

## **Studer Editech Dyaxis:**

### **Introduction:**

There are quite a number of hard disk recording systems available today, and several of these are based around the Macintosh personal computer. The best known, and one of the lowest-priced systems, is probably Digidesign's Sound Tools reviewed elsewhere in this magazine. Sound Tools suffers from one or two disadvantages as far as professional studio work is concerned, and Dyaxis aims to provide the system of choice for such work, albeit at a higher price. This article aims to give prospective Dyaxis users a complete overview of the system, a comparison with the facilities available in Sound Tools, and a report on how well the system works in practice.

### **Background:**

Dyaxis was actually developed a number of years ago as one of the first Mac hard disk recording systems, by a company called Integrated Media Systems out in Silicon Valley, California. In 1989, Studer of Switzerland (well-known manufacturer of analogue tape machines - need I say!) bought the company, and formed Studer Editech Corporation, as the manufacturers of Dyaxis are now known. They kept most of the original staff, and in particular, the R & D section, obviously seeing this as a way into the new technology without starting from scratch themselves. This is clearly a significant step towards the future for Studer, and shows that they have recognised the importance of this new recording technology. Since this new alliance was announced, there has been news that Digidesign intend to collaborate with Studer's rival, Otari (another well-known manufacturer of analogue tape machines - lower in price than Studer's), to develop more professional studio hard disk recording systems. Steinberg, which has just launched yet another Macintosh-controlled system called Topaz, is similarly collaborating with Mitsubishi to produce a professional version of its product. Presumably the race is now on between these companies to provide the next generation of digital recording systems for the studio, and one might speculate that Studer will develop a more expensive 'state-of-the-art' system, with Otari developing a more affordable, yet perfectly functional system. And I am sure that Mitsubishi may have some surprises up their sleeves too! We'll just have to wait and see!

### **Features:**

The Dyaxis System offers 2-track digital hard disk recording, playback, and editing, internal multitracking, offline sound file assembly, and digital format and sampling frequency conversion. To quote the Dyaxis brochure, "You can play back up to 12 hours of digital audio, freely edit any of the material to the resolution of a single sample, and combine an unlimited number of high quality digital tracks into remixed soundfiles, with full control over levels and pans. On-line digital signal processing, including EQ, gain, pan, time-scaling, and sample-frequency conversion is provided, and all sound sources can be referenced to internal or external timecode, and slipped relative to one another."

The system actually consists of an Audio Processor Rack for A/D and D/A and digital format conversion and an Accelerator card, containing a Motorola

56000 DSP chip, which slots into a NuBus slot in the back of your Macintosh; MacMix software running on the Mac to control the system; and various optional configurations of rack-mounted hard disk drives to provide storage and recall of up to 6 hours of 16-bit stereo digital audio. Data may be accessed virtually instantaneously anywhere on the disks, and this feature is one of the major advantages of hard-disk based over tape based systems. No more time lost rewinding tapes on sessions or locking to picture!

Studer currently supply three different hard-disk configurations: 320 Megabyte, 640 Megabyte, and 1.2 Gigabyte. These cost £3600, £5200, and £7000 respectively. You do have to use a Studer hard disk system with Dyaxis, rather than a third party system, for two technical reasons: the average seek time of the hard disk has to be under 20 ms, and the SCSI hardware in the Dyaxis system has been specially adapted to accommodate faster than normal data transfer via the SCSI bus. In other words, there are two 'bottlenecks' at work here, the mechanical seek time, and the data transfer rate via SCSI. The Dyaxis hard disks aim to optimize these. It is worth noting that Bauch will immediately swap your hard disk from special stocks in the event that it breaks down. This is a better level of service than that offered by a number of other suppliers of hard disks in the UK, because many of these products are made in the USA, and need to be sent there for repair or replacement.

The Dyaxis designers were originally involved in the prestigious LucasFilm Sound-Droid digital audio workstation project, which never actually saw the light of day, unfortunately. In particular, they worked on the design of the A/D and D/A convertors. They have built on this expertise to design Dyaxis, which has four times oversampling on the analogue inputs, and uses a very high-quality proprietary 20 kHz analogue filter on the output side. Dyaxis also has a variable tracking filter that comes into play when using the scrub-editing feature. This filter will follow the playback sample frequency to provide the highest sound quality at any sample rate. If you use sample rates lower than 44.1 kHz, there is an option to 'Use Best Filter' which selects a fixed filter to suit whichever sample rate you have set, when you are sampling via the analogue inputs.

There is also a handy 'Digital I/O' function available via a software command that allows you to transfer any digital format to any other, in realtime, straight through the system without putting audio onto the hard disk. This should be of interest to many professional users who for instance, may want to transfer from Sony 1630 to DAT or vice versa.

