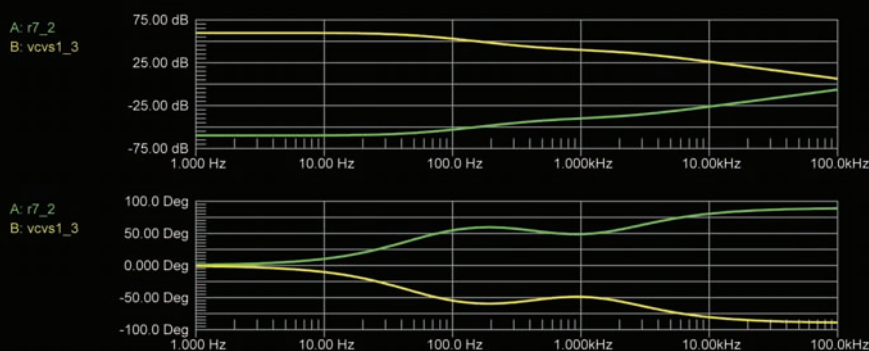
$L = L + R$ and $R = L - R$. These are especially useful if you’ve stereo-transferred a mono 78-rpm disc.

You can combine the two groove walls of a laterally-cut or vertically-cut recording optimally. There are separate level adjustments of the two channels and a time delay adjustment. In both cases, the mouse is used for coarse adjustment

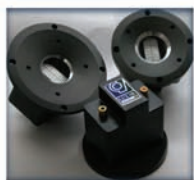
and the arrow keys on your keyboard allow fine-tuning. Again, many presets and a preview mode are included.

Many restoration engineers prefer to do stereo transfers of mono records and tapes. Later, in the digital domain, phase and level corrections can be made for optimum sum of the two channels to mono. You can use the file conver-

FIGURE 1: The RIAA recording and playback characteristics deviate from a flat response both in amplitude and phase, but phase is seldom considered because it happens automatically with analog filters. The top graph shows the familiar RIAA frequency response, and the bottom graphs show the phase response. The yellow traces are the recording curves (the record played by a magnetic transducer), and the green traces are playback. The graphs were generated by computer simulations.



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13KHz/92dB/2.83V/1M (300W)
Impedance: 8 ohm / 12 ohm Ribbon Size: 15 x 25 x 0.006mm



DEQX PDC 2.



sion tool for this in conjunction with the X-Y vector display, also known as a Lissajous pattern (Photo 7). The preview mode allows real-time adjustments while viewing the results on the X-Y display, before processing the entire file. You can also use the X-Y vector display to check whether a monaural recording has been issued in fake stereo (you can play a CD track from within DC Six's CD ripping window).

If you've done a stereo transfer of a mono source, split and recombine allow independent processing of the left and right signals, before putting them back together. Both the file conversion and the split and recombine are incredibly powerful tools normally found on much more expensive restoration software. On a future release, they might consider a file conversion setting that converts $L = L + R$ and $R = L - R$ stereo into normal L and R stereo. This would be useful for decoding an MS recording in the digital domain.

Two forensic tools are also included. A De-Clipper can reduce distortion on clipped waveforms. Presets are included for various types of clipping, including digital waveforms, analog tape, and various types of amplifiers. Normally, you must first reduce the overall level of the file before the program can eliminate the flat-topping. You can configure a brick wall filter as high-pass, low-pass, bandpass, or band-stop. DC Six includes a multi-filter function, which is really a chainer that lets you daisy-chain multiple processors together.

DC SIX EDITOR

The DC Six editor is very fast, but not nearly as easy to use as Sound Forge or Audio Studio. You can't zoom with the mouse wheel; you need to use the zoom buttons on the toolbar, or select them from the pull-down menu. If the file has been zoomed so that only a portion of it fits on the screen, the DC Six editing window doesn't scroll during playback. Once the cursor reaches the

end of the visible portion of the file, it goes off the screen and disappears. With Sound Forge and Audio Studio, the editing window scrolls the waveform so the playback cursor is always on the screen, which is much more sensible.

DC Six will store its own markers in the Wave file, but it does not recognize markers and regions embedded in Wave files by Audio Studio, Sound Forge, or AudioSurgeon, and those programs won't recognize DC Six's markers. It's unfortunate that DC Six doesn't use the professional, industry-standard file marking system supported by these

The advantage of the fast mode is increased speed, but there's a danger of overwriting your original file with the processed file unless you do a "Save As" after processing. The source file and destination file concept of classic mode ensures that your original file is not changed. But, if you do any editing on the source file and then close the file, it will be automatically saved without prompting you. I don't understand the logic behind this.

