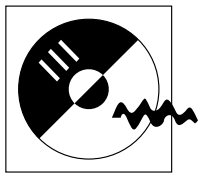

SONIC SOLUTIONS

SonicStudio 5

TimeTwist/Pitch Shift

(SS-806)

SonicStudio 5, Time Twist / Pitch Shift (SS-806)

Written and designed at Sonic Solutions, 101 Rowland Blvd., Novato, CA. 94945, USA

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Contents

TimeTwist/Pitch Shift (SS-806)

TimeTwist is a signal processing option for SonicStudio™ that changes the length of a mono or stereo Sound File without altering its pitch. Pitch Shift changes the frequency of a Sound File without altering its duration.

TimeTwist and Pitch Shift can operate as background processing tasks, or as foreground tasks that pre-empt the system until completion. The background mode of operation requires the addition of either an SS-800 or SS-801 FX Processor card or an NN-102 or NN-107 NoNOISE card. Foreground operation does not require any additional hardware.

Hardware

TimeTwist may be used without adding any hardware to the basic Sonic system. In this mode, TimeTwist can proceed only in the foreground, bringing a halt to any editing or other operations until the TimeTwist process reaches completion.

By adding an additional signal processing card to the system, TimeTwist processing may be moved into the background, allowing you to proceed with editing, recording, and other processes on SonicStudio at the same time that audio is being processed.

To use TimeTwist in background mode, the system must be equipped with one of the following:

- One SS-800 or SS-801 Sonic FX Processor

  or

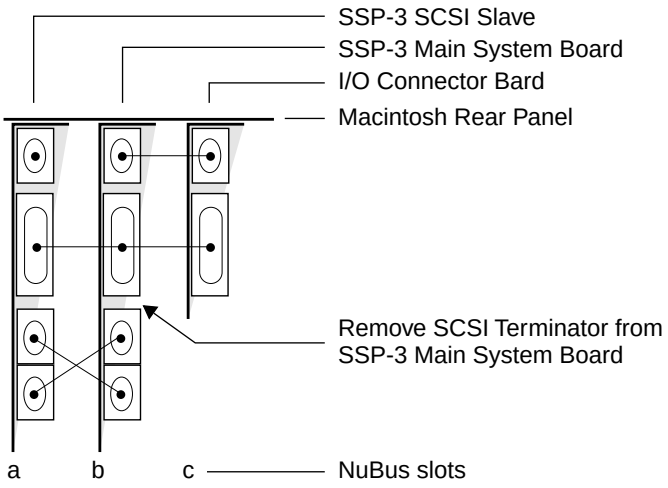
- One NN-102 or NN-107 Sonic NoNOISE Processor Card

These are functionally equivalent, each being a version of the SSP-3 card that is used as a building block throughout SonicStudio. Either version of the board can be used for NoNOISE or TimeTwist, as well as for other non-real-time signal processing functions.

Note – Installation procedures for Sonic System hardware are described in the SonicStudio manual titled *Installation and Maintenance.*

Installing the Sonic FX Processor

Normally, the processing board is connected with the main system board in the SCSI Slave configuration, with the SCSI connector of each board joined by a common ribbon cable. Below is a view of the FX processor installed with the main SSP-3 board, seen from above, with the computer lying on its side.



The SCSI connector of the main board is connected to that of the FX board using a special, 3-headed ribbon cable.

The two boards are also joined by means of the board-to-board cables. These ribbon cables are connected in a criss-cross configuration, with the connector on one board bridging to the opposite connector on the other board.

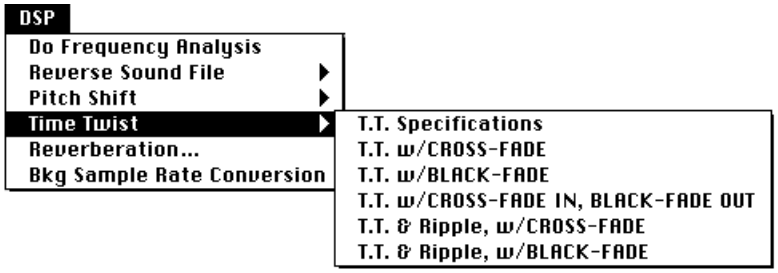
Termination

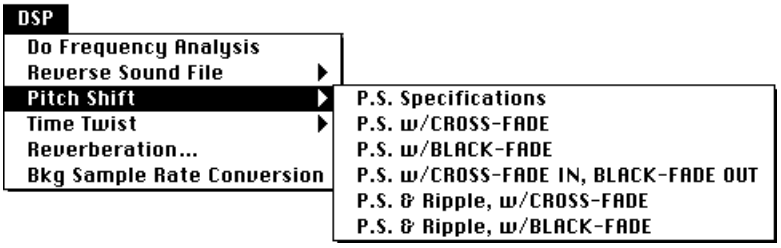
Each SSP-3 card is delivered with a SCSI terminator on the board. The terminator, similar in appearance to a DIP IC, is mounted in a socket located directly underneath the SCSI connector along the top of the circuit board.

