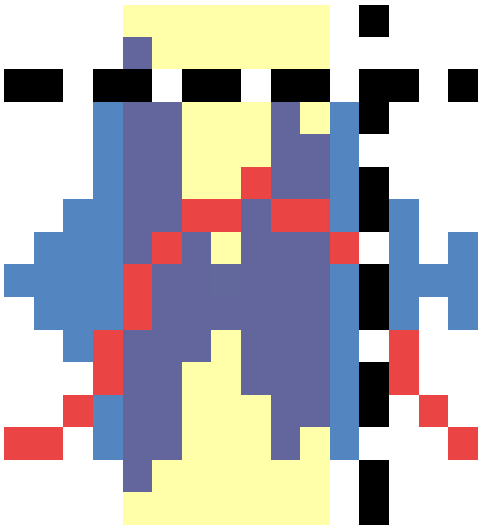

The LAoE tutorial serie - First steps

first edition, august 2002

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LAoE is a rich featured graphical audiosample-editor, based on multi-layers, floating-point samples, volume-masks, variable selection-intensity, and many plugins suitable to manipulate sound, such as filtering, retouching, resampling, graphical spectrogram editing by brushes and rectangles, sample-curve editing by freehand-pen and spline and other interpolation curves, effects like reverb, echo, compress, expand, pitch-shift, time-stretch, and much more...

Table of Contents

1. Introduction

The LAoE tutorial serie is a serie of articles focussed to LAoE-users. These articles have been written with the idea to bring LAoE to a larger public, and to discover many unexpected features, because LAoE isn't as easy to use without documentation. At the time of writing this article, no documentation was existing about LAoE.

In this article, we will introduce LAoE, focussed to beginners making the **first steps** with LAoE.

This article is based on LAoE **version v0.4.08** to **v0.4.09**. So when you read this lines, maybe a newer version of LAoE will be out, and the graphical user interface will probably have minor differences to the figures of this document.

2. Welcome

...to the fantastic world of LAoE - **L**ayer-based **A**udi**O** **E**ditor! LAoE is a soundfile-editor which allows to create and manipulate digital sample-based recordings and signals (sound, wave, mp3). Not confound with music-editors, which arranges midi and samples to a complete clip with the help of multitrack-editing. LAoE is limited to sample-based files. LAoE is fully graphical-based, contains many features for editing, filtering, performing effects, analysing... and much more.

3. Why LAoE?

LAoE has many (seen and) never-seen features. The clip, layer and channel concept, where each clip may have multiple layers, where each layer may have multiple channels, without logical limitations, where the layers are painted one on top of each other, in analogy to multi-layer capable image-processing tools. The uniform clip concept, where each curve, each variable parameter, each spectrum view, each envelope-, resampling-, distortion- and and and... -function curve is editable as it were a normal audio channel. Every usefull and senseless effect may be performed on them. The zoomable and editable spectrogram, where you can isolate and filter out sound-parts which are not separable in the classical sample-curve view. The all-domain sample-curve view, where audio samples may be zoomed until sample-by-sample dimension. The selections with its smooth intensity, to perform effects and functions progressively without hard edges. These are a few reasons why LAoE exists for you!

4. Features summary

LAoE has many features, and the features-list is constantly growing. Here an incomplete list of the features of LAoE:

- readable filetypes: `.mp3 .wav .au .aiff . gsm`
- writable filetypes: `.wav .aiff` (will grow later)
- extensible file format and file type architecture
- an own (readable and writable) file format `.laoe` which keeps the layer-information and editing-settings
- multi-channel support (mono, stereo, 3 and more), number of channels limited by hardware and sound-system only
- multi-layer support (tracks containing multiple channels), number of layers limited by memory only
- floatingpoint sample precision
- a vector-based volume-mask per channel
- several standard editing functions like copy, paste, cut, move, duplicate, crop...
- unlimited undo-history with absolute view
- extended select functions with variable intensity curve to define smooth selections, markers and several selection manipulation functions
- layer-stack and channel-stack to manipulate these objects
- extended zoomable sample-curve view
- zoomable and configurable spectrogram-view
- analysis tools like spectrum view, histogram, measure tools, statistics, calculator...
- diverse waveform generators like signal-generator (rectangle, triangle, sinus...), harmonics generator, pitch generator, freehand generator with diverse interpolation features...
- divers amplitude functions like balance, divers fades, compress expand, distortion, autovolume...
- diverse sample-functions like constant and variable resampling (may also be applied to a selection only), diverse math functions, convolution, forward and inverse fast fourier transform (yes, you can edit the freqeuncy domain!)...
- some filters like parameter-filter, equalizer, multi-notch filter, FFT filter...
- a great spectrogram-filter, which allows to edit in

spectrogram-domain, using a brush and rectangle tool to select shapes

- many audio-effects like multiple reverbs, delay-echo, chorus-flange, multipitch, disharmony, pitch shift, time stretch etc...
- a disharmony-plugin to completely disharmonize a sound in several ways
- mouse-drawed shortcuts! e.g. draw a simple "u" with the mouse to start the undo-history plugin...
- some plugins (effects and functions) accept a function curve as parameter, to perform free variations in time of a parameter of that effect or function
- uniform clip concept allows to perform all these effects and functions on usual time-domain audiosamples, frequency-domain spectrums (magnitude, phase) or any parameter curve
- markers to define multiple areas
- extensible plugin architecture

5. Installation

System requirements

I have to confess, LAoE is very resource-hungry. Here follows the list of minimal hardware and software requirements to work confortably with LAoE.

