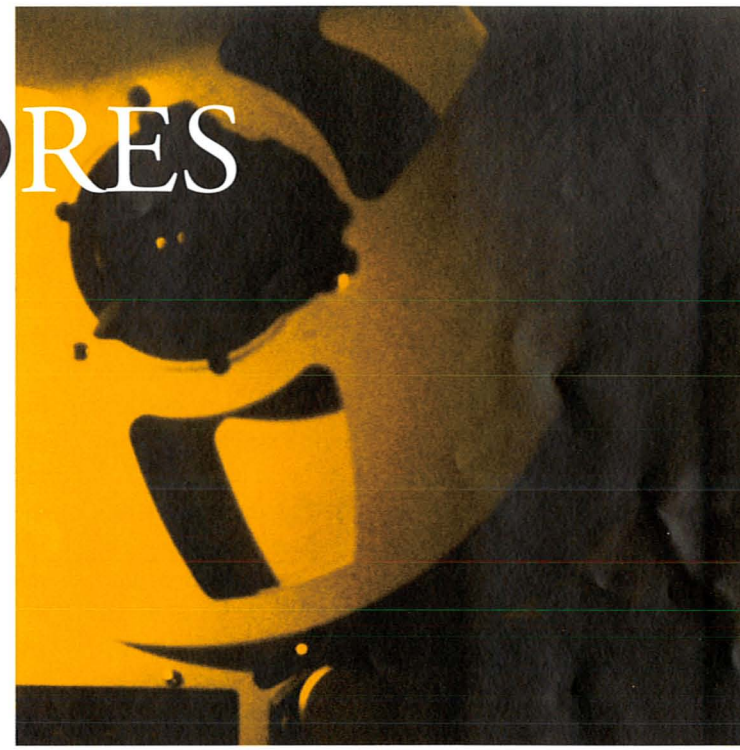
SOUND SCORES



by

RICHARD K. THOMAS

INTRODUCTION • ONCE AN AGREEMENT HAS BEEN REACHED ON A SPECIFIC STYLE FOR THE SOUND SCORE AND THE SOUND CUES HAVE BEEN "SPOTTED" INTO THE SHOW, WORK CAN BEGIN ON THE CREATION OF THE ACTUAL SOUND SCORE. SINCE A GREAT DEAL OF DATA OF DIFFERENT TYPES WILL BE GENERATED, A SYSTEM IS NEEDED TO ORGANIZE THE COMPUTER FILES ON THE HARD DRIVE.

This article discusses the use of computers to create sound scores for theatrical productions. It starts by addressing the overall set up of the hard drives on which the sound score will be stored. It then examines the types of files that are typically stored on hard drives in the creation of computer scores, most notably, audio sequences, and audio sample files. Audio sequences are further broken down into techniques involved in working with the tracks that make up the sequences, and, finally with the data that makes up the individual tracks. Although many examples are given along the way, they are by no means exhaustive. They are, rather, an attempt to demonstrate the type of organization and usage that a sound score designer might make of computers in the preparation of the theatre sound score.

HARD DRIVE CONSIDERATIONS

• CHOOSING THE RIGHT HARD DRIVES

The first problem that needs to be addressed is the size and type of storage required for a typical theatre sound score. One system that has worked extremely well is to have a smaller (e.g., approximately 100 MB and usually housed inside the computer) hard drive on which all show data is stored except actual sounds. Actual sounds (which use up a lot of hard drive space) are then stored on a much larger hard drive (e.g., 600 MB to 2 gigabyte).

There are a couple of reasons for setting up the hard drives in this manner, besides the typical space requirements of both. First, since many of the typical files such as correspondences, sequences, cue sheets, and technical drawings are usually fairly small, they have a tendency to fragment the hard drive. This is usually not a problem for the programs that run such files, but can cause playback glitches when the same files fragment a hard drive that is being used for hard disk playback. The second reason has to do with developing a reliable system for backing up all work.

Anyone who has ever worked with a computer knows the importance of backing up anything stored on a hard drive. There are several methods commonly in use in the computer industry to back up hard drives, but the creation of theatre sound scores has its own special requirements due to the large amount of space used for sound samples. Keeping all of the smaller files together on the smaller hard drive allows the sound score designer to back up these extremely important files on a regular basis. The much larger sound sample files on the larger hard drive are typically backed up less often (e.g., only when the samples are changed, and only the changed files).

Another common difference between the techniques used to back up the two different types of files is the medium used for backup. Smaller files can be typically backed up on removable media, while larger files are more economically backed up on digital audio tape.

A good procedure for backing up the smaller hard drive is to get two sets of removable hard drive cartridges. The first set is stored in the studio, the second set is stored in a sturdy safe. The hard drive is backed up to the first set and then stored in the safe. The next time the hard drive is backed up, the second set is used, stored in the safe, and the first set is brought into the studio, ready for the next back up. In this way there are always three sets of computer data: the current data on the smaller internal hard drive of the computer, the most recent backup which is safely stored in the safe, and the oldest backup which is stored in the studio, ready for the next backup. Another backup cartridge can also be used for the "dead storage" of old shows.

The technique for backing up sound samples to digital audio tape will vary with the software, but one caveat is in order. Since the backup is relatively inexpensive (one digital audio tape can easily back up a one gigabyte drive), it is a good practice to back up all samples twice, preferably on different tapes. If theses samples are extremely valuable, the most recent tape should again be stored in a safe. Separate backup tapes should be kept for the computer's sound library and for the current show. This may seem redundant, and it is. However, it seems like there is never enough redundancy in backing up sound files.

Keeping the large hard drive from getting too fragmented usually means that periodically, such as at the start of work on a new show, the hard drive is backed up and then reformatted. If the hard drive is only being used to store sound samples for the current show, once the show is finished, the samples can be put into storage, and the disk reformatted.