One terminator must be at the end of a SCSI chain. Before installing, the terminator must be removed from one of the cards. In the configuration shown above, the terminator is removed from the main SSP-3.

Invoking TimeTwist and Pitch Shift

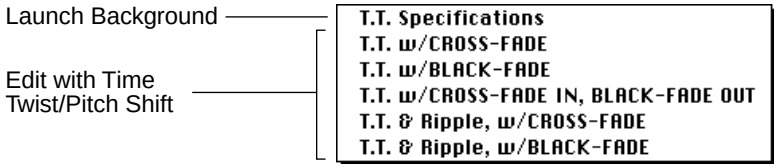
If the TimeTwist / Pitch Shift option is installed in the system software, two additional commands appear in the DSP menu. Selecting TimeTwist or Pitch Shift brings up a submenu with several items.





If a NoNOISE / FX coprocessor card is installed, all commands in the menu will be active. If there is no coprocessor, only the first command, T.T. or P.S. Specifications, will be active.

There are two separate methods for applying the functions.



Foreground/Background Processing

The first procedure is to specify a Sound File and a set of processing parameters using the T.T. or P.S. Specifications dialog boxes, then to launch the processing.

This method may be used with or without an FX coprocessor card. If the coprocessor is installed, TimeTwist or Pitch Shift will launch its process, then return to the system. You can then proceed with editing and other activities while TimeTwist continues to work in the background.

If there is no coprocessor card, the process will begin but you will be locked out from other actions until the function finishes processing the designated material.

Editing with TimeTwist/Pitch Shift

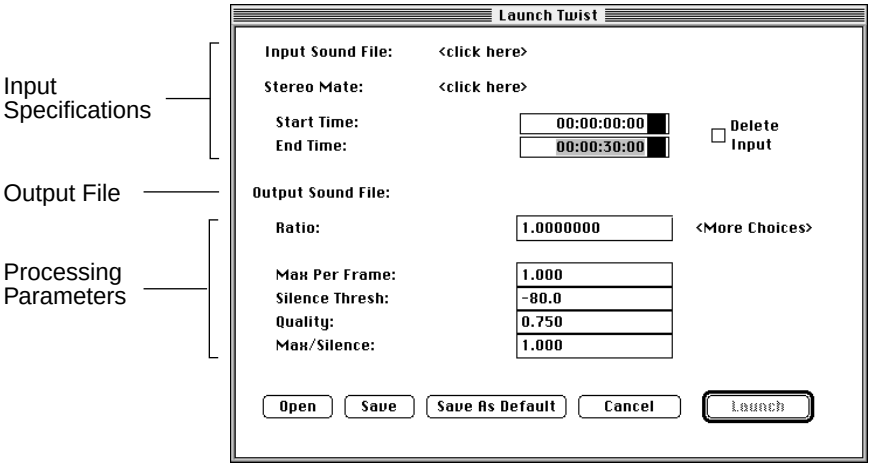
Alternatively, TimeTwist or Pitch Shift may be specified as part of an insert editing command similar to the standard editing commands. Instead of selecting Insert or Insert & Ripple, you choose the equivalent command from the TimeTwist or Pitch Shift submenus. These T.T and P.S. commands automatically process the source audio to accommodate a different length, as specified by the placement of In and Out points in the Source and Destination panels.

The TimeTwist editing commands are not available unless an FX coprocessor card is installed.

TimeTwist

Launching TimeTwist

The command T.T. Specifications, in the TimeTwist submenu of the DSP menu, is used to invoke time compression / expansion for a Sound File or a portion of a Sound File. This command is available whether or not the FX coprocessor is installed in the system. Selecting the T.T. Specifications command brings up the Launch Twist dialog box.