- Pentium III, 500MHz, or aequivalent
- 256MB RAM
- 200MB free space on harddisk (exclusively to store the undo-history, since LAoE code is smaller than 2MB)
- mouse with 3 buttons (only needed if you want to benefit of the mouse-drawed shortcuts)
- Linux or Windows operating system or any other platform where java is running.
- Java runtime environment jre 1.4.0 or higher

Download from the web

You will find the latest version of LAoE at the official homepage of LAoE, at `www.oli4.ch/laoe` for free. Go to the download-page and download the newest binary. The name of the file to download is `laoe_bin_v0_4_08.tar.gz` (here for version 0.4.08). Please download the newest stable version.

Installation procedure

If not installed, download the java runtime environment jre 1.4.0 or higher. You will find it at the official website of java, `www.java.sun.com`. And install it according to the instructions of this product. Make the jre capable of running from any directory. To test if the jre is really working, enter the command in a shell:

```
java -version
```

This prints the current running jre's version. Now your machine is ready for LAoE. The binary file of LAoE is a gzipped tar-file. Simply extract it to any location of your machine. You need to preserve the file-hierarchy of the tar-file, if you don't, LAoE will not work. On linux, you need to type following command in a shell to perform the extraction:

```
tar xvzf laoe_bin_v0_4_08.tar.gz
```

On windows, doubleclick the tar-file, and probably winzip will start. This tool is capable of extracting gzipped tar-files.

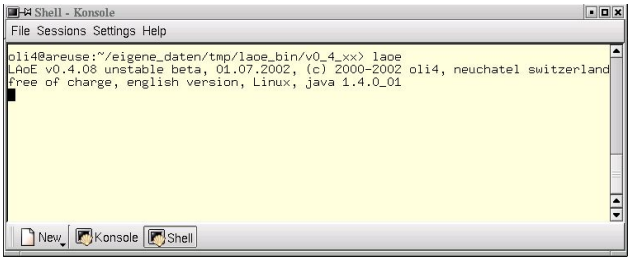
That's all, LAoE is now installed.

Launching LAoE

On linux, open a shell, go into the path `.../v0_4_xx` and start the script `laoe`.

On windows it is very similar. Open a DOS-command-terminal, go to the path `...\v0_4_xx` and start the batch-file `laoe.bat`.

Now the following (or similar) text should appear in the terminal/shell.



Then a splash-window should appear, where startup informations is shown. After a few seconds, the LAoE main frame appears, and LAoE is ready to be used.

Problems

Most of the problems reported can be reduced to follwing mistakes:

- An older version of the java runtime environment than 1.4.0 is installed. In this case, the script/batch terminates with error-messages. Maybe jre 1.4.0 is installed, but an older version is also installed and started per default. In this case update your paths. Maybe jre is installed but not added to the path, so your system doesn't know where to search for the jre-binaries. In this case add the path to your system. The version of the current running jre can be checked with the command `java -version`.
- The binary file was extracted without file-hierarchy information, flat, into one single directory. In this case LAoE may begin to start, but will fail during startup. Check if in the directory `v0_4_xx` you have a subdirectory `history`.
- LAoE has been installed on a machine without the required resources. It seems to work, but much too slow. Memory swap doesn't end, after minutes the result is visible. If you have a Pentium 1, 133MHz, 64MB RAM, LAoE will maybe run, but too slow to work with.
- LAoE has been launched from another directory, like:
  `/xxx/yyy/laoe`
  where /xxx/yyy is the path. LAoE will not work properly when launched from another directory. Change into /xxx/yyy and start LAoE from there, like this:
  ```
  cd /xxx/yyy
  laoe
  ```
- Your computer has not enough memory to launch LAoE, an error message appears. There is an issue to tell LAoE to use less memory. Edit the file `laoe` (or `laoe.bat` on windows). Replace the memory size with a smaller number like:
  ...java -Xms128M -Xmx128M -jar laoeUi.jar...
  or
  ...java -Xms64M -Xmx64M -jar laoeUi.jar...
  which corresponds to the number of megabytes to use. Ok, you will not be able to edit as big files as with the original LAoE, but LAoE will work on your computer.

If your installation still doesn't work, and if none of these points above concerns you, send me an e-mail to `laoe@oli4.ch`. I will try to help. The file `trace.txt` contains debugging information. You don't need it, but maybe I will ask you to send me that file.

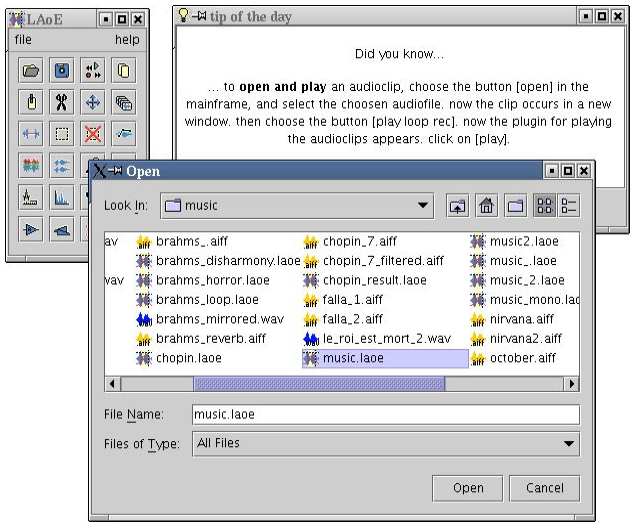
Homepage

LAoE has its own official homepage at `www.oli4.ch/laoe`. In addition to the program itself, you find informations related to LAoE, screenshots, documentation, news, tutorials (also this document) and an online forum. So if you want further information, have a look there.