One final note on storing samples on large hard drives, and hard disk fragmentation: Since fragmentation really becomes a problem only when attempting to play back sound files in real time, it may be advisable to buy, say, two one-gigabyte drives rather than one two-gigabyte drive. This would allow samples and a sample library to be stored on one hard drive (that would not require reformatting, due to the way samples are loaded into the random access memory of the sampler), and samples that are to be specifically played back from a hard drive to be stored on another. This second hard drive could then be reformatted on a regular basis, without disturbing the sample library.

• ORGANIZING THE HARD DRIVES

Start by creating an empty folder on the smaller hard drive which is subsequently titled with the name of the show. Inside this folder, create four more folders for each of the following: Cue Sheets, Sequences, Correspondences, and Technical Drawings.

On the sampler hard drive, create folders for the sampler data and the raw samples themselves. Note that not all samplers allow you to store the instrument data separately from the raw samples—these samplers should be avoided due to

the tremendous amount of space the raw samples take up. If the sound score designer wants to use the same sample in two different cues with only a slight variation (e.g., the way the sample is panned) that does not affect the sample (a very typical case in a lot of theatre sound scores), the entire sample must be resaved. Given that the trend in samplers appropriate for theatre use is toward larger and larger amounts of RAM (e.g., 32–64 megabytes), a theme that is used throughout the show could wind up using hundreds of megabytes in redundant storage.

All new samples for a show should be stored in the same folder for ease in backing up these files. When the show is finished, a determination can be made about whether these samples will be used in another show (typical for sound effects) or retired permanently (typical for music selections). If a sample is used from the sample library in a show, it is, of course, presumed to be already backed up. However, if the raw sample is modified, a copy should be put into the show sample folder to make sure that it is backed up with the show data.

USEFUL SEQUENCER TECHNIQUES

• PREPARING THE SEQUENCES

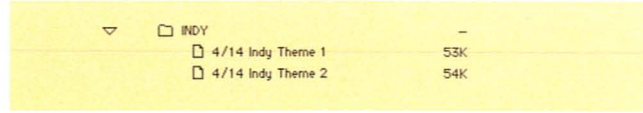
The next step in the preparation of the sound score is the creation of sequences used in the show.

The development of powerful computer sequencing capabilities has created an environment for the sound score designer that allows for complete control over the entire score, including analog recordings, on the sequencer. Since the sequencer will be the heart of the system, it is imperative that the sequencer is selected carefully. There are several excellent sequencers available that will, in one way or another, accomplish the tasks described in the following section. Remember when purchasing a computer sequencer that it is the single most important control software in the sound score designer's toolkit. You will be endlessly adding new synthesizers, samplers, and controllers. You will not want to ever have to go through the trauma of learning a whole new sequencer, so choose carefully and stick to a professional quality sequencer.

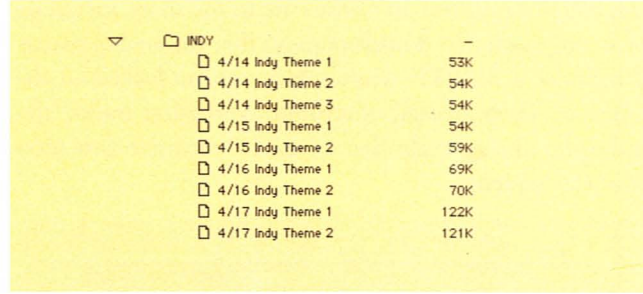
The first decision that needs to be made is whether to create a separate file for every cue, or to store all cues as separate sequences in the same file. The primary problem that can occur when storing all of the sequences in one file is a computer that runs the sequences too slowly. This has become much less of a problem due to the advent of faster computers. Therefore, the latter method has proven to be much more advantageous, and will be used throughout this discussion.

Once again, the first important decision needed to be made is how to save the sequence. If your entire show is being held hostage in a single sequence, Murphy's Law would suggest that the file will become irreparably damaged. It is important to devise a method of saving sequences that always allows you to get back to the version you were working on before the disaster occurred.

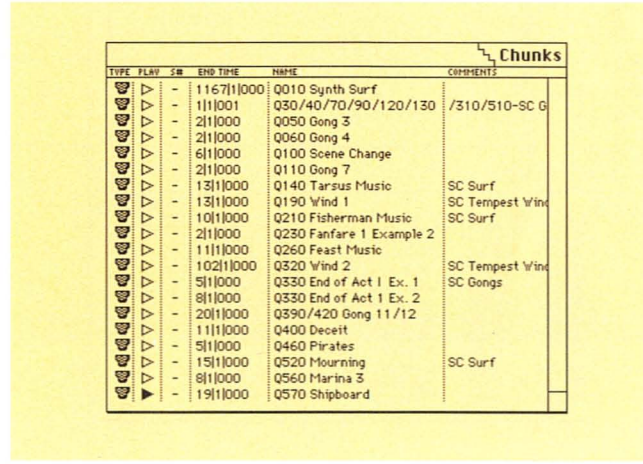
The question that must always be asked when considering how often to save and how often to back up is, "How much of this work am I willing to do again?" The answer is almost always, "Not very much." A good rule of thumb is to save the current sequence about once every 15 minutes. If you are extremely concerned about a damaged file, save your work alternately with different titles:



Also, since all of your work will be kept in one file, it is a good idea to start each work day by opening the previous day's file and saving that file with the new date attached. In this way if the file ever becomes damaged you will have access to old versions of the same file:



You will create a separate sequence for every cue in the show:

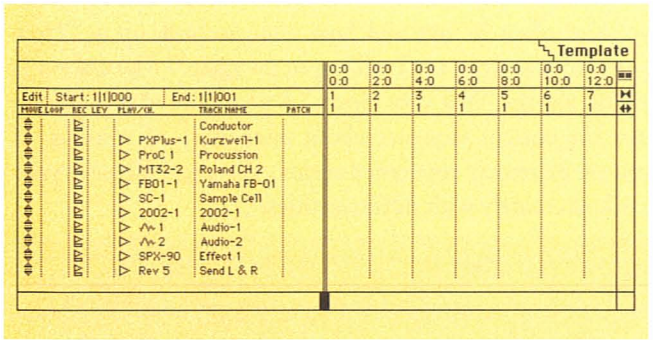


Note in the above example the sequences that house multiple variations of the same cue (e.g., Q30/40/70/90, etc.). This is a useful way of creating variations on a theme simply by adding an additional track, or making tempo changes, etc. Also note that the name of the sampler bank that must also be loaded is listed in the Comments column.