### **Backup:**

Studer Editech offer a 'Computer DAT' backup system specially for use with the Dyaxis system. This unit is not a normal DAT machine, it is only intended to be used to back up computer data. It is a 19" rackmount unit, styled to match the rest of the Dyaxis racks, and costs £3,800. It allows you to do a complete backup of your soundfiles, including your edit information, and edit decision lists. The control software is similar to Apple's Font/DA Mover utility, and allows you to copy folders containing your work onto a DAT tape. This is a real-time system, so the time taken to backup is about the same as the amount of time represented by the recordings you are backing up. The

process can be automated, such that you could instruct the Computer DAT to re-load the appropriate soundfiles at, say, 8.30AM the following morning, ready to start your next session at 9.30AM. The standard DAT tapes hold 1200 megabytes (1.2 Gigabytes) of data, which gives you up to 2 hours stereo recording time.

As an alternative, you could record the audio out onto a normal DAT recorder or other digital tape recorder with a centre-track timecode. You could even put the audio onto an analogue tape if you were not too concerned at the slight quality loss during the transfers. You would still need to save your edit decision lists onto floppy disk if you needed backups of these. However, you make edits to sample accuracy in Dyaxis, and if you backup the audio to tape with timecode, you will only retain frame-accurate edit points, not sample-accurate, because the resolution of tape transports can only be frame-accurate using SMPTE synchronisation.

This means that the Computer DAT system is a much better option, which behaves rather like a slow hard disk as far as Dyaxis is concerned. It keeps all your work conveniently in one place, and retains the original sample-accurate edit points, which should lead to more productivity and save you money in the long run!

### **Digital Formats:**

Audio sampling to 16-bit resolution can be set to 32 kHz, 44.056 kHz, 44.1 kHz, or 48 kHz rates, or to any one of 100 other user-selectable frequencies. Besides balanced analogue XLR audio inputs/outputs at nominal levels from -10 to +8 dBm, Dyaxis also features all the most common digital input/output formats. These include AES/EBU format, using a 9-pin 'D'-connector rather than standard XLRs; Yamaha Stereo which can be used to connect to the Yamaha DMP7D digital mixer via this 9-pin D-connector; SDIF-2 to interface to Sony 1600 series PCM machines via a 15-pin D-connector; and the Sony/Philips S/P DIF interface via RCA phono connector, which is used on DAT and CD players. Various of these connectors may also be used for Sony PCM-601 format, Studer DASH, and Mitsubishi Pro-Digi in/outs.

So Dyaxis can connect directly to the majority of digital reel-to-reel and PCM/video recorders, signal processors, and other digital devices; to any Yamaha digital console or signal processor; and to the DUB "C" ports of PD-Format machines. As a result, Dyaxis is an ideal tool for editing DAT or other digitally formatted mastertapes, where, previously, more expensive studio editing equipment would have been needed. The timecode references available for every soundfile can actually be used to prepare PQ Subcode lists of start/stop time durations for Compact Disc mastering, which allows you to save time (and thus money) if you do this before taking your recordings into an expensive CD-Mastering suite.

### **Uses:**

Studer quote worldwide sales of over 300 Dyaxis systems and suggest that Dyaxis may be put to work in a variety of different situations: For music production, you can edit master mixes, or slip mono/stereo tracks against timecode. For broadcast production you can record and edit dialogue, music

libraries, news stories, and other items for instant-access replay either on-air, or within an off-line production studio. For video post production you can use Dyaxis for sound effects, track slipping, music editing, and accurate lock to picture. For radio Commercials, you can use it to produce :15, :30, :45, and :60 second versions of a basic ad with different tags and IDs. For TV commercials you can produce various length versions of audio soundtracks, with full interlock to film or video.

Dyaxis does provide good facilities for Automatic Dialogue Replacement (ADR) during film and video post-production and re-recording. You can simply mark dialogue visually, or you can use the scrub-edit feature to select sections to cut and paste. It is very easy to assemble different versions of your edits and then A/B the results. These tracks can then be slipped in time to sample accuracy. The big advantage here is the improvement in quality over the 35mm mag tape that has been the standard in film work for many years.

For use in video editing, the Dyaxis 'Virtual Machine Interface' lets you slave the Mac-based system to an external video editor or controller, via a series of custom interfaces and software upgrades. This allows audio-follow-video from an external editing system or from an Abekas A60-Series digital videodisc recorder. In fact, Dyaxis can communicate with any VCRs or VTRs which use the industry-standard Ampex VPR3 interface protocol for full digital audio lock to picture.

Talking about lock-to-picture, the Dyaxis MIDI Timecode Interface includes a SMPTE/EBU timecode reader, a SMPTE/EBU to MIDI Timecode converter, and a MIDI to Macintosh serial port converter. The more sophisticated 'Dyaxis System Synchronizer' adds a VITC/LTC reader/generator, enabling the entire digital system to lock to vertical-interval timecode from videotape, film tach, or external sync clocks (and it also provides enhanced MIDI capabilities).