6. Open and playback

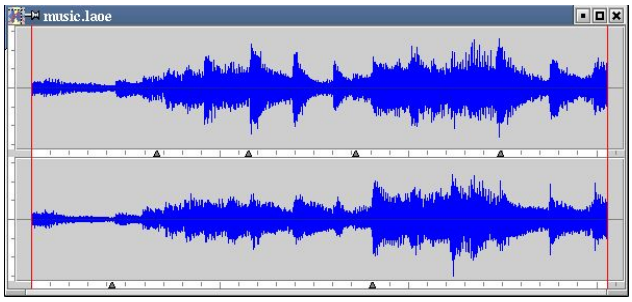
Open

Let's start with simply opening an audioclip and playing it. After launching LAoE, the main frame appears (the small frame on the top left, with the title LAoE), which allows to start most common functions and plugins, through the buttons. In addition, the `tip of the day` frame appears. Read them is a good point of start, to learn more about LAoE. They are very complete.



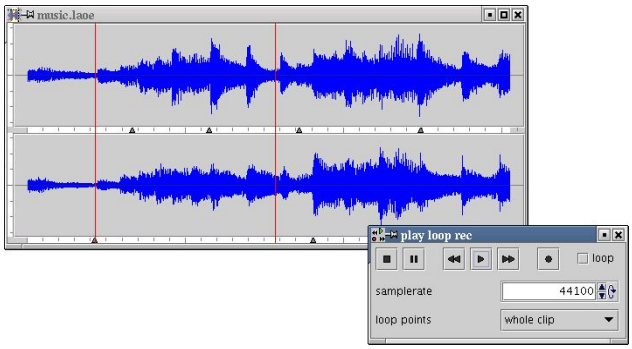
So let's open an audioclip. Click the `open` button or

select the menu [file] [open]. The open dialog frame occurs, here we select the file music.laoe. The clip frame music.laoe appears. It is a stereo clip, both channels (left and right) are visible one on the top of the other.



Playback

Now we need to start the plugin [play loop rec] in the main frame, or through the popup-menu inside the clip frame. The red vertical lines in the clip represents the played range (or loop points). They can be moved with the mouse.

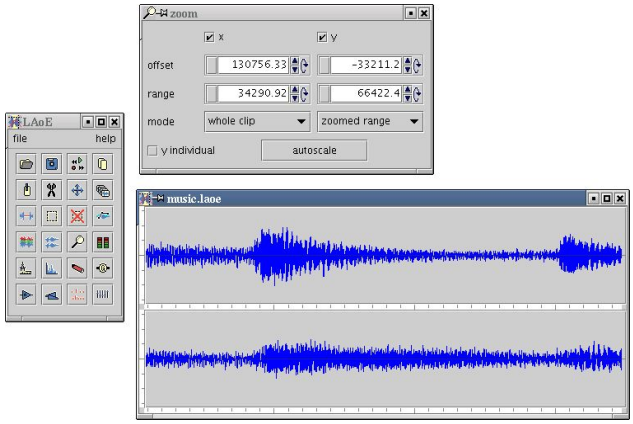


Click on [play] to hear the defined range of the audioclip, and click the [loop] checkbox to hear it continuously looping. Select [whole clip] to hear the whole clip from beginning to end again.

7. Editing

Zoom in

Now we want to cut a middle part of the clip. Since the actual view doesn't give enough details to work precisely, we first want to zoom into the considered range of the clip.

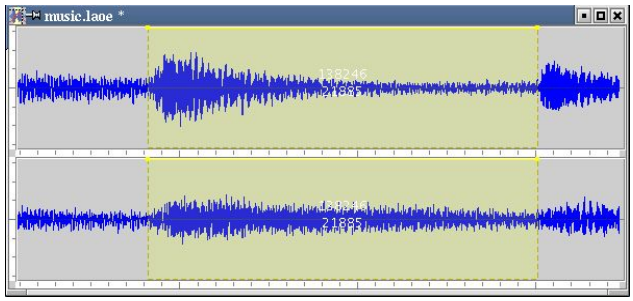


Start the [zoom] plugin from the main frame, select the zoomed range's left corner, press the [shift] key, and press down the mouse's left button. Keep the mouse pressed, drag to the right corner of the zoomed range and release the mouse button. During this manipulation, you see a dashed line of the future zoomed area of the clip.

After releasing, the zoomed range occupies the whole clip frame. The zooming is valid for all channels, even if performed in one channel only. You can zoom in and out freely. Press the [shift] key and click with the mouse zooms out with factor 2, with doubleclick you can autoscale the time axis to the whole clip again. The same is valid for vertical zooming, when pressing the [ctrl] key.

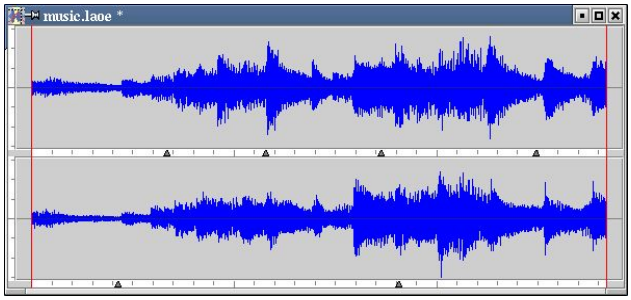
Select

Now start the [select] plugin from the main frame. Begin dragging the mouse from the top channel, from left to right down to the bottom channel. A selection is build in both channels, they contain the same range. Selections are painted in yellow, and they contain two visible values, the upper is the offset, the lower is the length. This is a way to create same selections on neighbour channels. If you want to select in a single channel only, stay inside this channel when dragging the mouse.