The full-screen display in either mode may be uncomfortably large on some screens. You can re-size it in a window, but the re-sizing is not retained with the file. It will default to full screen every time you open it.

You can use an undo command when you don't like an edit or a signal process you performed. There's no redo command, but there are ways to redo. For any filter or process operation, you can run the filter or processor with the same settings as before. If you're in the fast edit mode, there's a history window that will allow you to redo anything that you undo.

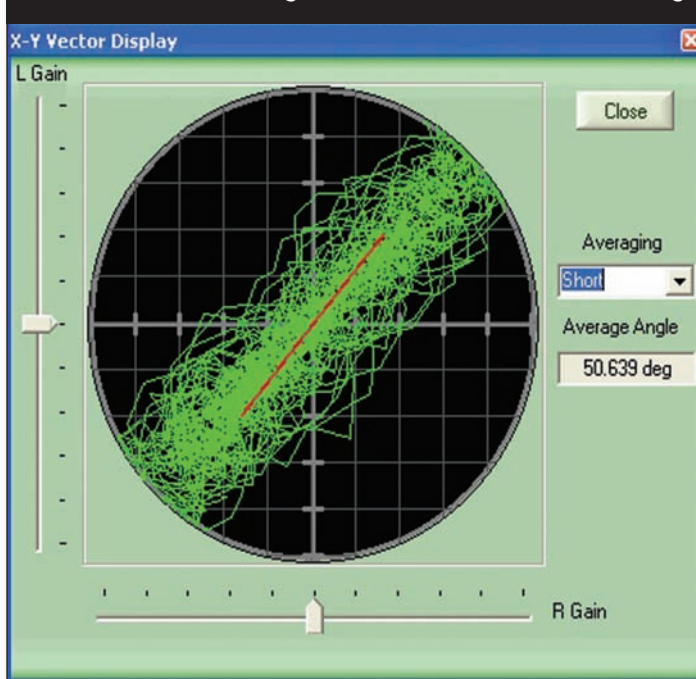
In the classic mode, there's no way to redo edits, because the history window doesn't work in the classic mode. This is also strange, because the classic mode is supposed to be the preferred method for editing

and processing. Both Sound Forge and Audio Studio have redo commands on the edit menu.

DC Six includes its own volume control for playback monitoring. Once you open it from the view menu, it stays on top of the program at all times. I find this a really nice feature, one I wish Sony would incorporate into the Sound Forge and Audio Studio programs.

DC Six supports DirectX plug-ins, even though its own processing programs are not DirectX-compatible. I tried using my Sony Noise Reduction 2.0 DirectX programs within DC Six and couldn't get them to work. This is not really an issue, because I'd much rather run them in the Sound Forge editor. The

PHOTO 7: DC Six's X-Y Vector display is an extremely useful tool that you can use for azimuth adjustments, stereo-to-mono-file conversions, and checking for fake stereo on a mono recording.



other programs. DC Six has a paste silence function, which is basically the same as insert silence. You can paste a silence of any length to the beginning or end of a file, or the beginning of a selected area. This last is a bit different from Sound Forge and Audio Studio, but it works.

There are two edit modes—classic and fast. In the default classic mode, the original file opens in the top window. After that file has been processed, the processed version appears in the lower window. In fast mode, there's only one window, which fills the whole screen vertically and changes from the original file to the processed version after processing has been done.

DC Six restoration programs are not DirectX compatible. DC Six will extract the contents of a CD, but each track is saved as a separate Wave file. DC Six also supports recording via your sound card, with resolutions up to 32-bit and sampling rates up to 192kHz.

DC Six doesn't burn CDs. After you add markers to a file, you select Chop File Into Pieces from the CD Prep menu, which breaks your file up into separate Wave files. Then, you use CD burning software of your choice to burn your CD. Because DC Six's markers aren't recognized by other programs that do disc-at-once burning, it is not suitable for serious classical music editing.

RESTORATION RESULTS

Table 1 is a list of recordings I transferred for evaluation of audio restoration programs. Since my computer is in a different location from my main audio system, I transferred all recordings to a CD-R using a Sony CDR-W66 professional CD recorder and extracted the tracks to individual files using Sound Forge. I have considerable experience with restoration of these recordings with Sound Forge 7.0 and Sony's companion Noise Reduction 2.0 package.