Dyaxis actually includes several features that make it ideal for producing digital audio soundtracks for film or video. If you are mastering to D1 or D2 digital video formats, or if you plan to shoot Dolby Stereo L-R from a digital on-location master, Dyaxis can deliver first-generation edited soundtracks in the appropriate format. Even after multiple generations, passes, or layers, there is no audible degradation in the sound quality. Also, your video edit information, from imported edit decision lists (EDLs), timecode numbers, or feet/frames, can be used to configure digital audio to picture. Production dialogue from DAT or PCM recorders can easily be transferred into Dyaxis via the digital inputs. You can record ADR, Foley, and sound effects tracks directly into the system for editing to picture and other audio cues. Or you could call up pre-recorded effects tracks stored on hard disk, edit them to length, and then align them to timecode stop/start times using the paste-to-timecode function. Another useful feature is the keyboard 'macro' function which lets you streamline the dialogue-editing process.

Dyaxis can also be very useful for radio and TV stations, especially when there is a need to edit commercials to produce :15, :30, or other short lengths with different intros, voice-overs, and tags. The timings of these can easily be adjusted, say to fit a 34 second spot into a 30 second slot, without any

accompanying pitch-shift. Using a Dyaxis system, a library of jingles and station IDs (and of any other music) could be built up in digital 16-bit format to provide very high quality source material for broadcast. Again, because material originated from Compact Disc, DAT, PCM, or other digital sources can be copied directly into this system in the digital domain, you avoid the generation losses that occur with analogue systems.

### **MacMix software Features:**

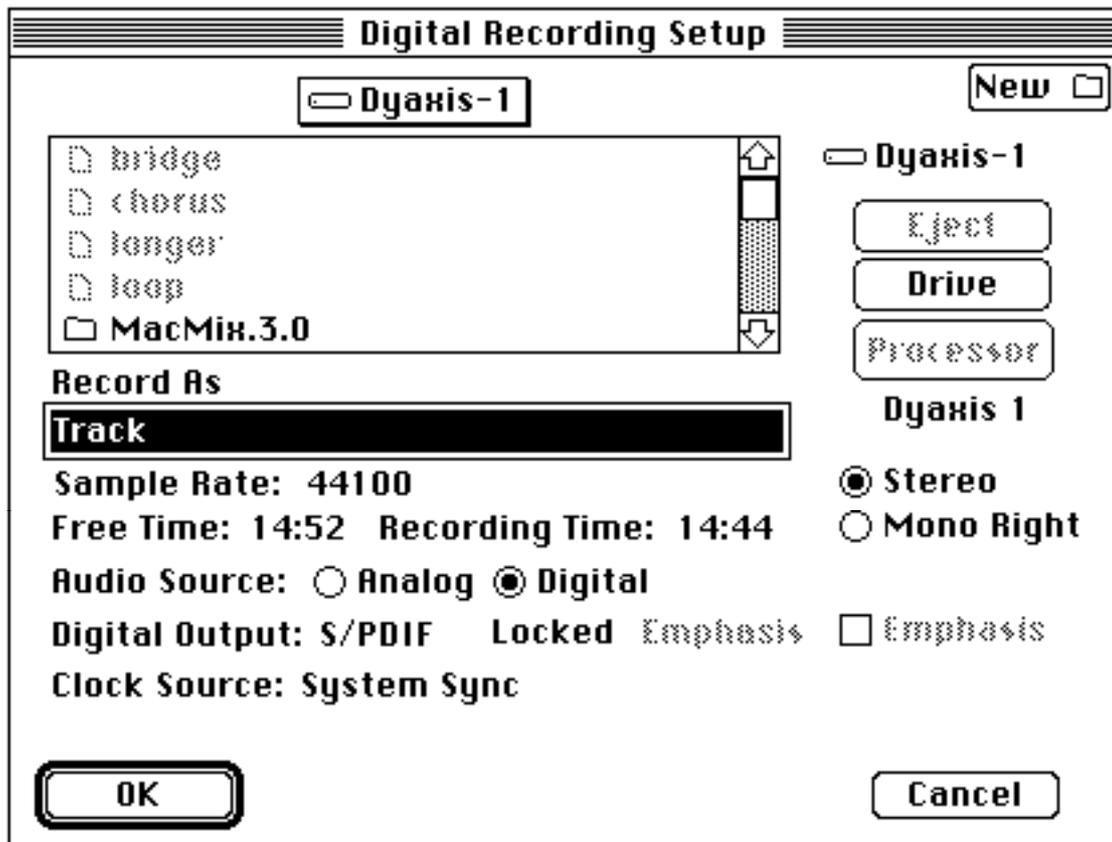
Using the MacMix software, soundfiles can be easily edited using cut and paste techniques, just like editing text in a wordprocessor. All the edits are non-destructive, so you can always recover the original, unedited soundfiles. The software conforms quite well to the standard Apple Macintosh User Interface Guidelines, and if you have used any Mac software previously (whether that be Performer MIDI sequencer or MacWrite word processor or whatever), you will find the software very easy to use. Even for beginners, the learning curve is relatively shallow.