• PREPARING SEQUENCER TRACKS

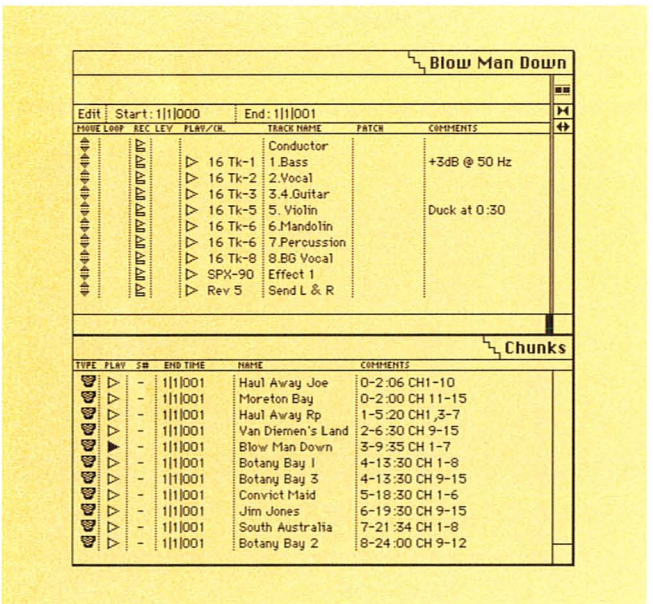
Setting up templates: It is assumed that you will set up a custom template that is appropriate for your studio. This

template should be set up in such a way that it allows you to quickly get to work! One way to do that is to create a separate track for each of your sound devices in the template:

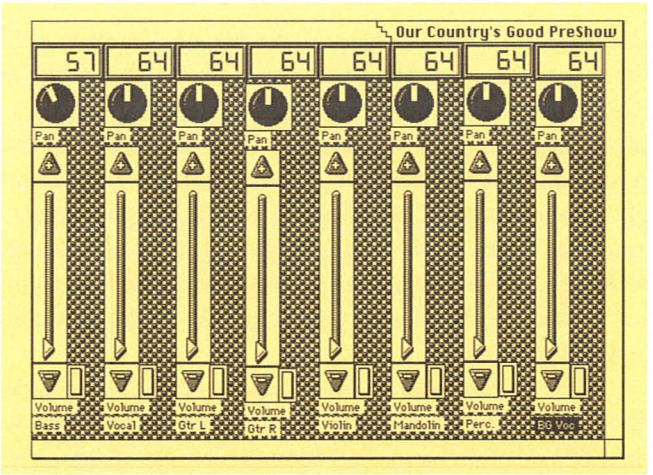


You can then use this template as a starting point for each new cue, and delete the unused tracks when you have finished sequencing each cue.

As previously mentioned, even if you are not using synthesizers and samplers, the sequencer makes a good place from which to control all of the cues in the show, including the analog audio. To do this requires that the analog material includes a SMPTE stripe which can be locked to the sequencer. Then, instead of creating synthesizer tracks, create dummy analog tracks that are used to record information about the sequence:



In the above example note the use of the first window as a standard "track sheet" for the multitrack and the use of the Comments column for operational nuances. In the second window, note the use of the Comments column to keep track of the SMPTE position on the tape and which tracks of the multitrack each song is using. Additional conveniences afforded by this procedure are the ability to import tracks into the digital hard disk recorder of the sequencer for digital editing, and the ability to automate the mixdown of the multitrack from within the sequencer:

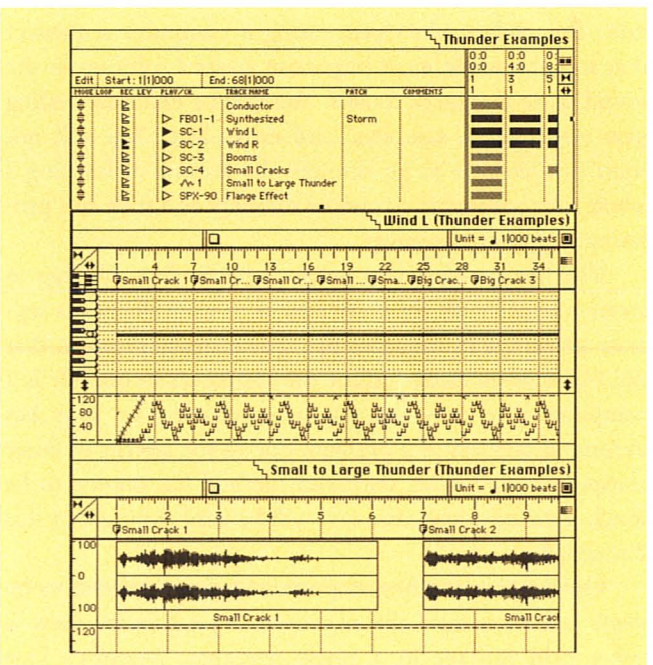


• MAXIMIZING SEQUENCER FLEXIBILITY

The largest advantage of a sequencer, however, lies in its ability to combine real time audio recordings with stereo samples and outboard synthesizers and signal processors in an extremely flexible environment in which sound cues can be created. The rehearsal process requires the ability of the sound score designer to quickly modify existing sequences during the rehearsal process. It is not unusual to note a change required in a sequence in rehearsal on one night, and needing to get the change into the very next rehearsal. To do this requires a method of organizing sequencer tracks that allows maximum flexibility to accomplish changes quickly. In this section, several useful general techniques will be discussed to create sequencer tracks that allow maximum flexibility to modify the sequence.