DC Six did a generally decent job on most vinyl LP scratches. One disc that gave it some trouble was the Ives. This LP has a series of once-around clicks due to a pressing defect, lasting about two minutes. The vinyl restoration module included with Sound Forge and Audio Studio is the only program I've used that removes them all in one operation. A barely audible noise is left in place of the largest clicks.

With DC Six, there's no single pass approach that will fix this file. You must use manual interpolation to remove each click. Zoom in on each one, highlight it, and hit "i" on your keyboard. Then you can run E-Z Clean to remove the remaining crackle.

I sent the most difficult portion of this file to Enhanced Audio's tech support to see what they could do with it. Their cleanup was not as effective as what I achieved with one pass of Sony Noise Reduction 2.0 using the default settings and no manual operations. The DC Six restoration left noises in place of the large clicks and was not as effective in removing the remaining low-

level crackle as Sony Noise Reduction 2.0.

In general, I found the E-Z Clean to be the best method for vinyl click removal in DC Six. I also needed to use the interpolation on the large click in the Furtwängler Beethoven 9th excerpt. Again, Sony Noise Reduction 2.0 took it out with one pass on the default settings. Neither program was completely successful with the *Belshazzar's Feast* LP I deliberately damaged. The Hindemith and Wagner discs, with light-to-moderate random ticks, fared well on both programs.

On 78-rpm material DC Six is capable of good results, but you must be prepared to do a lot of fiddling. On the Toscanini Traviata Prelude, Sony Noise Reduction 2.0 click and crackle remover did an excellent job with this very crackly disc using the program's default 78-rpm setting. The various presets in DC Six are just a rough starting point, and much user intervention is required beyond that. With DC Six, you must spend a lot of time and do a great deal of adjusting to achieve satisfactory results, but I was never able to get the *Traviata* Prelude as quiet as the Sony-processed file.

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I also found that DC Six added a very subtle texturing to the high string sound in the *Traviata* Prelude. The sound with Sony Noise Reduction 2.0 is silky and smooth after processing—sim-

ply more natural. Similarly, on the Caruso “Over There” recording both the primitive orchestral accompaniment and the voice sounded more like the unprocessed record with Sony Noise Re-

duction 2.0. It was difficult to achieve a satisfactory reduction in crackle at the beginning of the Toscanini *Midsummer Night's Dream* Scherzo with either program without compromising the music.

I have two friends in the audio restoration business who do tape hiss reduction using Cedar and Sonic Solutions equipment and software. Both have said that 6 to 8dB of hiss reduction is the most that can be achieved without audible side effects. What's interesting is that I found exactly the same thing to be true of Sony Noise Reduction 2.0 program.

The first side effect, if you go too far, is an audible reduction of high frequencies. You can often compensate for this with digital equalization included with Sound Forge. If you go too far, you will get audible artifacts such as high-frequency swishing sounds.

I used DC Six's continuous noise filter (CNF) to reduce tape hiss on the excerpt from the Fauré *Requiem* conducted by Nadia Boulanger. You normally begin hiss reduction by taking a sample of the noise where the music is silent. Although the manual doesn't make this clear, the spectral subtraction mode was designed primarily for speech or very noisy recordings.

On this recording, using the spectral subtraction mode with even 6dB of hiss reduction produced audible artifacts and strange swirling sounds. The Normal CNF mode worked much better. The 15ips reel-to-reel default settings include 35dB of noise reduction, which is way too high for most applications.

With more realistic levels of noise reduction—10 to 12dB—DC Six did a very good job with this file. I wonder whether the calibration for the amount of attenuation is accurate in DC Six. Subjectively, Sony Noise Reduction 2.0 seemed to achieve lower levels of hiss for a given decibel amount of noise reduction than DC Six, so I'm not sure the calibrations for the two programs are comparable. DC Six certainly did a good job with hiss reduction on this example. Groove Mechanic uses the spectral subtraction method, but it also did a fine job with this excerpt using the most conservative setting, as I noted in my review of that program.