The first thing you need is some material to work with, so let's take a look at how the sound files are organised using MacMix: Firstly, you work with a 'Soundfile', into which you record your audio material. [You can, of course, use existing material on the hard disk, such as a library of sound effects.] These soundfiles are always kept intact on the hard disk, unless you specifically delete them, but you have to view and edit them via a different type of file, called a 'View File'. You can enter instructions into a View File to play back just selected sections of this soundfile, skipping over or leaving out whatever you don't want to use. If you want to actually look at the waveform on the Macintosh screen, then the software needs to calculate the waveform first. If you zoom in to less than 3 seconds, the waveform will be displayed automatically, but if more than this needs to be displayed, you have to invoke a menu command to make a permanent waveform display. This organisation of files, while simple enough to grasp, does seem to present an extra level of complexity when compared with Sound Tools' one soundfile window.

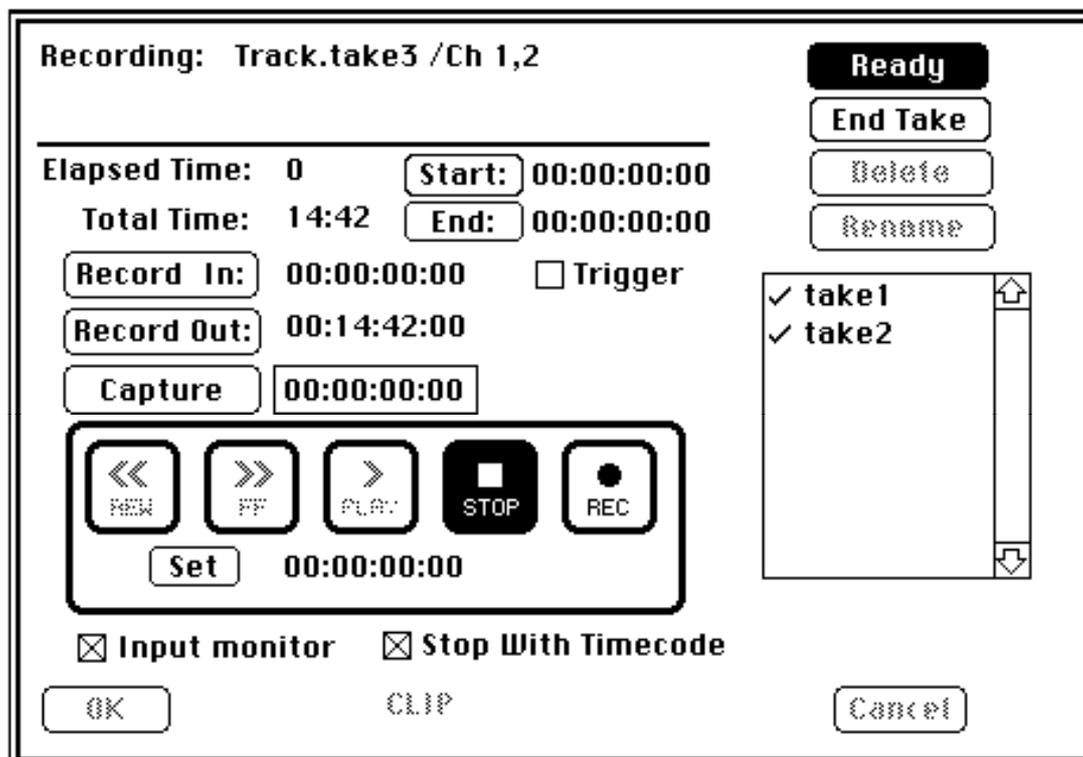
On the other hand, one neat feature of the Dyaxis soundfiles and viewfiles is that you can actually play them without opening them. You just select a file by highlighting it in the Open File dialog box, and then you click and hold down the mouse on a Play button in this dialog box. This could be very handy if you have forgotten what is in a particular file and you want to quickly check it before going to the trouble of opening it.

### **Recording:**

You select Record from the File Menu, and up comes a dialog box that allows you to enter a name and a sample rate (which defaults to 44.1kHz), and to select a stereo or mono file. You can also enable or disable Emphasis (level-independent noise reduction) for your analogue recordings.