• ORGANIZING EXAMPLES SEQUENTIALLY

In the first example, a sequence is created to demonstrate a range of thunder samples to a director:

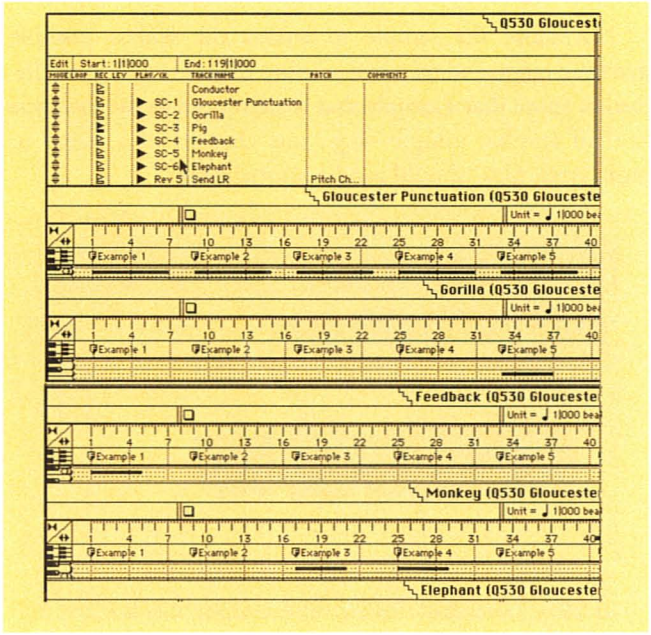


These are taken from the sample library and arranged from the smallest boom to the largest crack available. Note that the sequence has a wind track created behind it to mask the fade outs of each thunder sample similar to the ambiance used behind the thunders in the production. Room is left between each thunder example to put an appropriate vocal identification on the rough sound cassette. Note that several tracks of thunders have been created that may be played back against the wind one at a time.

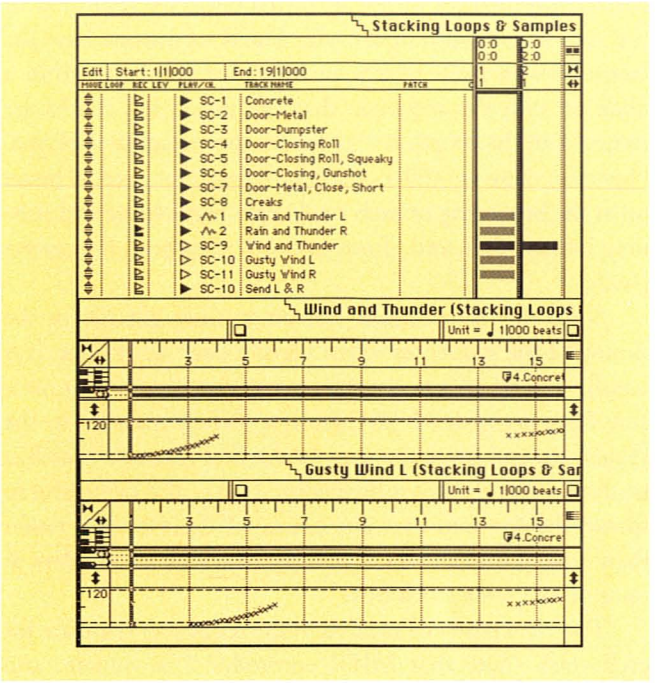
The advantage of setting up a sequence in this manner, rather than simply creating a bank and assigning the thunders to different keys is that the sequencer can trigger an infinite number of audio samples and is not limited by the RAM of the sampler. Also, once the sequence is created, there is a visual identifier for every crack of thunder available either by using a marker (e.g., below the ruler in the middle window), or by the label attached to the sample (see bottom window). It is not necessary to search through the sampler to try to figure out what sample is assigned to each key. Finally, sequences such as this are useful for common sound effects in the library and can be demonstrated simply by opening the sequence and playing it back. In this example, any time a storm is called for, the sound score designer has a ready made demo that can be readily modified to meet a director's needs.

• LAYERING TRACKS

Another way to use a sequencer to prepare demonstration sequences for a director is in the layering of sounds. In the following example, the director felt that the initial "Gloucester Punctuation" was not threatening enough and desired the basic effect to be layered with other sounds at the same time. A sequence was quickly prepared using stock animal screams from a sound effects library that could be demonstrated in various layering combinations. The director simply had to pick the combination he liked the best:



The same technique of layering can be used to demonstrate different possibilities of ambiance loops. In the following example, the wind samples have been looped and can be made to play as long as whatever scene they underscore. The director may then choose which loop is appropriate for the effect desired or mix the ambiance's together:



• TIME ALIGNING TRACKS

The advent of signal alignment technologies has enabled listeners to become more critically aware of phase anomalies of loudspeaker systems and the listening environment in general. Time differences between two signals can be heard with as little as 50 microseconds of delay between them. The same problems that plague the listener when loudspeakers are misaligned can be inadvertently created by the recording engineer when using multiple microphones in a recording. This can be especially apparent in classical music, where a main array of microphones is placed in the auditorium to pick up the whole orchestra while individual highlight microphones are placed much closer to the acoustic source. Typically in mixing, the highlight microphones are brought up just enough to lift a soloist out of the rest of the orchestra. However, the difference between the path lengths to the two microphones can create phase anomalies that deteriorates the quality of the overall sound. Many engineers will delay the highlight microphones to match the arrival of the main microphone array.

This can be quickly and precisely accomplished in the digital editing process, and saves the need to tie up delay units to accomplish the same objective. The digital wave forms of each track are visible on the screen, and can be "slipped" in time relative to one another.