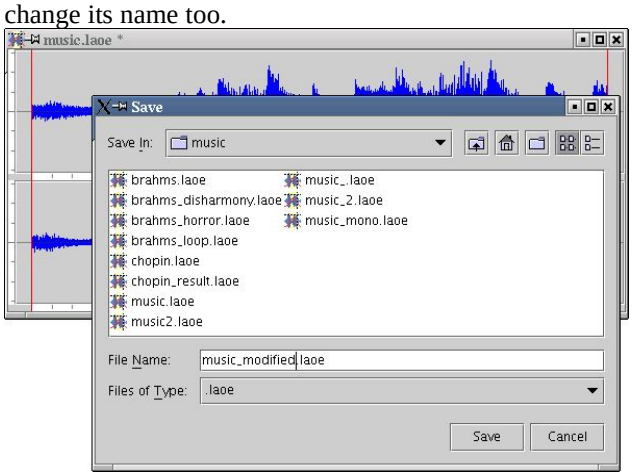
Cut

We want to cut the selected part. Perform the [cut] plugin from the main frame, and the selected part is cut immediately. The clip is a little shorter now, and the selection has gone. Now [autoscale] the clip (from the zoom plugin), and the whole clip is visible again, with the cut part in the middle, as in the figure below.



Save

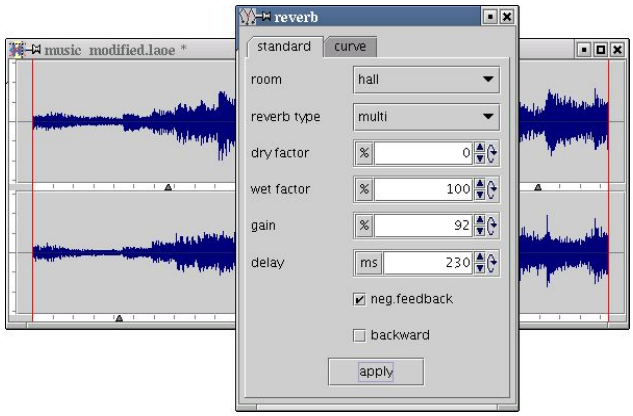
We want to save this modification in a new file with the name music_modified.laoe. Start the [save as...] plugin in the menu [file]. We keep the LAoE-specific fileformat .laoe. The clip frame will change its name too.



8. Simple effect

Reverb

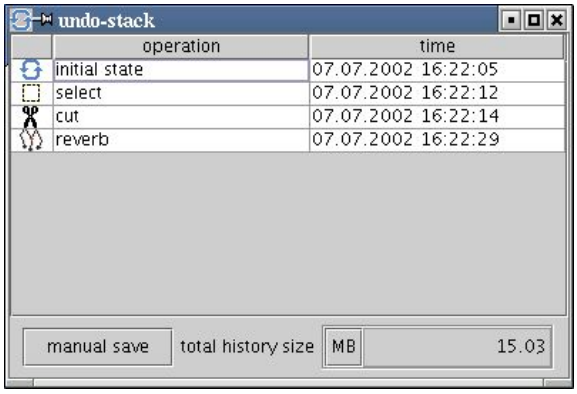
We want to add a reverb on the whole clip, and fade out the ending. Effects like reverb must be started from the popup-menu of the clip frame, when clicking the right mouse button. You find it under [clip] [effects] [reverb...]. Since the effect should be performed on the whole layer, no selection is required, because no selection means whole layer selected.



Let's try with a [hall] room, [multi] reverb type, a gain of about 92% and [negative feedback]. The unit of the numeric fields can be swapped when clicking on it. When the settings are done, press [apply] to perform the effect.

Undo stack

You can now hear the result with the [play loop rec] plugin. Probably you are not happy with the reverb effect. So how to annulate the reverb? Just start the undo-stack plugin in the popup-menu [edit] [undo stack]. This plugin shows almost each edit-step you have done on this clip in an absolute view.

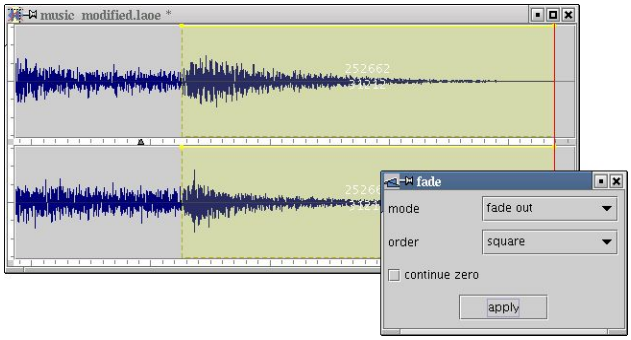


The undo-stack shows the oldest action on top, newest on bottom, adds a timestamp and allows to go back to any intermediate state at any time. Just click on the line you want to go back. In addition, you can manually save an intermediate state. This makes sense, when all settings are prepared, before perform a critical effect where undo

is probably. The undo-stack stores also all settings, like zoom, loop points, selections, markers... etc.

Complete

So this allows to try the reverb as many times you want, until you find the optimum parameters, without loss of quality of the clip. Once the reverb is satisfactory, let's do the next step: we want to fade out the end. Zoom into the end of the clip, and select the range which should be faded. Start the fade plugin from the main frame (or the popup-menu in `[clip] [amplitude] [fade...]`). Set the `[fade out]` mode, and apply it. The samples visibly decrease now to the left.