The Boulanger recording is quite

TABLE 1: RECORDINGS USED TO EVALUATE DC SIX 6.0

LP Clicks and Pops

Charles Ives: *The Things Our Fathers Loved* - “Slow March,” “Canon,” and “There's a Certain Garden.” Helen Boatwright, Soprano; John Kirkpatrick, piano. Columbia Masterworks M4 32504, Record 3, Side 1, Band 1. (Loud crackles and pops at the beginning due to a pressing defect.)

Beethoven: Symphony No. 9 in D minor. Berlin Philharmonic Orchestra conducted by Wilhelm Furtwängler, Rec. London 1 May 1937. Toshiba/EMI WF-60073-74. Excerpt from 2nd Mvt. (There's a gouge in these otherwise pristine records on Side 2, causing two ticks, one minor and one very loud.)

Wagner: *Tristan und Isolde* - Prelude to Act 1. Los Angeles Philharmonic Orchestra conducted by Erich Leinsdorf. Sheffield Lab LAB-7 (Direct-to-Disc). (Light, random ticks.)

Hindemith: *Symphonie Mathis der Maler* - Mvt. 1 Introduction. Boston Symphony Orchestra conducted by William Steinberg. Deutsche Grammophon 2530 246. (Moderate, random ticks.) (An outstanding performance by an underrated conductor that deserves a CD re-mastering by DG.)

Walton: *Belshazzar's Feast*. Crane Chorus and Crane Symphony Orchestra conducted by Brock McElheran. CSM-1003, a record produced privately by The Crane School of Music, SUNY Potsdam, from analog tapes I recorded in 1984. (I had some extra copies of this record lying around, so I sacrificed one for de-clicking tests; I put three large, evenly-spaced scratches at the beginning of the piece, and three more large scratches 1/2-inch apart at the beginning of Side 2.)

Tape Hiss

Fauré: *Requiem* - “Libera me.” Crane Chorus and Crane Symphony Orchestra conducted by Nadia Boulanger. Spring Festival of the Arts, 1958. 15-ips full-track mono original tape.

Respighi: *The Birds* - “Prelude.” *The Pines of Rome* - “Pines of the Villa Borghese.” London Symphony Orchestra (Birds) and Minneapolis Symphony Orchestra (Pines) conducted by Antal Dorati. Mercury CD 432 007-2. Digital re-mastering from original 15-ips, 3-track analog tape. No digital de-hissing was done on the Mercury CD transfers, so there is some residual tape hiss on this recording.

Clipping Tests (These LPs were deliberately transferred to digital at excessively high recording levels, resulting in clipped waveforms on peaks.)

Stravinsky: *Firebird Suite* - “Infernal Dance.” Atlanta Symphony Orchestra conducted by Robert Shaw. Telarc DG-10039.

Wagner: *Siegfried* - Act I Conclusion (“Forging Scene”). Wolfgang Windgassen, tenor (Siegfried); Gerhard Stolze, tenor (Mime); Vienna Philharmonic Orchestra conducted by George Solti. Decca (Germany) 6.35252.

Wagner: *Die Walküre* - Opening of Act II. George London, bass-baritone (Wotan); Birgit Nilsson, soprano (Brünnhilde); London Symphony Orchestra conducted by Erich Leinsdorf. Decca (England) 7BB 125-9.

78-rpm Tests (These discs were transferred to digital using a Technics SP-15 turntable, SME-3012R tonearm, Stanton 500AL cartridge with truncated elliptical styli of varying sizes, and my modified McIntosh C-8 preamplifier. Playback speeds and phono equalization are noted for each record. A modified Phoenix Systems Parametric Equalizer was also used for the acoustical recording.)

Mendelssohn: *A Midsummer Night's Dream* - Scherzo. New York Philharmonic Orchestra conducted by Arturo Toscanini. Brunswick 50074-A, rec. 1926. 78.26-rpm, 400Hz bass turnover, no treble rolloff. (Clean copies of this record are hard to find—mine has severe crackle at the beginning and a number of ticks and pops.)

Verdi: *La Traviata* - Prelude to Act I. Philharmonic-Symphony Orchestra of New York conducted by Arturo Toscanini. Victor 6994-A, rec. 1929. 77.0-rpm, 300Hz bass turnover, -5dB at 10kHz. (An unworn copy of a late-1930s pressing, but there are a large number of clicks and pops, plus the usual steady-state surface noise.)