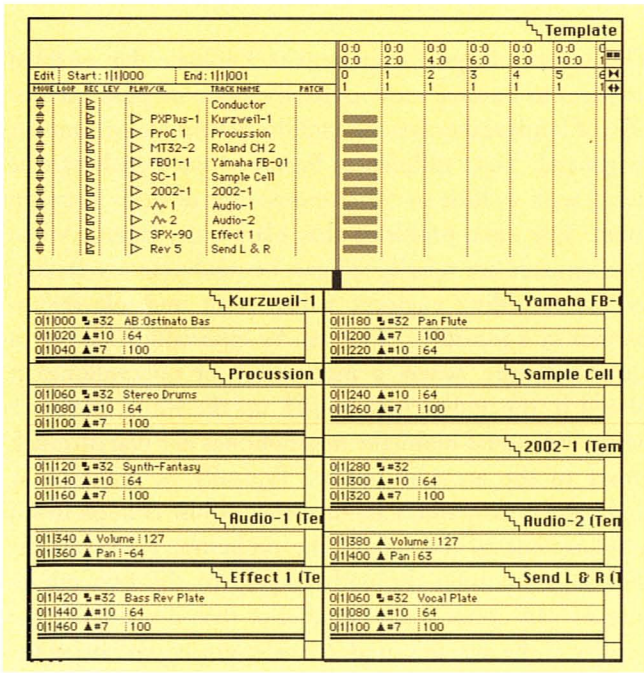
PREPARING INDIVIDUAL TRACKS

• SETTING UP EACH TRACK FOR CORRECT PLAYBACK

The final layer of the sequencer is within each track where MIDI data pertinent to each track is stored. The first step in organizing each track is to make sure that each track has the correct information to get it started correctly regardless of the state of the synth or sampler. Good sequencers have the capabilities to store system exclusive information within a track or with the sequence that can make sure synths are returned to the proper set up before the sequence is played. However, there are still a couple of things that need to be set up at the beginning of each track: opening volume and panning information, and, if not recorded elsewhere, the correct patch.

Since this information can often cause glitches in the timing of the sequencer when playing back all at once, it is usually a good idea to set the start of the sequence to measure 0, or measure -1 (if there is a pickup measure to the sequence), and place the data in the first measure, which is reserved solely for this information. It may also be helpful to spread the data out over the course of the measure, rather than have the sequencer try to play back all of the data at once on the same clock tick.

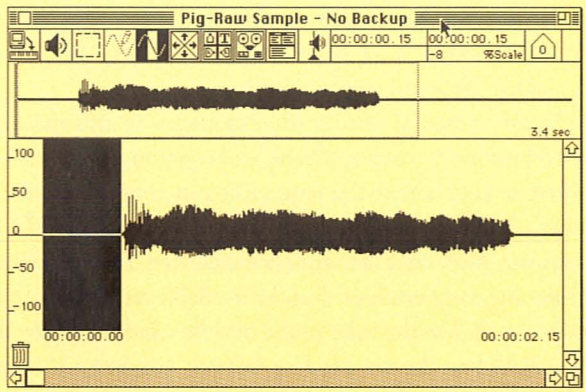
This data has been created in the sequences template for each track (note that MIDI controller 7 is volume, and MIDI controller 10 is pan):



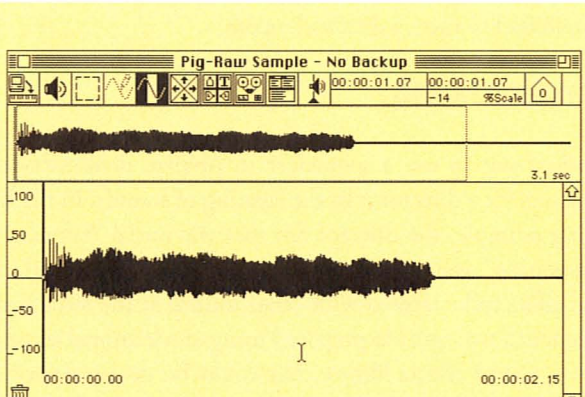
• PREPARATION OF SAMPLES

Individual tracks are also used to trigger samples which must be prepared from raw recordings. Although many samplers have facilities to automate the preparation of samples, experience has shown that the best results come from preparing the samples manually. The following steps are necessary in the preparation of individual samples:

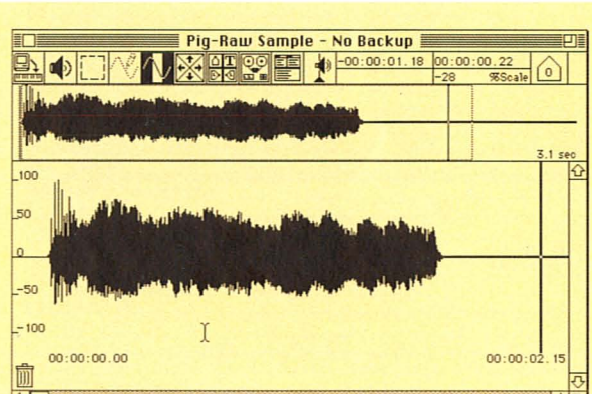
1. Trim unnecessary silence from the front of the sample:



2. Fade in the very beginning of the sample to ensure a zero crossing at the start of the sample and no audible click when the sample starts:

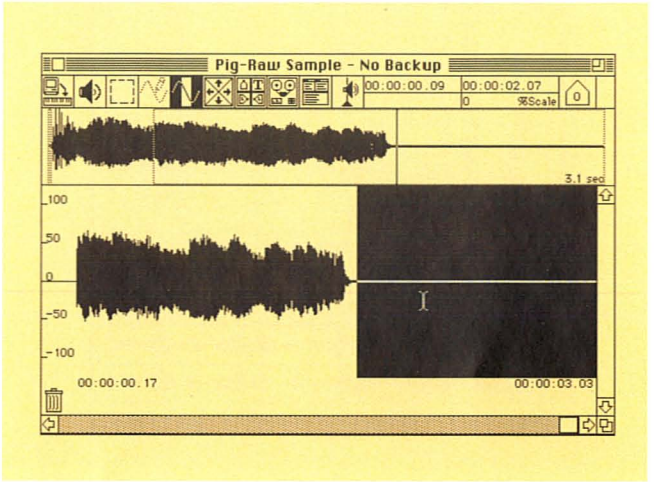


3. Normalize the sample to ensure the widest possible dynamic range and minimal amount of low level digital distortion (note that a sample that is referenced to the dynamic level of another sample—e.g., one channel of a stereo or multi track file—should not be normalized):