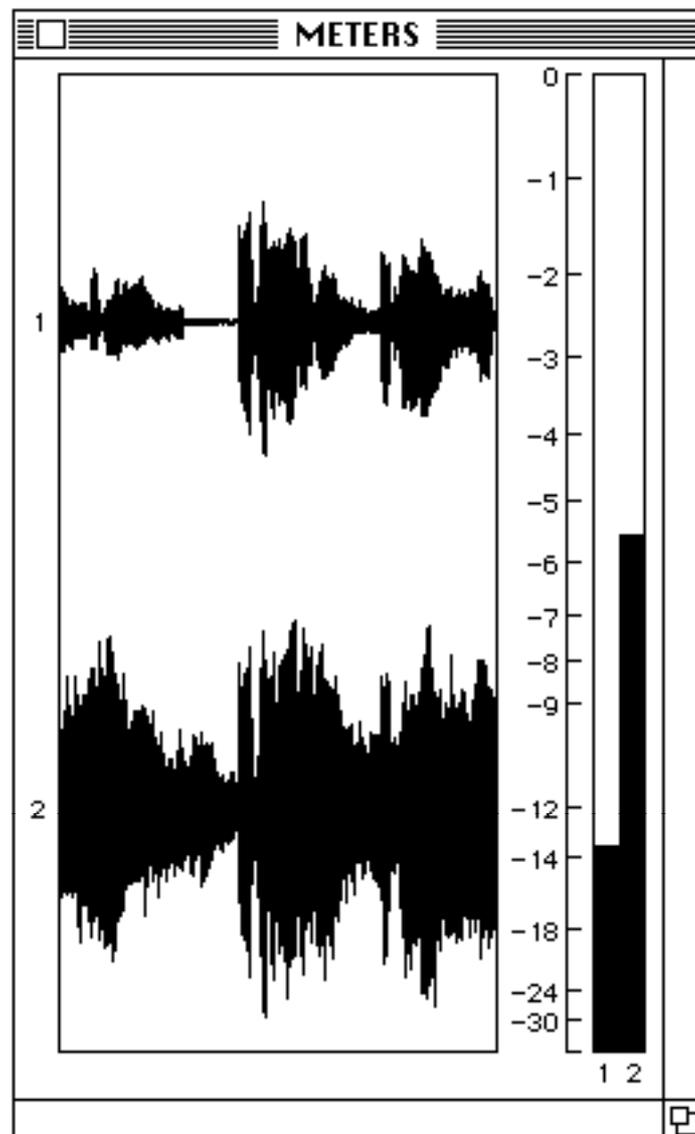


Once these options are set, you hit the OK button, and up comes a different dialog box, which has the usual tape-transport style controls.



Once you have set your input levels, you have to select Record in the Recording dialogue box to start your recording. You can cancel a recording, which will delete the partially recorded file, and then start over again at any time. Canceling returns you to the Recording Setup dialog box, with the options you chose originally still selected. I find this to be somewhat clumsier than having just one dialog box that allows all these functions, as in Sound Tools, but the system does work OK when you are used to it.

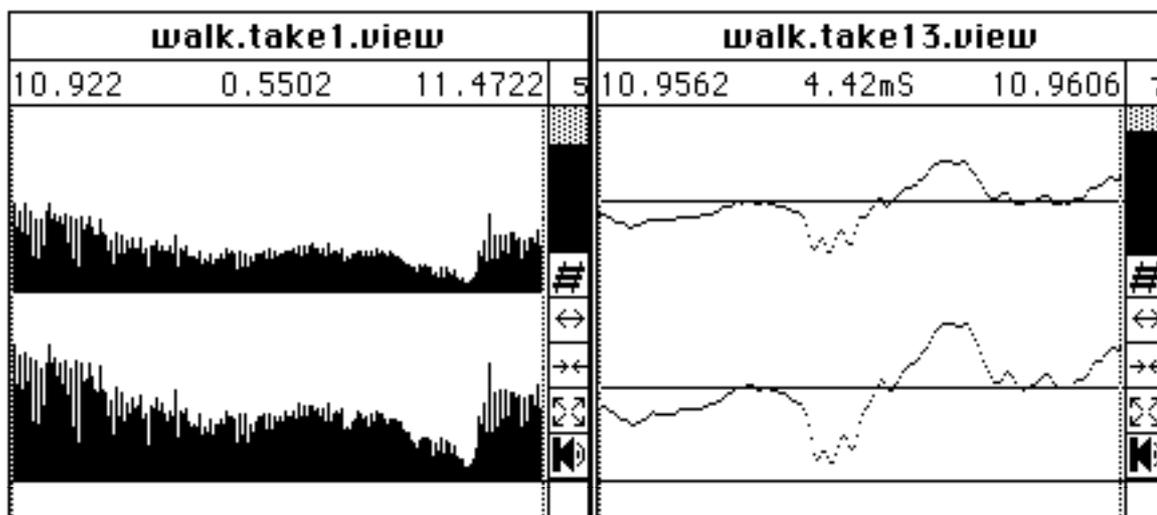
The Dyaxis processor is automatically switched to monitor the input when you are using the record dialogue boxes. To help you set levels, there is a meters window that has PPM-type metering, and also shows a realtime scrolling display of the waveform being recorded or played back.



When the recording is finished, a view window is created automatically called '(whatever).view'.

**View Files:**

The window on the left contains a waveform display showing the envelope, and the one on the right shows a different file zoomed in to less than three seconds to show the waveform in much finer detail:



### Editing:

Once you have your view file, you can edit it without actually looking at the waveform if you like, moving a cursor along the file and selecting edit points by ear. When you are close to an edit point, you can then zoom in to examine the actual waveform more closely. When the view displays less than 3 seconds of the recording, the software automatically displays the waveform so that you can see it to edit it. If you want a waveform to be visible in any viewfile window size, you use a command to 'Make Permanent Display'. This is a realtime process while the software writes the waveform envelope file. When this is done, a waveform will always be drawn in any size of the view window.