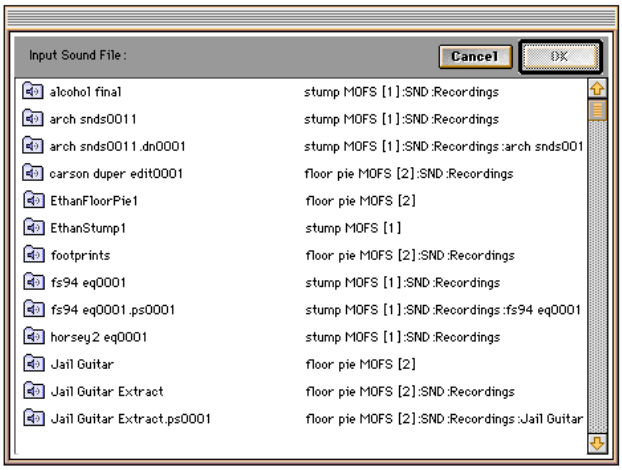


This dialog box lets you select a sound file to process, name the output file, and specify the rate of compression / expression. The system will process the designated source audio and create a new Sound File containing the processed audio.

Specifying Source Files

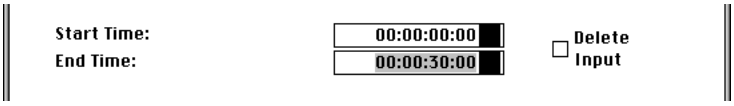
The uppermost section of the dialog box selects a mono or stereo Sound File for processing. You may elect to process only part of the file by entering values into the Start Time and End Time fields. In that case, the system will process only the portion of the file between those two points.

To select a file for processing, click where it says <click here> next to the words Input Sound File. This brings up a MOFS (Media Optimized File System) browser for all available soundfiles.



If the selected file is a member of a stereo pair, the system displays a dialog box to ask if the second channel should be processed as well. If the answer is Yes, the other file is automatically placed in the Stereo Mate field. If need be, you can select a different file to be processed as the second channel of a stereo group. Mono or stereo TimeTwist is available with or without an FX coprocessor. The difference is the required length of time for processing.

When you select a file, the end time of the file is automatically entered in the End Time field. If you wish to process only a section of the file, enter time values in the Start Time and End Time fields.



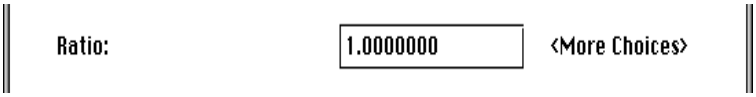
A Delete Input checkbox exists to automatically delete the input sound file(s) at the finish of processing. Do not select this box unless you are certain that you want to delete the source file. Remember that the results of TimeTwist are somewhat variable. If the source file is deleted, you cannot recover if the output is not exactly as desired.

Specifying the Output File

Before processing can begin, you must also specify the file name for the output sound file. Click next to the words Output Sound File to bring up a file select dialog box in which you can designate the name and storage location for the file to be created.

Specifying Ratio and Processing Parameters

The most important parameter of processing, of course, is the amount of time compression or expansion to be applied to the source audio. This is expressed as a ratio of the length of the original audio to the length of the output Sound File.



The ratio may be viewed as a factor by which the length of the original Sound File is to be multiplied to get the length of the new file. Thus, values that are less than one correspond to time *compression,* while values greater than one result in time *expansion.*

The default value is one exactly, so you will almost certainly need to enter a value before launching processing. TimeTwist can alter the length of a source segment by roughly a factor of two in either direction. Thus, legal values for Ratio are from 0.50 to 1.50. Note that processing becomes more problematic at either extreme.

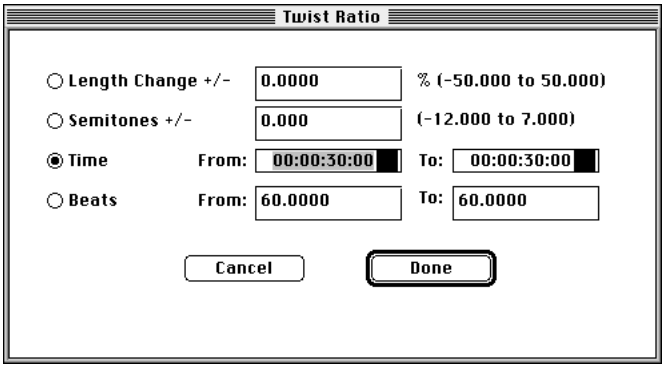
Note – The parameter values fields in the TimeTwist dialog box do not support type over of the numeric values.

To enter a new parameter value in any field in the TimeTwist dialog box, first delete the digits that are to be replaced.

To specify time modification in a form other than a straight ratio, you can open a larger dialog box.