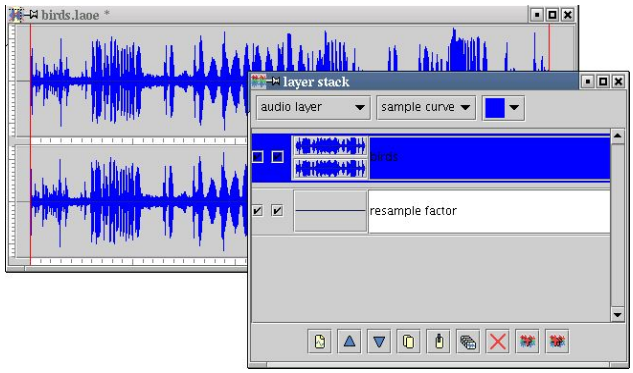


Finally unselect the layer with the `[unselect layer]` button from the main frame. Zoom out to the whole clip, performing `[autoscale]` in the zoom plugin, and save this clip. Your first audio-manipulation with LAoE is now terminated!

9. Complex effect

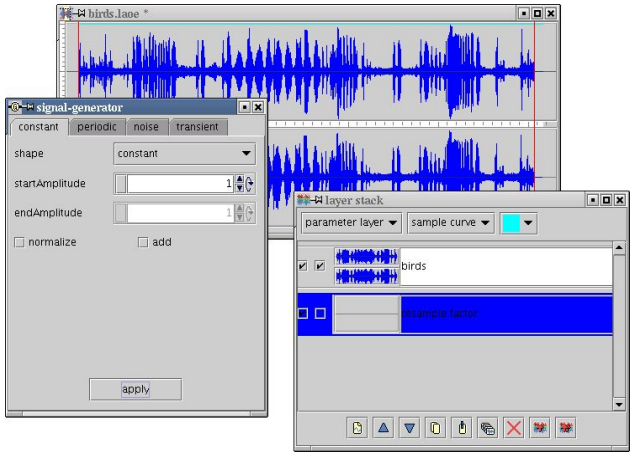
Variable resampling

Now we will make more complex operations. We want to resample the clip in variable manner, using a curve to define the resampling factor in function of time. This allows to perform doppler effects. How to proceed? First of all, we need a second layer, where this factor is defined as a parameter-curve. Start the layer-stack from the main frame or from popup-menu in `[clip] [samples] [layer stack]`. The layers are represented in a list. At the time, only one layer exists. This contains the bird-song. Click on [new layer], to create a second layer. We only need one channel at the moment. The layers may be renamed.



The new layer `[resample factor]` contains all zero samples, full length. Select this new layer in the layer stack. It is important to select the right layer, because all manipulations will be performed on that selected layer only. athe selected layer is painted in blue. This new layer's type must be a parameter layer, so it is not hearable when playing the clip. To hear such a parameter makes no sense here.

Since the neutral factor of resampling is 1, we generate a constant signal with all ones. To do this, start the signal-generator plugin from main frame or from popup-menu `[clip] [generator] [signal generator...]`. Select the `[constant]` tab, and apply a constant curve with an amplitude of 1.

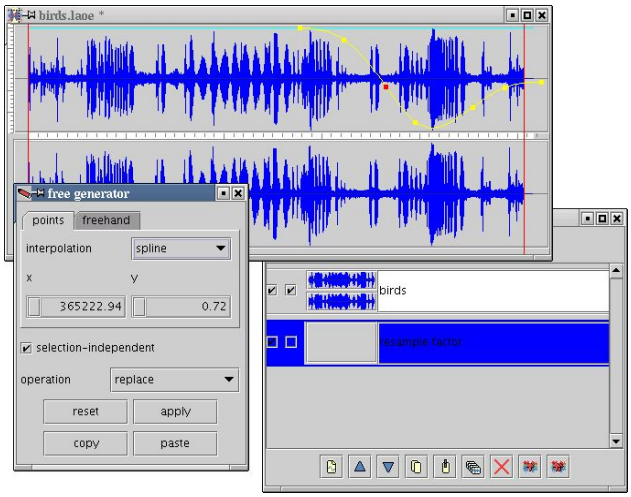


Now the constant signal is visible in light blue, and the bird song in dark blue. Now the best way to go is to zoom the parameter layer in the range about 0.5 to 1, so we can work precise enough.

The free generator found in `[clip] [generator] [free generator...]` allows to draw a curve with the mouse, which is used to design the parameter. We want to decrease slowly to 0.5, and then increase again to about 0.75. Several interpolation methods are possible, we choose the `[spline]` interpolation, which gives a very smooth curve. Editing the curve is very easy:

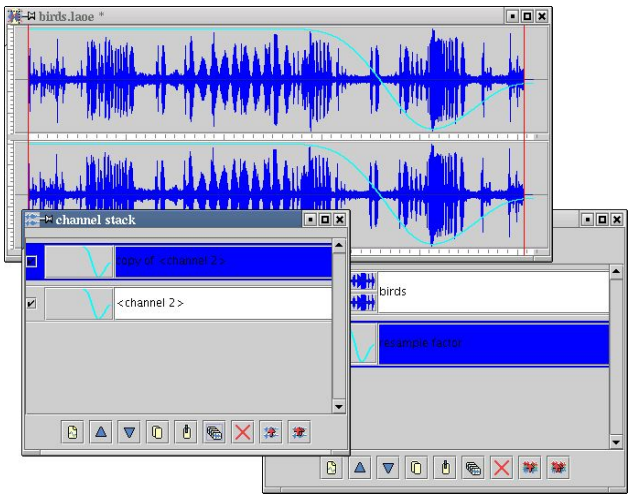
- mouse clicks adds new points
- mouse clicks with pressed [shift] key erases the current (red) point
- mouse drag moves the current point

Once the curve is edited, press [apply] to perform this curve on the layer.