You can place edit markers in the view window 'on the fly', by just clicking on the mouse as the file is playing back. [At the time of this review, this is not possible using Sound Tools on the Mac, although it is possible on the Atari version, and will be added to the Mac version soon.] You can use keyboard commands to move two cursors, one to mark the left point and one to mark the right point of any section you wish to edit. Once you have marked approximate edit points you can then zoom in and identify the exact locations visually. Alternatively, you can use the 'Scrub feature', where you use the mouse to move the soundfile playback up to and away from the edit points manually, in a similar way to rocking the reels of a tape recorder to identify edit points. Dyaxis scores highly here, because this function actually works very well in practice, unlike the similar feature in Sound Tools that does not really work anywhere near as well.

If you like, you can use the 'Capture selection length' command to define a 4 bar section, or whatever, if you are doing a dance mix for instance. This loads the distance between the cursors into the Mac's memory, and you can then select 4 bar sections by just choosing the in or out point. When you have your edit points marked, you can quickly check them using the 'Loop' command in

the Play menu. This simply repeats the selected section over and over, so you can easily hear any glitches.

### **Mixing/Mix Files:**

Once you have one or more View Files prepared, you will need to open a Mix File to arrange to play your View Files in sequence in relation to SMPTE time, and here you can also specify stereo pan positions, track muting, volume level changes and crossfades between tracks. Also, individual files can be 'slipped' against each other freely in time, or locked to specific timecode start times.

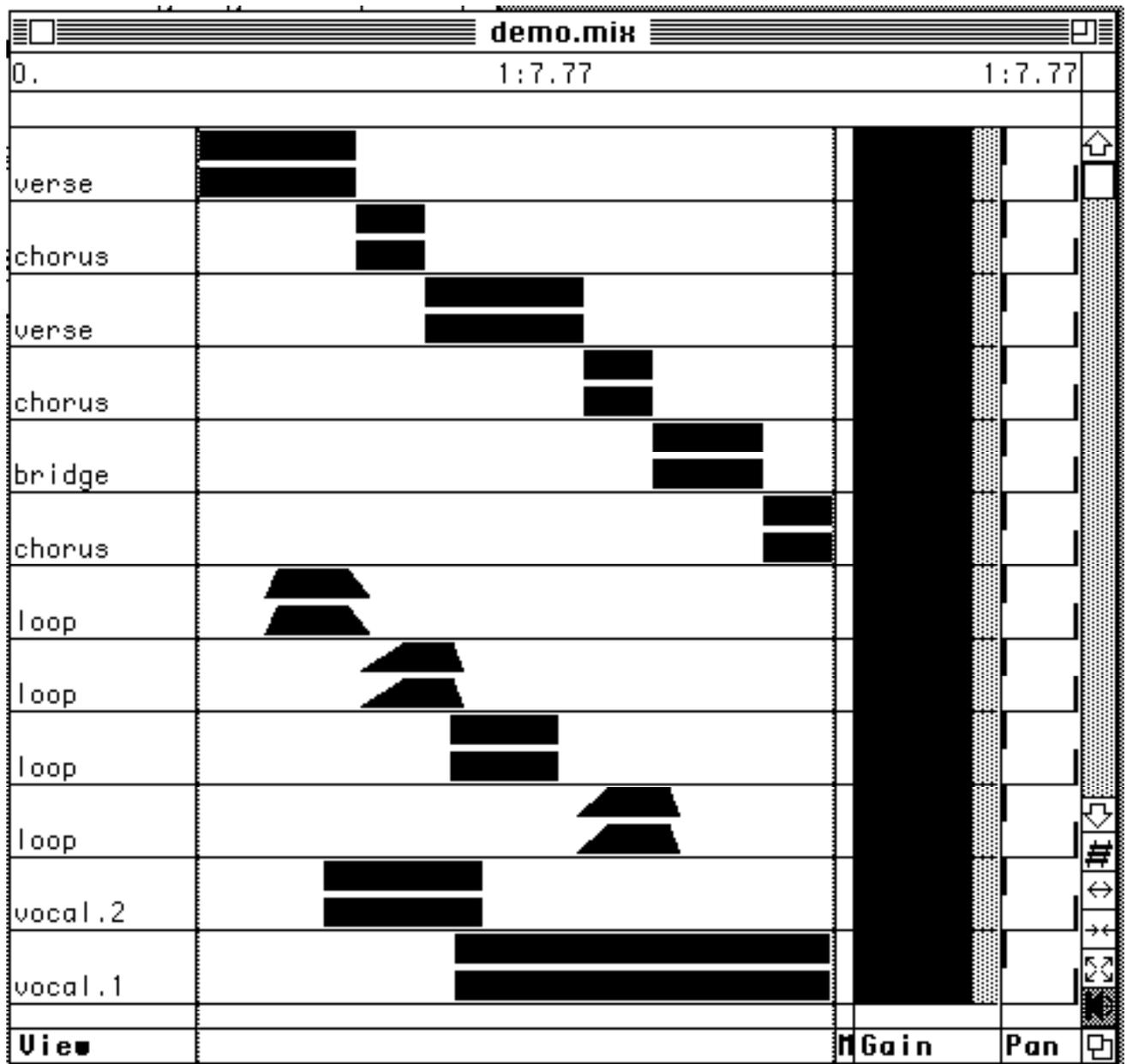
If you have just defined a section from your view file, you select 'Copy To Mix' from the edit window, and up comes a 'name this view' dialogue box. Here you name your first section something such as 'Part 1', and click on the 'paste to left cursor' button. Now, finally, up pops a Mix file window with 'Part 1.view' installed as its first element. If you need to edit any of the elements further, you can just click on its name in the Mix window. This will open up the view file with the waveform, and any edits you make here will be reflected in any other section of your mix that uses this element. To playback your mix while you are working on it, you will probably choose 'Fast Mix' from the options menu - rather than create a new soundfile of the mix at this point. This option treats the Mix window as an edit decision list.