To enter TimeTwist ratio in another form:

1. Click the words More Choices in the TimeTwist dialog box.
   This expands the Launch Twist dialog box to express the ratio of time modification in several forms.



Besides conversion by time ratio, the change in rate may be expressed in terms of:

- A percentage speed change
- Pitch transposition in musical semitones
- Change in sample rate
- Change from original play time to new time

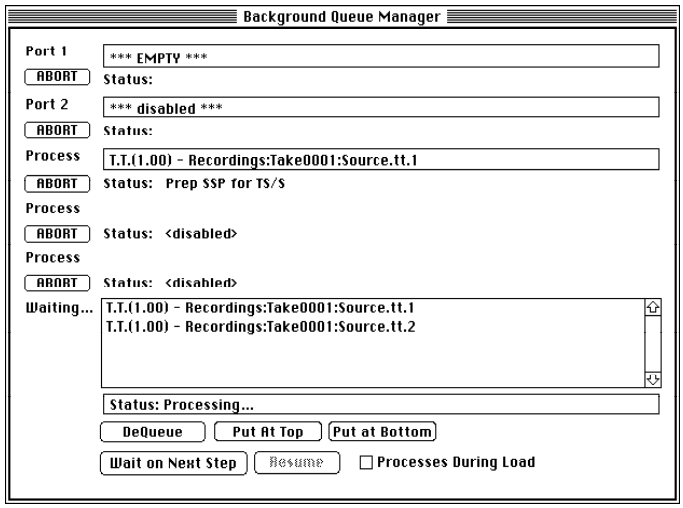
- Change from original to new tempo, expressed as beats-per-minute

Values may be entered in any of these forms. Note that altering by pitch transposition does not actually affect pitch. A change in this value shifts the other settings accordingly but frequency will not be affected once launched.

Launching

Once the parameters of processing have been set, click the Launch button to start the process.

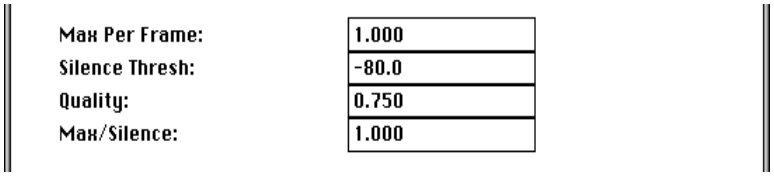
If an FX board is installed in the system, the TimeTwist process will be placed in the Background Queue, and will proceed to completion during which time you are free to engage in other work (including launching additional TimeTwist processes, if desired). The progress of execution may be followed by opening the Background Queue Manager dialog box, found in the Managers sub-menu of the File menu.



If no FX processor is installed, the Background Queue Manager dialog box appears automatically and cannot be closed until the current process has completed. Thus, you can perform time squeeze/stretch operations without an additional coprocessor board, but in that case must wait for each job to complete before other work can proceed.

TimeTwist Processing Parameters

Besides the ratio of compression/expansion, four parameters affect the results of TimeTwist processing as illustrated:



To understand how these parameters affect the results of processing, it is helpful to understand something of the way that TimeTwist operates.

How TimeTwist Works

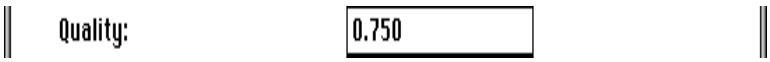
TimeTwist uses a time domain approach to time compression, in which bits of audio are either deleted (compression) or repeated (expansion) in order to squeeze or stretch audio to fit the defined time ratio. The art of producing a good result consists of determining splice points that will provide the needed ratio with minimal audio artifacts.

In the first stage of processing, SonicStudio analyzes the source Sound File. From this analysis, a list of possible splice points is prepared. Each candidate splice is assigned a rating (Quality) that indicates the relative seamlessness of each possible splice.

In the second stage of processing, the system examines the source file in blocks of 16K (16, 384) samples, (a TimeTwist frame, corresponding to a little under a third of a second at a sample rate of 48 KHz). In each frame, the system determines whether one or more splices are needed to maintain the specified ratio of compression or expansion.

If splicing is called for in a given frame, the system examines the candidate splices from the list prepared during the first processing stage and determines whether a qualified candidate is available. If it is, the splice or splices are performed and the system proceeds to the next frame. If there is no qualified splice available, the system moves to the next frame, but accumulates a deficit that must be made up somewhere later in the file.

The processing parameters determine the criteria that are used to decide whether a given splice is acceptable.