Cohan: “Over There.” Enrico Caruso, tenor; Victor Orchestra conducted by Josef Pasternack. Victor 87294, rec. 1918 (acoustical recording). 75.00-rpm, flat phono EQ, parametric equalizer set to +6dB at 180Hz, 0.7 octaves. (A pristine, single-faced copy with virtually no clicks or pops, but the usual steady-state surface noise from the abrasive fillers used in Victor's shellac formula.)

Verdi: *Il Trovatore* - “Miserere.” Rosa Ponselle, soprano (Leonore); Giovanni Martinelli, tenor (Manrico); Victor Orchestra conducted by Giulio Setti. Victor 8097-A, 77.0-rpm. 400Hz bass turnover, flat treble. (The usual steady state surface noise present on scroll-label Victors from the late 1920s, plus some clicks and pops, and distortion on the final chord caused by too high a recording level.)

primitive, with very little real treble, which is why I was able to achieve more noise reduction without side effects than I would on high fidelity material. For a real test, I tried hiss reduction on two tracks from Mercury's *Dorati Conducts Respighi* CD. Mercury normally put recording tape, rather than leader tape, complete with room tone between movements, so it's easy to find places to get a sample of the hiss. I decided to push both DC Six and Sony Noise Reduction 2.0 a bit by doing 12dB of hiss reduction on the two tracks from this disc.

I generally preferred the processing with Sony Noise Reduction 2.0, which softened the treble a bit and also truncated the hall ambience slightly. With DC Six, there was greater reduction of hall ambience, and the soundstage shrunk both left-to-right and front-to-back. DC Six also added a bit of artificial texture to the strings, particularly the violins. The Sony-processed file sounded closer to the original.

DC Six's De-Clipper works quite well on files with short-duration, moderate clipping. With digital clipping, you must reduce the overall level of the file by 3dB in order to give the program some headroom to rebuild the peaks. The transients on the "Infernal Dance" from the Telarc *Firebird* were rebuilt quite effectively, not exactly like the originals, but reducing the offensive part of the distortion.

The clipped peak restoration module in Sony Noise Reduction 2.0 produced slightly cleaner results, however. Like Sony Noise Reduction 2.0, DC Six won't salvage a file with severe, continuous clipping. The program must have leading edges from which to rebuild peaks.

I generally preferred the various noise-reduction programs supplied with Sony Noise Reduction 2.0, both in terms of performance and ease of operation. The DC Six package offers good performance for the money, though. Beyond the two "E-Z" noise removal programs, the learning curve is rather steep.

Like any program of this type, results will depend a lot on operator skill. The manual is over 400 pages long. About a quarter of it is a glossary, but you'll probably need to read most of the remainder, and do a lot of experiment-

ing, to become really proficient with the program.

CONCLUSION

Sound Forge Audio Studio is—hands down—the best low-cost editor I have seen, and at the street price of around \$52 it's a steal (try www.ecost.com). It combines the speed and ease of use of far more expensive programs with a well-chosen set of features, including an effective vinyl restoration module. Its biggest limitation, like professional Sound Forge, is the lack of disc-at-once burning. I hope Sony will add this in the future.

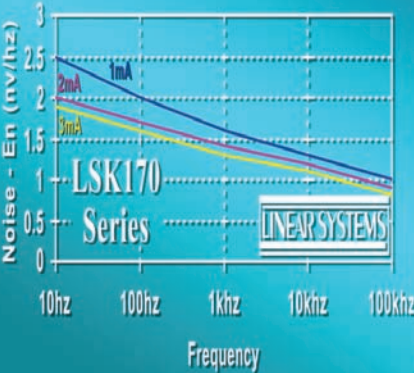
At around \$30, AudioSurgeon provides a decent set of basic editing functions, but editing and processing functions are rather slow. Its built-in disc-at-once burning, which recognizes industry-standard Wave file markers, makes it an invaluable program if it will work with your CD burner. It's easily worth the money even if you use it only as your CD burning software. Combine it with Sound Forge Audio Studio, and for less than \$85 you'll have a pretty serious editing/burning system at an

amazingly low price. Improved support for recordable CD drives is sorely needed, and can only help Voyetra's sales.

DC Six combines a basic editor with a large number of audio restoration tools and effects for a very reasonable price, more than you would expect for \$199. The editor is rather cumbersome compared to Sound Forge or Audio Studio, and Sony Noise Reduction 2.0 package offers superior results and easier operation for vinyl restoration and 78-rpm noise removal. The DC Six package is a lot less money than the combined cost of Sound Forge and Noise Reduction 2.0, and many of the modules included with DC Six are not available with the Sony programs. Some, such as DC Six's file conversion and X-Y Vector display, are extremely powerful, and normally found only on much more expensive software. Your choices will ultimately be determined by your specific needs and budget.