Your next step might be to return to the original soundfile, define another area in the edit window, and then copy this to your Mix. This time you could choose to 'Abut' this second section to start to play from the end of the first section. Alternatively, you could layer this, and other new sections, on top of the first. Once you have several sections in the Mix window it is easy to re-arrange, duplicate, or crossfade sections.

Dyaxis will even let you create edit lists using sections from different recordings, either on the same hard disk or on a different one. This is not as easy using Sound Tools: you could always paste in additional data from another SDII file, but no region definitions would be transferred this way, so these would have to be redefined before entering into the playlist. Digidesign can provide an additional utility program called Master List that does let you import playlists from various files into the current playlist, but this again is less convenient. Also, Dyaxis lets you do crossfades directly from hard disk without using the Mac's RAM, whereas Sound Tools does need to use available RAM. So there is no limit to the length of crossfades in Dyaxis, whereas lack of available RAM may limit these in Sound Tools. On the other hand, the crossfades may be executed more quickly in Sound Tools via RAM. So both systems have their strengths and weaknesses.

### **Mix Window:**

In this example you can see the verse, bridge, and chorus sections of a song abutted to form a typical song-arrangement running order. Two separate vocal takes have been used, and you can see that they actually overlap for a while. There are four 'loop' sections overlaid in suitable places, and some of these crossfade in and out, or overlap, as required:



Once you have finished editing, you can either save your Mix file containing the edit decision list, or you could then create a Mix Output File, which is a brand new soundfile containing the actual audio data which represents your mix. This process takes an amount of time that depends on the length of the original data, and, when complete, the mix is played back one time automatically, for you to check it. Obviously, you need sufficient available hard disk space before you can do this, if you want to keep all your original un-edited material, although you may be happy to delete all the original material once you have your new mix file.

At this point, you could open a View File on this output file, and start the whole process all over again - perhaps to re-edit your mix at some point in the future. However, if you anticipate the need to re-mix, it would probably be better to just keep the original soundfiles with the Mix window EDL.

#### **Multi-channel operation:**

Using the Mix functions, unlimited 'multi-tracking' can effectively be achieved internally, although only two channels can be recorded at once, and only two output channels are provided. The Dyaxis 2 + 2 system has been developed to provide four-channel operation where this is required.

This is achieved in practice by linking two processor racks with their associated hard disk drives to provide simultaneous playback and/or overdubbing on all four channels. This Dyaxis '2 + 2' system locks together the word clocks of both processors and allows instant access to all the hard disk drives, while providing four separate inputs and four separate outputs.

### **Time Compression/Expansion:**

The algorithm used here was developed especially for Dyaxis by Blank software, and is actually claimed by Studer to be better than the Alchemy algorithm. It works fine with music up to 10% and with speech up to about 40%. I tried speeding up a file containing speech by 40%, and the results were first-rate. [As it happens, speeding up always sounds better than slowing down, because you are taking out little bits rather than adding in synthesized elements.]

You may specify the amount of time compression/expansion in any of several ways, as you can see from the dialogue box, choosing whichever way is best for your purpose:

<b>Time Scale</b>		<b>OK</b>
<b>Original File:</b>	walk.take1	<b>Cancel</b>
<b>Process File:</b>	longer	<b>Calculate</b>
<b>Time Scale Factor:</b>	<input type="text" value="1.2500"/>	
<b>Subtract:</b>	<input type="text"/>	<b>seconds</b>
<b>Add:</b>	<input type="text" value="01.85"/>	<b>seconds</b>
<b>End Point:</b>	<input type="text" value="00:00:07.42"/> <input type="text" value="00:00:09.27"/>	<b>seconds</b>
<b>Duration :</b>	<input type="text" value="00:00:07.42"/> <input type="text" value="00:00:09.27"/>	<b>seconds</b>
<b>©1989 Blank Software Ltd.</b>		

### **Use with other Macintosh Software:**

Dyaxis files can be opened by one other Macintosh digital sound-editing program, Passport's Alchemy, and Alchemy files can be transferred to Digidesign's Sound Designer II. Alchemy offers sample editing, analysis, and resynthesis, and places Dyaxis at the centre of a 'Distributed Audio Network' of samplers, with data conversion between Dyaxis and any member of the

network. You can save Alchemy files in Dyaxis format, so you could also transfer Sound Designer files to Dyaxis by saving first in a format which can be opened by Alchemy, then saving this in Dyaxis format.