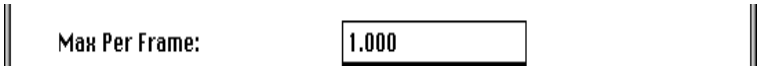
The primary criterion in determining the acceptability of a splice is its quality rating, which is a numeric value between 0 and 1.

The Quality parameter tells the system how good a splice point has to be before it will be accepted. The higher the value specified, the better a splice must be to be accepted. The system will absolutely not do a splice if the quality value that the processing determines for the splice is below the value set for the Quality parameter. If this value is set too high, the system may be unable to find enough acceptable splice points to deliver the requested ratio of compression or expansion.

Greater amounts of compression or expansion require correspondingly more splices. Thus, the further the Ratio parameter is from 1 (either above or below), the lower the value of Quality that can work.

The default value of 0.750 will support the full range of 2 to 1 compression or expansion for most *non-musical* program material. For smaller amounts of compression or expansion, higher values may yield improved results by forcing the system to use only the best of the available splice points.

Note that any setting of Quality higher than zero will tend to distort short-term timing. For compression or expansion of musical material, therefore, the recommended setting is zero. A somewhat higher value may possibly be of use for non-rhythmic or rubato material.



If a splice is called for in a given frame, but none is acceptable (Quality rating equal to or greater than the value set for the Quality parameter), the process accumulates a deficit of splices that must be made up for in later frames. The value of the Max Per Frame parameter tells the system how much flexibility it has in the expansion process. The legal range is 0.5 to 3.0.

Note that this parameter applies to time *expansion* only. (It is ignored for ratios less than 1.)

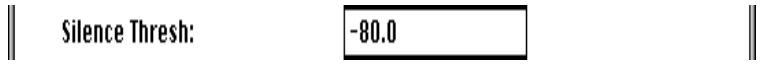
Max Per Frame should normally be set to value about 0.05 greater than the expansion ratio. For example, if the ratio is set to 1.061 (a musical half-tone), then set Max Per Frame to about 1.111

For particularly difficult cases, Max Per Frame can be set to a higher value, such as 1.5. This will cause the system to put all the expansion in just a few choice spots rather than spreading the expansion evenly over the duration of the sound.

However, the rhythm of the sound may be adversely affected if too many splices are allowed in a single frame. If a high ratio of expansion is selected with a relatively high setting for the Quality parameter as well as a high setting for the Max Per Frame parameter, the system may be unable to find qualified splices in one section, and then throw many splices in later in the piece.

The result can be a pronounced rubato in which the sound speeds up and slows down. If this is a problem, reduce both parameters so that the splices are more evenly distributed.

During silence, the TimeTwist system automatically reduces the setting of the Quality parameter to zero, while regulating the number of splices that can be incorporated in a single (silent) frame in order to prevent unnatural stretching or chopping of pauses. If the Max/Silence parameter is set higher than the Max Per Frame parameter, splices will be concentrated in frames that are silent. This can help to avoid audible artifacts with active audio, but may have a noticeable effect on the pacing of spoken word material.



Sections of silence in the source file are opportunities for processing. The Silence Thresh parameter is a value in decibels that determines what will be recognized as silence. If the average energy in a TimeTwist frame is below this number, then the entire frame will be declared as silent.

In a silent frame, the Quality parameter does not apply. The system will accept any splice point without regard to its Quality rating.

Recommended Settings

In general, there is a trade-off between sound quality and rhythmic accuracy in TimeTwist operations. If a high value is set for Quality (.75 or greater), there will be relatively few artifacts, but the splices will be concentrated in only a few places. If the Quality parameter is set to a low value (such as 0), then there may be many artifacts (depending on the material), but splices will be spread more evenly throughout the sound.

While every situation will be different, a couple of rules-of-thumb may be applied:

Dialog

For dialog, set the Quality parameter high (.75 to .85) and set Max Per Frame parameter to its largest value (3.0 for stretch, 0.5 for squeeze).

This will cause the system to perform splices in the good places, but also allow it to do lots and lots of splices in those good areas. The result will be that it will tend to put all the splices in the vowels and leave the consonants alone.

In the extreme (Quality of .95, say) this gives the speaker a rather odd prosody that is somewhat reminiscent of a Maine or Maritime accent, but the sound is quite clean. Similarly, the Max/Silence parameter can be set very high (3.0 is the limit) so the quiet regions between the words will be stretched or squeezed by large amounts. This has the effect of putting much of the stretch (squeeze) in the air between utterance. See the table below for a range of usable high values.