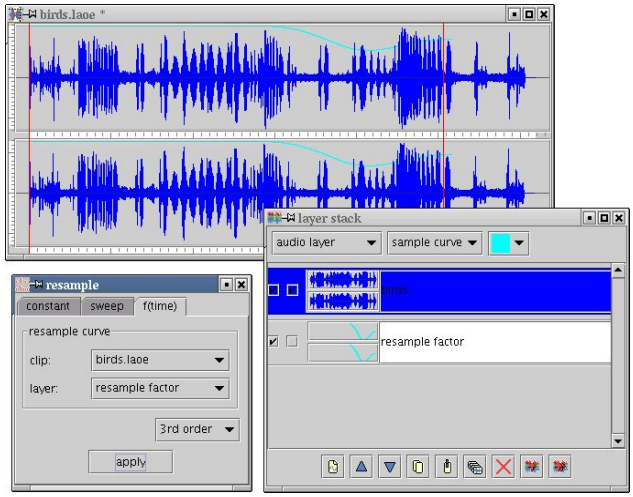
The curve is now finished. The incredible thing in LAoE is the fact, that any parameter curve has the same edit-possibilities as a normal audio curve. So you could perform any effect on a parameter curve!

Since each layer may have a separate parameter curve, we need to create the second channel. We want the same curve for both channels. The easiest way is to duplicate the first channel with the help of the channel stack, found in the main frame or the popup-menu in `[view] [channel stack]`.



Now we have two beautiful identical curves in the `[resample factor]` layer. Our target was to resample the `[birds]` layer in a variable way. So select the first layer again, this is the layer we want to modify, and start the resample plugin found in the main frame or the popup-menu `[clip] [samples] [resample...]`. Select the `[f(time)]` tab, and choose the parameter layer here. After applying, the clip has become longer, because the resampling factor is partly below 1, and values below 1 makes the clip longer.

Now we dont need the parameter layer anymore, we can delete it with the button `[delete layer]` in the layer stack.



Progressive effects

After resampling, we want to perform a progressive filter at the end of the clip, as if the original sound comes slowly from an old radio. Progressive effects may be done with almost any effect. This is possible with the concept of selection-intensity.

Selections are not only capable of selecting a sample-range with an intensity of 0% or 100%, but any value inbetween is also possible. What does this mean? Manipulation based on such selections are finally mixed with the original sound instead of just replace them, in the proportions given from the intensity value of the selection, which typically varies in time. A selection intensity of 30% means, the modified part is mixed with the original part, the modified part is 30%, the original part 70%.

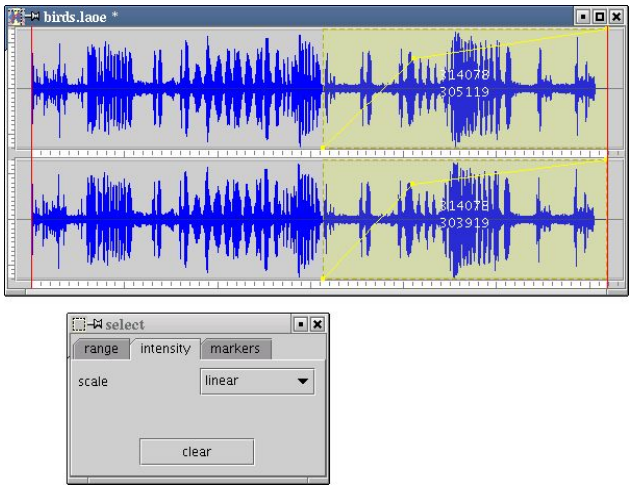
The variable intensity allows to make filtering, reverb, chorus... etc. begin or end in a natural, progressive manner, instead of beginning immediately in one shot.

We select the right part of the clip if the well known selection plugin found in the main frame or the popup-menu in `[select] [select...]`. To do this, the `[range]` tab has to be selected. The mouse has different functionality depending of which tab is selected. So drag the mouse down-right, to define your range.

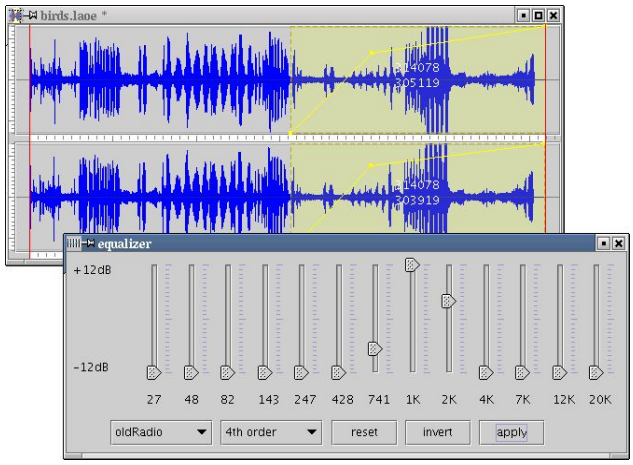
After the range is defined, select the `[intensity]` tab, and begin to define the intensity. The intensity is represented as a yellow segmented line inside a selection. Similar to the free generator's interpolated lines, the manipulation of the intensity line is done by mouse:

- mouse clicks adds new points
- mouse clicks with pressed [shift] key erases the current (red) point
- mouse drag moves the current point

The shape of the segments keeps the proportions when resizing the selection-range.