By the time you read this, Sony will have introduced Sound Forge 8.0, which will be bundled with CD Architect 5.2, for a preliminary combined price of \$299.96. If you are a teacher or a stu-

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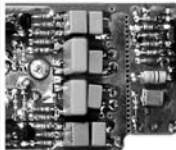
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dent, academic pricing is available on the Sony products (and hundreds of others). Try Academic Superstore (www.academicssuperstore.com) or CCV Software (<http://www.ccvsoftware.com>), both of which normally sell the Sound Forge/CD Architect bundle for around \$155 or Sound Forge Audio Studio for less than \$50. You'll need to e-mail them a .jpg file of your faculty or student ID card in order to qualify for the educational discounts.

Manufacturer's response:

I was impressed with the thorough nature and think that overall, this review was a pretty positive experience. With that being said, there were a few issues both technical as well as some general comments on the review.

If this was an ad for Sound Forge, I think it would be wonderful, but if you're comparing three products, probably a power user of one is not the best person to review the other two. I don't believe one point was made either positive or negative about our product without the mention of how much better Gary felt about Sound Forge. I'm very happy for him. He likes Sound Forge ... been using it for years ... that's great.

Here are a few things that users may not know. First, the average age of an Audio Restoration and Enhancement customer is 50+. Not all of these individuals are computer savvy. When they have a problem ... who do they call? With EnhancedAudio, they call us, we answer the phone and talk them through it. Whether that call takes an hour or 10 minutes, our customers know that they can count on us to support the product. When a customer of Sound Forge, who isn't a veteran of the product calls Sony, who do they talk to? My guess ... a voicemail telling them to get out the old credit card. And they paid about \$200+ more for that privilege. This should be mentioned, as support is a real issue until you become the power user that Gary is ... of any product.

With regard to automatic saving, in classic mode, everything is saved without prompting. This is one of the reasons that average folks without several years of Sound Forge experience can use it safely. Everything is also reversible to any degree.

Also, you are right that there is no redo for "edits" in classic mode—cuts, pastes, copies, for example. Our theory being that if you did an incorrect cut, you'd undo it and why would you want to do it again incorrectly? And, for lots of editing functions, we do recommend Fast Edit mode as the correct choice (the

article states that we recommend classic for both processing and editing).

Again in classic mode—any processing function (one that produces a destination file) can be redone either with the same settings or with new ones. Once processing is done, it is not necessary to close your filter window to listen to the resulting file. If you don't like it, just click run filter again and it'll be done again.

Next, it's true we will normally end up with separate wave files when done. We recommend this as the way for folks to use the program. However, this does in no way mean you can't do disk at once. Just load our wave files into Nero and tell it to burn DAO. You can also, depending on the burning program, specify the amount of silence between tracks. In longer classical pieces that you want to split into files, just choose Zero seconds. There's no problem that we are aware of in producing CDs mastered any way you want using a good program like Nero.

Finally, spectral subtraction filters will produce artifacts at much more than 6dB. That's why it's not the default setting for DC Six. We call the Normal CNF normal because it's a much better approach allowing greater degrees of continuous noise reduction without as much artifacting.

By the way, this filter is flexible enough in its internal design to allow it to remove the last traces of crackle as well. The amount of noise reduction is displayed accurately we believe.

Jeff Klinedinst

Enhancedaudio.com Inc.

.....

Gary Galo is Audio Engineer at The Crane School of Music, SUNY Potsdam, where he also teaches courses in music literature. A contributor to AAC since 1982, he has authored over 230 articles and reviews on audio technology, music, and recordings. He has been the Sound Recording Reviews Editor of the *ARSC Journal* (Association for Recorded Sound Collections) since 1995, was co-chair of the ARSC Technical Committee from 1996 to 2004, and has given numerous presentations at ARSC conferences (www.arsc-audio.org). Mr. Galo is also a frequent book reviewer for Notes: *Quarterly Journal of the Music Library Association*, has written for the *Newsletter of the Wilhelm Furtwängler Society of America*, and is the author of the "Loudspeaker" entry in *The Encyclopedia of Recorded Sound in the United States*, 1st edition. **ax**