Music

For music, set the Quality parameter low, at least below 0.1 (0.05 is recommended) and set the Max Per Frame parameter to be 0.1 more or less than the ratio.

This gives the system the freedom to place the splices anywhere in the frame, but will constrain it not to work too hard on any one frame.

The Max/Silence parameter should be set the same as the Max Per Frame parameter.

The following table may help in determining ideal settings for TimeTwist functions. It represents the high range of Max Per Frame or Second settings for given ratios.

Ratio	Max Per Frame (Seconds)
0.9	0.5
0.91	0.55
0.92	0.6
0.93	0.65
0.94	0.7
0.95	0.75
0.96	0.8
0.97	0.85
0.98	0.9
0.99	0.95
1	1
1.01	1.2
1.02	1.4
1.03	1.6
1.04	1.8
1.05	2
1.06	2.2
1.07	2.4
1.08	2.6
1.09	2.8
1.1	3

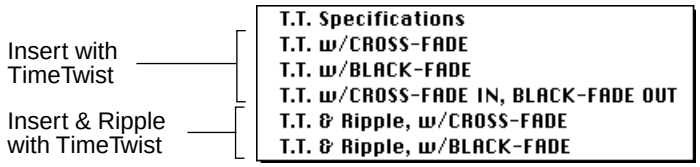
Process Limitations

TimeTwist is an *active* process that makes decisions as it goes concerning optimum placement of splices. Because of this, sometimes the actual length of the output is longer than that specified.

When this occurs, it is an indication that the system was unable to find enough strategically-placed splices that met the criteria for Quality defined in the Launch Twist dialog box. If this happens, reduce the setting of the Quality parameter, and relaunch processing.

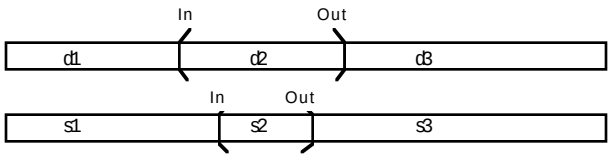
Editing with Background TimeTwist

If an FX Processor board is installed in the system, TimeTwist may be invoked by using the five edit-like commands in the TimeTwist pull-right menu.

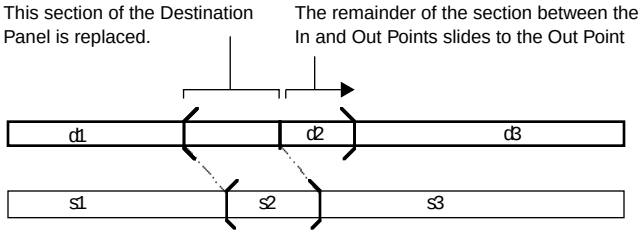


These are variations on two basic commands: T.T. and T.T. & Ripple.

These commands resemble the regular Insert commands in form, but they differ in the way that they affect the placement of audio in the Destination panel(s).

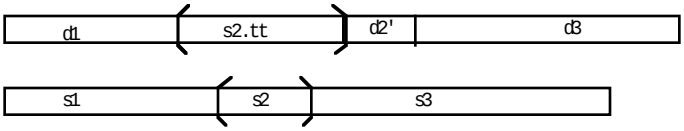


The figure above represents a Source and a Destination panel with Sound Elements which are marked and ready for TimeTwist editing. The In and Out points in each panel define the Source audio segment, and the length that it is required to fill in the final product. Regions in each panel are designated s1, s2, d1, d2, etc. to identify each section.



In the figure above, T.T. (without Ripple) replaces a section of audio in the Destination panel that matches the length of the original source segment.

Both the bare T.T. commands and T.T. with Ripple commands change the length of a panel by moving audio to the right of the edit points in the Destination panel.



In time compression, the effect is similar, except that in that case, all of d2 is lost, along with part of d3.

The T.T with Ripple commands preserve all audio, simply displacing everything to the right of the In point. In that case, the result in the example above has the segments in the order d1, s2.tt, d2 (all), d3.

If the time delimited by the In / Out points in the Source panels is the same as the time delimited by the In / Out point in the Destination panels, then no squeeze / stretch will be involved. The result will be identical to a normal insert edit.

As TimeTwist edits are performed, the system automatically computes the ratios needed for processing and launches the required processing into the Background Queue. Initially, a bar indicator will appear in the Destination panel(s) where the audio is inserted. As processing proceeds, this bar is progressively replaced by audio waveform.