Sound Designer has additional editing and digital signal processing functions, not available in Dyaxis. At the time of writing these include: Parametric and Graphic Digital EQ, FFT Analysis, Sample Rate Conversion, and transfer of audio to and from most popular samplers, such as the Akai S1000. However, Dyaxis will include Parametric and graphic EQ in the next upgrade, which will probably be available by the time you read this article!

Dyaxis may also be used in conjunction with Digidesign's Q-Sheet program which offers CMX-format edit decision lists, cue list and track-sheet printing, enhanced creation, capture, and editing of cue list events (MIDI and Dyaxis files), and so forth.

A Hypercard program called SoundBase is also available to provide an alternative front-end for Dyaxis and MacMix. SoundBase provides sophisticated sorting, cataloguing, recording, and database interaction with Dyaxis sound files.

### **Conclusions:**

The sound quality of Dyaxis is first-rate, and you can record from analogue sources at 48kHz, as opposed to 44.1kHz maximum from Sound Tools A/D In unit. Sound Tools' user interface is a little simpler and easier to use than Dyaxis', but there is not much in this once you are used to both systems. Dyaxis' input/output formats are fully comprehensive and professional connectors are used for these. Sound Tools has only S/P DIF and AES/EBU digital formats and uses semi-pro connectors for analogue input/output. The A/D filters in Dyaxis are currently higher in quality than those in Sound Designer, although Digidesign are about to launch a professional audio interface with high-quality A/D conversion for about £2500. [On input this Pro I/O will have 1-bit delta sigma modulation with 64 x oversampling, and on output it will have 18-bit D/A with 8 x oversampling and Apogee 964 anti-aliasing filters, balanced ins/outs, digital monitoring, and a BNC connector for Video Sync input.]

A four-channel Dyaxis system is available **now**, and this capability is not available on any other Macintosh system as yet. The file structure of Dyaxis is more complex than that of Sound Tools, and to carry out more sophisticated signal processing, or to interface with the many popular samplers currently in use in studios, you may wish to use other software/hardware, such as Alchemy or Sound Tools. It is a pity that Dyaxis does not let you save soundfiles in other formats, such as IFF, Sound Designer II, or whatever, as direct compatibility is a very desirable feature in any recording system. On the other hand, Dyaxis allows internal multitracking, whereas Sound Tools only offers a rudimentary mix feature with up to four files.

The Dyaxis system comes with hard disks optimised to work well with the system. If you buy Sound Tools, you have to choose your own hard disk systems from third-party suppliers. Also, a professional DAT backup system

may be purchased with Dyaxis, whereas you have to choose your own backup system for Sound Tools from a third-party supplier.

When you buy a Dyaxis system from the UK distributors, Bauch, you get the respected professional backup and service that Studer customers in the UK have come to value highly from a company who have been involved in Pro audio for many years. This contrasts with the much lower level of backup and service - which you could expect from distributors and retailers of other cheaper hard disk recording system sold via music instrument retailers. All these factors add up to making the Dyaxis system more suitable for professional use. As they say, 'you pay your money, and you make your choice'.

The 'bottom line': Sound Tools works well for straightforward mastering and remixing, has a very clear, simple user interface, and is ideal when creating 'dance mixes'. Dyaxis is designed for fully professional use, and allows you to create much more complex mixes with multiple overlapping sound cues. As a result, it is much more suitable when putting together sound effects tracks, and dialogue, effects, and music mixes when working to picture. Dyaxis is a much more professional system, and this is reflected in the price you have to pay.

### **Specifications:      Analogue Audio**

Input/Output Channels:	Balanced XLR
Maximum Input Level:	+ 24 dBm
Maximum Output Level:	+ 24 dBm (into 600W)
Frequency Response:	20 Hz - 20 kHz
Input Impedance:	50 kW $\pm$ 5%, 20 Hz - 20 kHz
Output Impedance:	50 W $\pm$ 5%, 20 Hz - 20 kHz

### **Digital Audio**

Sampling Frequency:	32 kHz, 44.056 kHz, 44.1 kHz, 48 kHz and 100 other user-selectable frequencies.
A to D Conversion:	16-bit, using discrete linear-phased optimized anti-aliasing filters.
Frequency Response:	5 Hz - 20 kHz $\pm$ 0.5 dB
Dynamic Range:	>90 dB noise floor to maximum output level
THD/Noise:	<0.02%
Intermodulation Distortion:	<0.02%
Phase Error:	Within 5 $\infty$
Squarewave reproduction:	Symmetry within 1%
Emphasis:	EIAJ, 50 - 15 mS

### **Time Code:**

Available types include: 24 frame non-drop, 25 frame non-drop, 30 frame non-drop, 30 frame drop, 30 frame colour.

**Mike Collins © July 1990**