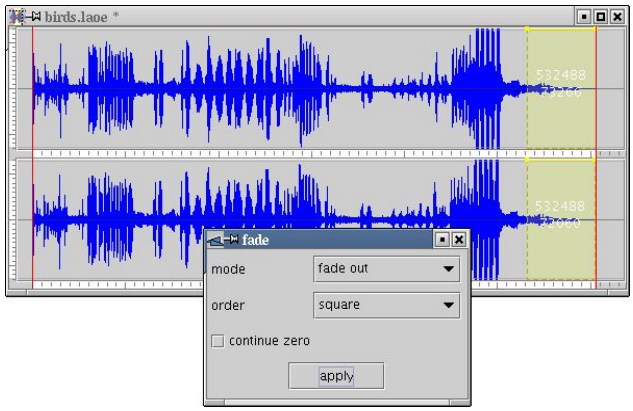


In this example we want the effect to begin progressively, so we begin with an intensity of zero and increase it in two segments to 100%. Once the intensity is edited, the selection is ready. We can now apply an effect on it. We have choosen the equalizer plugin, because its 13-bands allows easily to define a simple spectrum. We want an “old radio” effect, which amplifies most of the frequencies around 1kHz. To increase the filtering effect, we choose `[4th order]`.



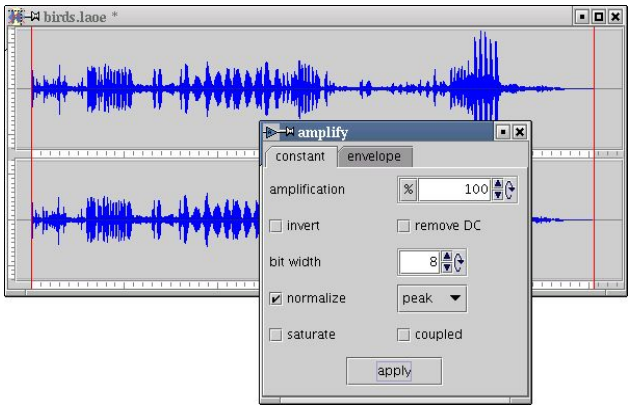
Finish

To finish our editing, we select a small end range and fade out, to reduce volume naturally.



And we have to normalize our clip, because the equalizer filter has increased the amplitude at some places, so we have disturbing clipping. Normalize is done with the help of the amplify plugin, found in the main frame or the popup-menu in `[clip] [amplitude] [amplify...]`.

Now our clip is ready to be saved.

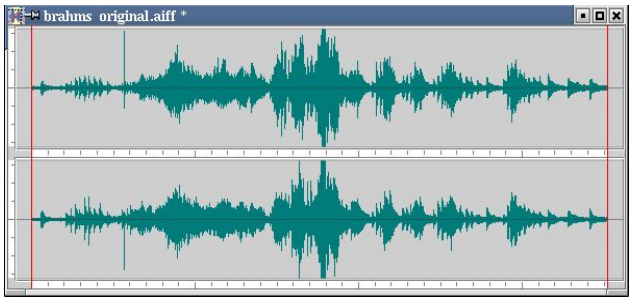


10.Reparing

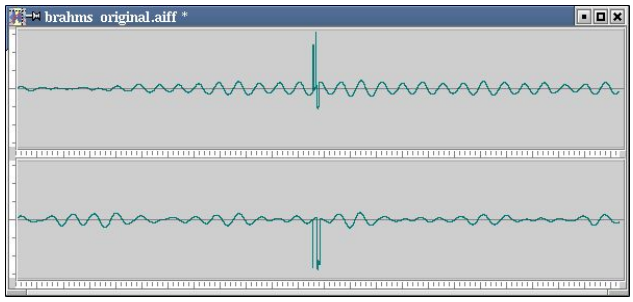
Clicks and pops

Users of sound editors often need to repair or revise their records. The source may be a vinyl record, magnetic tape or simply a bad recorded (clipped) digital record. LAoE may help to repair these records digitally, the noise, clicks and pops and other disturbing signals like can easily be removed. This chapter shows an example of a clip with such disturbing signals. We will remove them, step by step, and at the end we obtain a repaired clean clip.

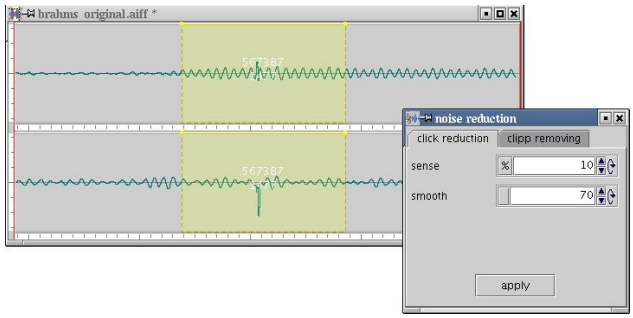
The clip `brahms_original.aiff` contains clicks and clipped samples. The clicks are visible at about 25% of the timescale, a big vertical peak is visible. The clipped samples are located at the middle of the clip.



Zoom into the click, and select the range around the click. The selected range should not be too narrow, it should have a length of several houndred of samples. The click reduction function needs enough space.



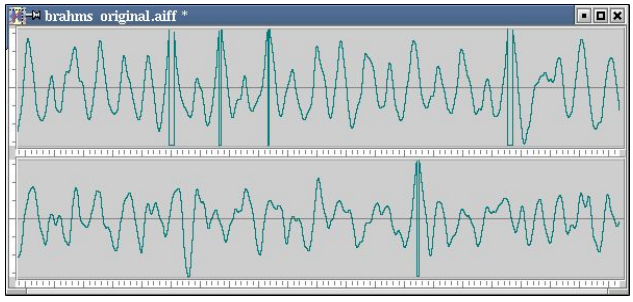
Start the noise reduction plugin in the popup-menu in `[clip] [effects] [noise reduction...]`. Select the `[click reduction]` tab, and try a sense of 10% and a smooth width of 70 samples. If the result is not satisfactory, use the undo-stack to go a step back and retry with other parameters.