There is no need to wait for completion of processing on one segment before performing another TimeTwist edit. The system will automatically queue as many processes as are required.

Defaulting of the Parameters

Launching a TimeTwist editing command does not pop up the dialog box. The parameters of processing are derived by the system from the length of the Source segment and the length of the Destination segment.

The Ratio is set to the time between the Out and In points in the Destination panels over the time between Out and In points in the Source panels. This ratio must be between 0.5 and 1.5 for these commands.

Max Per Frame and Max / Silence parameters are coerced to the value of the Ratio plus or minus 0.1.

Quality and the Silence Thresh parameters come from the default settings for TimeTwist. They can be set from the TimeTwist dialog box using the Save as Default button.

Processing an Edited Sequence of Segments

The Source panels may contain a single segment, or an entire edited sequence of segments. In this case, each segment will be twisted separately, and then automatically edited back together in the Destination panels.

Since TimeTwist is not an exact process, it may be necessary to go back and adjust the resulting edits, since inaccuracies in the twist will cause them to be off by a bit.

If the Quality parameter is set at zero, the effect of the misalignment of the edits will be minimized, though not eliminated.

TimeTwist Application Notes

There are many potential applications for TimeTwist. Some of the situations for its use can become somewhat complex. The following notes may help you understand how to apply this powerful tool.

Processing Multiple Channels

Time-twist normally works on either a mono or a stereo source. For a stereo source, the splice points are selected based on the mono sum of the two channels, and the splices are performed in exactly the same places on left and right to help preserve the stereo imaging.

This gives very different results from those obtained if the left and right channels are processed separately, since the splices in left and right will not be forced to be in the same places. There can even be a different number of splices in left versus right.

This has further implications; TimeTwist cannot meaningfully be applied to a multi-channel recording beyond a simple stereo pair. That is, it makes no sense to try to twist, say, an 8-track classical recording, since it will be done as four stereo pairs, and each pair will lose synchronization with each other pair.

If, however, the eight tracks in question consist of slugs of applause, ambience, and sound effects, then the small shift in relative synchronization may be acceptable. In that case, there is no stereo imaging involved.

Processing In-Place

There is no single command to select an area in the Destination panels and change its length without moving it, but the same effect can be achieved with a multi-step process.

1. Copy the Destination panels to the Source panels.
   This may be done by reversing the Source and Destination panels, deleting all In and Out points, and doing an Insert command to copy the panels over. Then put the Source and Destination panels back the way they were. The effect is that the same, identical materials are found in the Source and the Destination panels.
2. Identify the region to be twisted by placing In and Out points in the Source panels and an In point in the Destination panels at the identical time as that of the Source panel's In point.
3. Place an Out point in the Destination panel at the location that the bracketed area in the Source panel will fill.
4. Enter a T.T. w/Crossfade command.

The In and Out points in the Source panel(s) will be twisted and edited into the Destination panels, and the region after the bracketed area will be slid (rippled) to abut the twisted region.

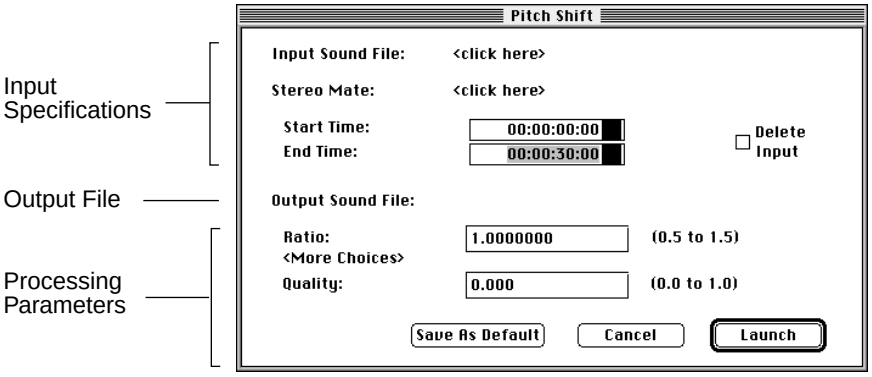
Replacing Dialog

TimeTwist can be useful in facilitating dialog replacement, for example, if you want to replace a blown line of dialog in an otherwise good take with a line from another take. Performing TimeTwist on the replacement dialog can fill in the gaps by sensing silences and *shaping* the line. If successful, the slipped dialog will appear to be in true sync.