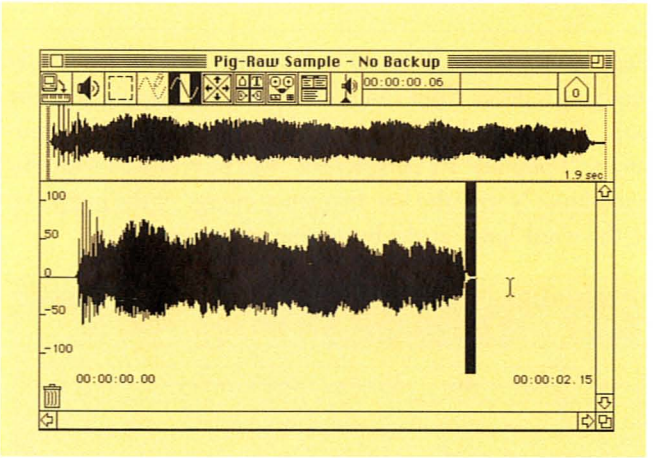


4. Play the sample through to ensure that normalizing did not adversely affect the audio quality of the sample;

5. Trim unnecessary silence from the end of the sample:



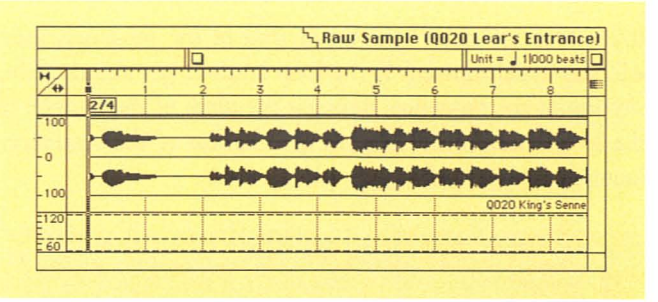
6. Fade out the end of the sample to ensure a smooth, click-free transition to silence:



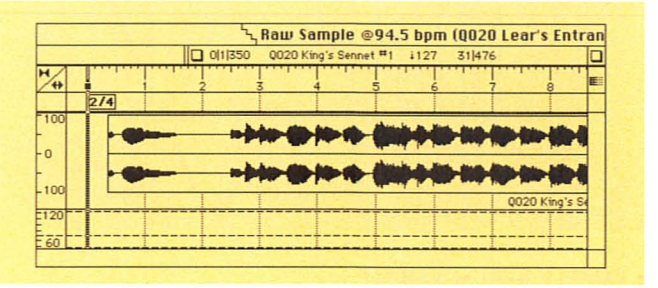
• MATCHING BEATS

Another important piece of processing that often needs to be performed with an individual sample in a track is tuning. While it is easy enough to tune a sample to standard concert pitch, a very common need in theatre sound is to tune a sample to the tempo of a piece of music. This is a very common technique in rap music, where samples that contain rhythmic nuances need to be tuned to the beat of the piece of music in which they are being inserted. This is made possible because the tuning process slows down the tempo of a sample when the pitch of the sample is lowered, and increases the tempo of the sample when the pitch of the sample is raised. The technique works very well in a sequencer that has the capability to view the sample against a time ruler of the meter.

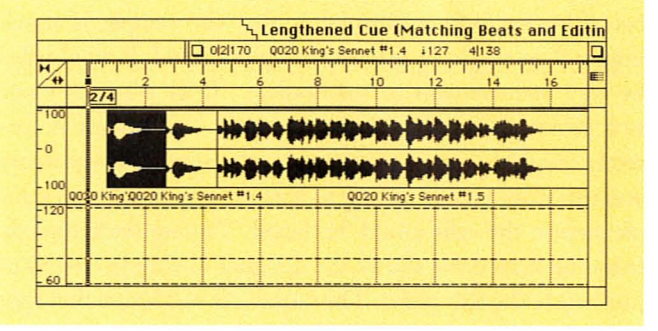
In the first example a piece of music with a fairly well defined rhythm is imported into the audio tracks of the sequencer:



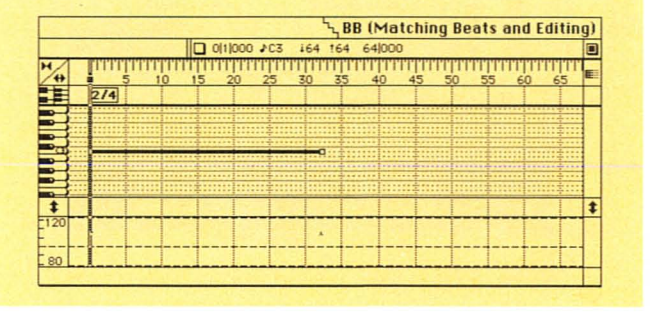
After careful listening, the down beats are visually identified and the tempo of the sequence is changed until the down beats fall (both visually and audibly) on the correct beats of the measure:



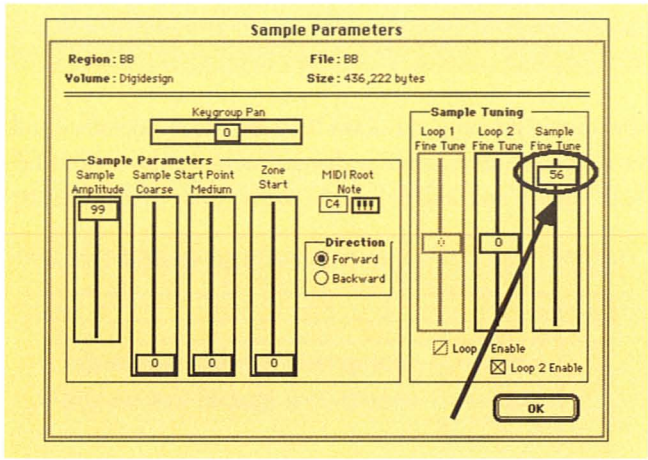
Now when the director asks that the piece be lengthened, it is a relatively simple matter to cut and paste regions of the sample into the track to extend the piece:



In the preceding case a lengthy sample was being played directly from the digital hard drive and the tempo was changed to match the sample. In many cases, the sample loop will be short and will be intended to be looped repeatedly within a preordained tempo by triggering a sampler. The sample will not be played back from a hard drive, but will be played back through a sampler. In this case, an appropriate loop is found for the sample, and the loop is played repeatedly while the tuning of the sample is changed to match the tempo of the piece. Set the loop to play against a click track over a couple of dozen measures.



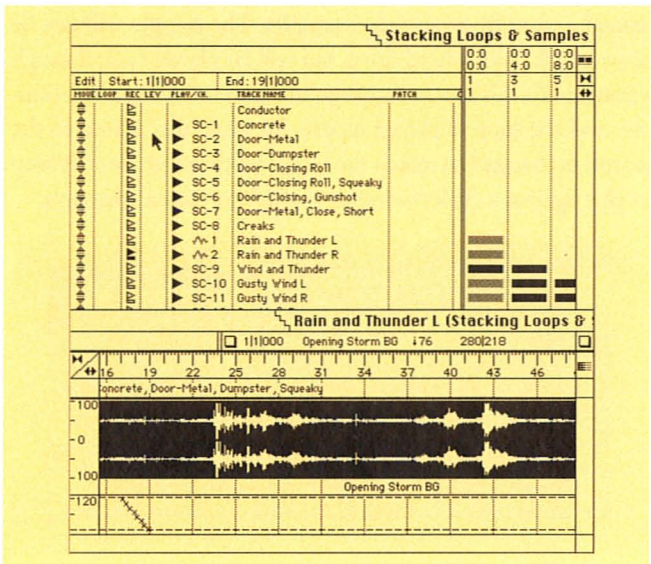
If the loop is "tuned" to the rhythm of the sequence, they will stay synchronized. If the loop tends to get ahead of the rhythm of the sequence, decrease the pitch of the sample. If the loop tends to fall behind the rhythm of the sequence, increase the pitch of the sample.



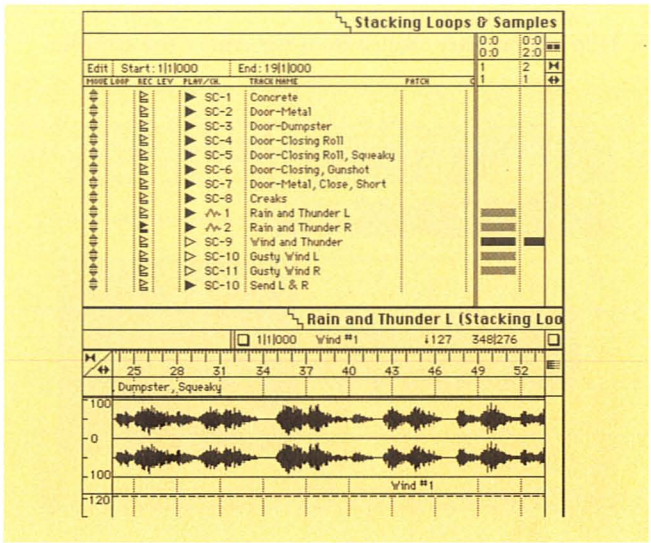
• SAMPLE REPLACEMENT

Note that in the following sequence there is a digital audio track that contains a potential ambiance. The reason this is being played back directly from the hard drive rather than being loaded into a sampler is that the sample is much longer than would fit into the sampler's RAM. It would also be very inconvenient to manipulate. If an edit was made two minutes into the sample, the only way to hear it correctly would be to trigger the sample from the beginning, and this would mean having to listen to two minutes of sample before the edit could be heard. Playing back directly from the hard drive allows the designer to simply rewind to just before the edit point. The sequencer will locate that spot on the hard drive and begin playing from there.

It is advantageous, however, to be able to quickly replace the samples within the track, without disturbing the mix, pans, etc. In the following example, the sample "Opening Storm BG"



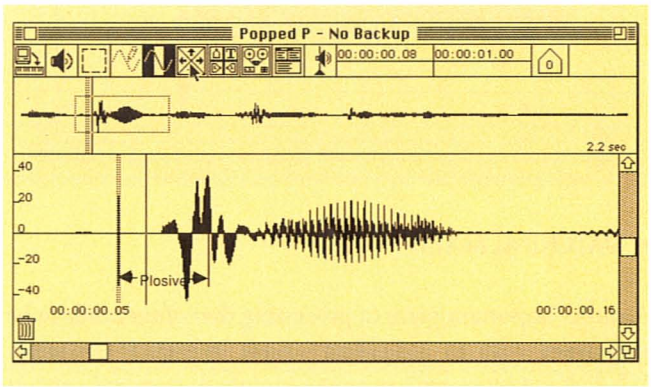
has been replaced with the sample "Wind 1" although the level, pans and position in the sequence has not changed:



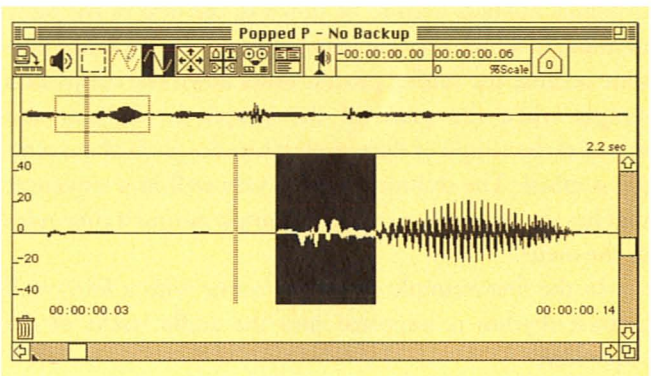
SAMPLE EDITING

• REMOVING POPPING NOISE FROM AUDIO TRACKS

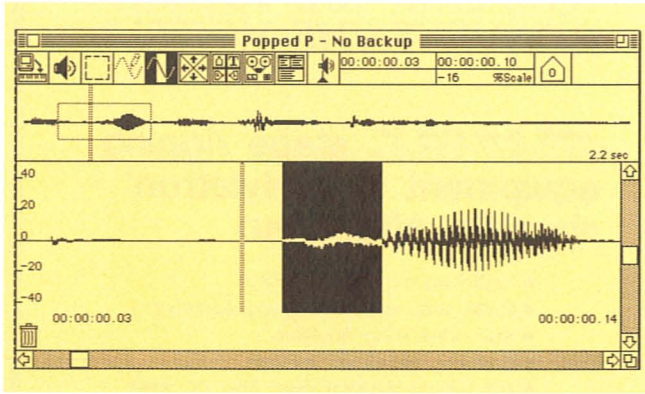
Popped 'P's in vocal tracks can be removed by repeatedly applying a notch filter tuned to the lowest frequency of the pop. The popped "P" in the following example of the sentence, "I pop my 'P's persistently," will be removed with this technique. Notice the low frequency energy of the popped p in the word "pop" at the beginning of the sentence:



The plosive section is selected and a deep (-24 dB) notch filter 25 dB wide is applied at 57 Hz to attenuate the lowest frequency (i.e., the longest repetitive pattern visually):



The process is repeated until the pop is brought under control. The next notch is set to 118 Hz:



Notice that the visual display of the wave form has now lost its strong low frequency content that was the source of the objectionable "popped p."

PLAYING BACK

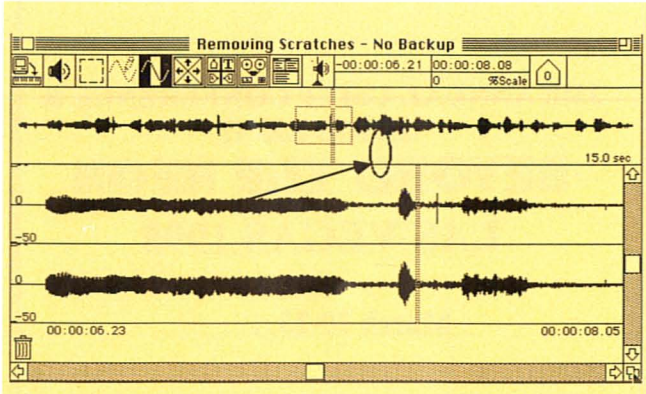
DIRECTLY FROM THE HARD DRIVE

ALLOWS THE DESIGNER TO SIMPLY REWIND

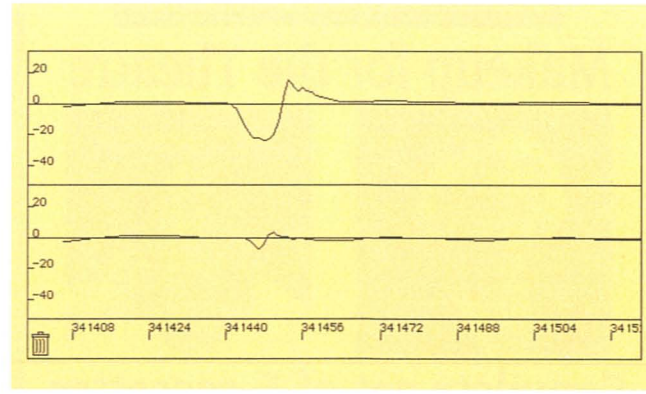
TO JUST BEFORE THE EDIT POINT.

• REMOVING POPS & SCRATCHES FROM OLD RECORDS

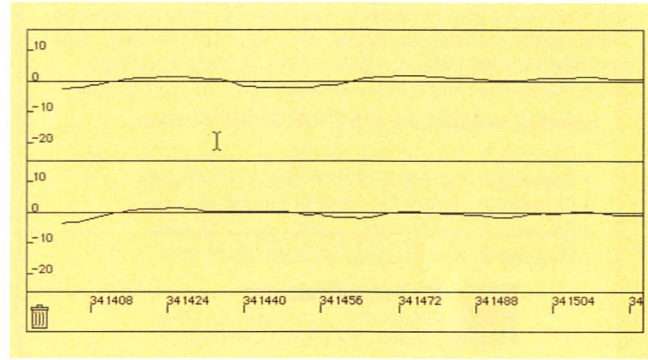
Another common problem involves the removal of scratches and pops from old vinyl long play recordings. It is a relatively simple matter to remove an isolated pop from a recording, although the job can become long and cumbersome when there are many pops and scratches to be removed. The scratch is usually clearly identifiable in the visual display of the wave form:



It is removed by expanding the horizontal image to display a single wave form,



and then redrawing the wave form with the pencil tool:



CONCLUSION

This article has explored some of the techniques and procedures useful in organizing and utilizing computers to create theatre sound scores. Computer usage in theatre is perhaps the faster growing area in theatre today, and tends to become outdated almost as quickly as techniques become adopted for use. Hopefully, this article has suggested some techniques that are sufficiently universal that they will remain viable for some time to come. It would certainly come as no surprise, however, if the techniques outlined here become archaic in a couple of years. **TD&T**

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RICHARD K. THOMAS *is the USITT Sound Commissioner and professor of theatre at Purdue University.*