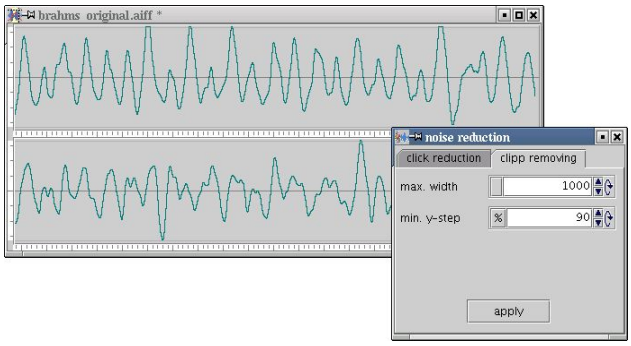
The click reduction function is an automatic function, which may be applied to the whole clip. It searches itself the clicks, and tries to reduce them. It will probably not completely remove the click, but it will reduce it strongly.

Clipped samples

Now zoom into the clipped part in the middle of the clip. A clipped sample is generated, when the recording was too loud or when amplification generates samples that contain bigger numeric value than the fileformat supports. The samples are typically projected to the opposite in negative range. You recognize such clippings in the figure below.



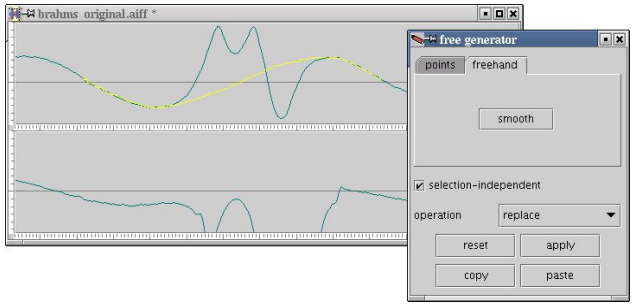
Since most of such clippings are difficult to remove by hand, because typically they appear in great numbers. LAoE provides an automatic clipp removing function, in the [clipp removing] tab of the noise reduction plugin, which may be applied to the whole clip. It finds them automatically and remove them. Compare the figure above with clippings and the figure below after removing.



Don't be surprised when playing the clip, nothing has changed, the disturbing noise is still there. This is normal, because the samples have still a too big value (bigger than the samplewidth allows). We have only repaired the shape of the sample curve. Now we have to perform a last step: normalize the clip with the help of the amplify plugin, found in the popup-menu in [clip] [amplitude] [amplify]. Set the amplification to 100% or below, and select the [normalize] checkbox. Now the clip may be played, and you will not hear any disturbing noise at this section anymore. The clipp removing works very well, it gives satisfactory results in most of the cases. There is just one condition: the clipping must be distortion- less, it must be a clean numeric clipping without non-linear changes.

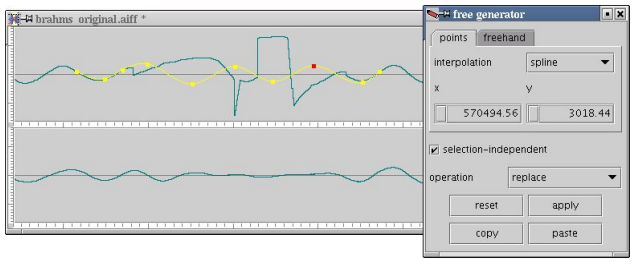
Reparing by hand

We have seen before, the click reduction doesn't remove the clicks perfectly. There is an issue to increase click removing, but with the price of more work by hand. Clicks may be removed with the help of the free generator, in the popup-menu in [clip] [generator] [free generator...]. When zooming very deepely into the click, you may estimate how the sample curve would look like, if the click would not exist. Now select the [freehand] tab, and draw your click-less curve with the freehand generator. You may redraw it partly, correct it many times, smooth it or erase the ends when pressing the [shift] key and dragging to the left, or snap it to the original curve when pressing the [ctrl] key. Once you're happy, you may apply the freehand curve. The samples will follow your curve now. If you want to edit the second channel, please select the second channel in the channel stack, found in [view] [channel stack...].

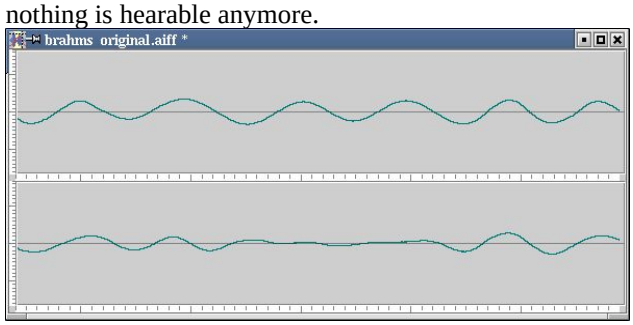


Now play the clip. The click has gone perfectly, you will even not be able to locate the click again, the curve is too smooth.

There is another method to generate smooth curves. Select the [points] tab in the free generator and try to draw a spline curve. The curve is generated quicker, the curve will be guaranteed smooth. In general it is preferable to use this spline curve than the freehand, but both methods are usable.



Compare the figure above, with a click, and the figure below taken at the same area, after removing the click with the help of a spline curve. The click has totally gone, nothing is hearable anymore.



You see, LAoE is really usable for repairing damaged audio clips.

That's all folks!