Pitch Shift

Launching Pitch Shift

The command P.S. Specifications, in the Pitch Shift submenu of the DSP menu, is used to invoke pitch alteration for a Sound File or a portion of a Sound File. Pitch Shift functions like a combination of TimeTwist and Sample Rate Conversion, affecting the pitch of a sound file by altering its sample rate while keeping a constant duration. This command is available whether or not the FX coprocessor is installed in the system. Selecting P.S. Specifications brings up the Pitch Shift dialog box.



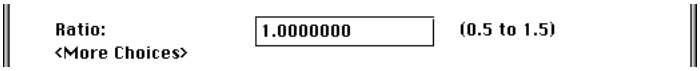
This dialog box allows you to select a sound file to process, name the output file, and specify the rate of pitch change. The system will process the designated source audio and create a new Sound File containing the processed audio.

Inputting and Outputting Sound Files

The Pitch Shift dialog box functions much like the Launch Twist dialog box. The input and output of sound files is carried out in the same manner.

Ratio, Quality and Processing Parameters

The interval of the pitch shift is expressed as a ratio of frequencies.



The ratio may be viewed as a factor by which the frequency of the original Sound File is to be multiplied to get the frequency of the new file.

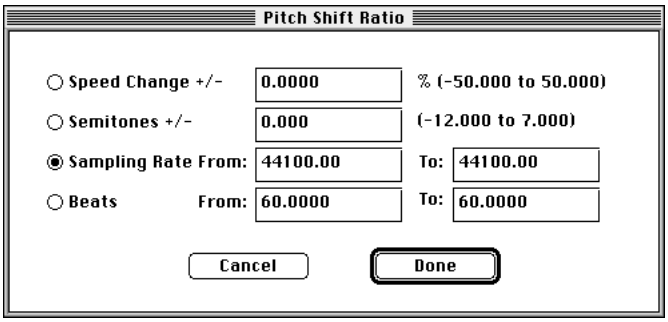
The default value is 1.2, so you will almost certainly need to enter a value before launching processing. Pitch Shift can alter the frequency of a source segment by roughly a factor of 2 in either direction. Thus, legal values for Ratio are from 0.50 to 1.50. As in TimeTwist, settings at either extreme are least likely to be successful.

Note – The parameter values fields in the Pitch Shift dialog box do not support type over of the numeric values.

To enter a new parameter value in any of the fields in the TimeTwist dialog box, it is necessary to first delete the digits that are to be replaced.

Note that the Quality parameter in Pitch Shift functions precisely as it does in TimeTwist. An unsuccessful Pitch Shift will result in a correctly altered pitch but an incorrect sound file length.

As in Launch Twist, if you wish to specify frequency modification in a form other than a straight ratio, you may open a larger dialog box by clicking on More Choices. This expands the Pitch Shift dialog box to express the ratio of frequency modification in several forms.



Besides conversion by time ratio, the change in frequency may be expressed in terms of:

- A percentage speed change
- Pitch transposition in musical semitones
- Change in sample rate
- Change from original to new tempo, expressed as beats-per-minute

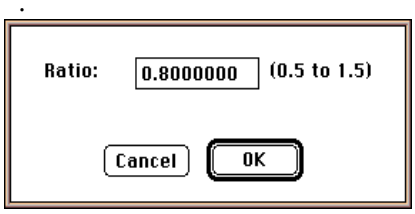
Values may be entered in any of these forms.

Launching

Launch Pitch Shift as you would TimeTwist.

Editing with Background Pitch Shift

If an FX Processor board is installed in the system, Pitch Shift may be invoked by editing using the five edit-like commands in the Pitch Shift submenu. Destination panels are affected as they are by similar commands in standard editing: rippling displaces sounds to the right of the out point the length of the imported, pitch-shifted segment. Note that no segment length changes take place in the Pitch Shift function. Engaging a Pitch Shift editing command brings up a dialog box allowing you to set the precise ratio of frequency change.



Processing an Edited Sequence of Segments

The Source panels may contain a single segment, or an entire edited sequence of segments. In this case, each segment will be pitch shifted separately, and then automatically edited back together in the Destination panels.

Summary

TimeTwist allows you to change the length of a section of audio while keeping the pitch of the output the same. Pitch Shift changes the frequency of a section of audio without affecting the length of the output file. TimeTwist and Pitch Shift may be used with or without an FX Processor installed in the system. In the latter case, processing will pre-empt other uses of the system until execution is complete.

TimeTwist and Pitch Shift may be invoked using a dialog box to define the source Sound File and a set of parameters to be used for processing. If an FX coprocessor is available, TimeTwist may also be incorporated in the process of editing.

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