

Tutorial 01

Audio Editing 101

The basics of manipulating sound files.

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As this is the first tutorial in the series, I thought it best to start at the absolute beginning with some really simple steps to understand how audio editing works. This tutorial is aimed at first time audio editors, but having said that everyone might pick up a useful hint or two, so have a scan through it to see if there's anything that might help you out.

First we need an audio editing program. As often as possible I will use free to download programs in the tutorials so that everyone can follow along on their own computers. I am using a program called Audacity for this tutorial which can be downloaded here:

<http://audacity.sourceforge.net/>

I work on PCs so if you work on a Mac you wont be able to follow through on the exact same program, but most of the terminology and ideas in all the tutorials are general to audio production, so you should be able to pick up stuff that you can do on your Macs.

Once Audacity is installed open the program and start by creating a sound for to work with. Go to the top menu: **Generate/Tone.**

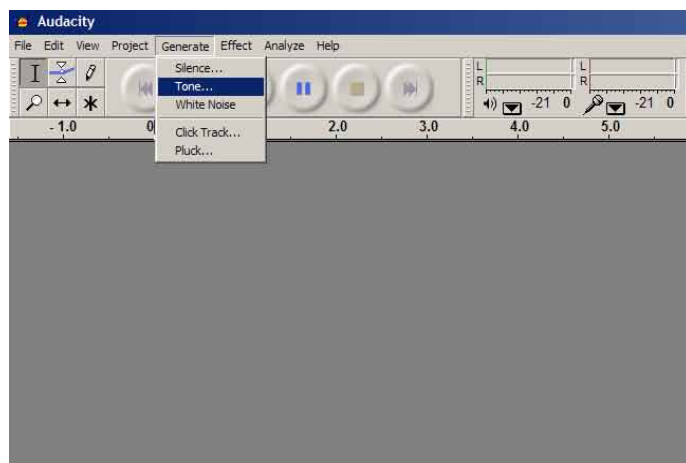


Figure 1. Generate Tone menu

A window with the various settings for generating a tone will pop up, for this tutorial the default settings will be suitable. This will create a 440Hz sine wave.

The settings of the **Create/Tone** window are:

- Sine wave** refers to the type of wave pattern.
- Frequency** refers to the pitch or note that the sound will be (The higher the frequency the higher the note).
- Amplitude** is how loud the sound will be.
- Time** is how long the sound will be in seconds.

This is a really good time to introduce the glossary page for the library. Go here (glossary link). Now you should have a little pop up window you can move around your desktop. It has a large list of audio and video terms and an explanations for them. In all cases if you need more info jump online to Google or go to Wikipedia.

www.google.com

www.wikipedia.com

Now there is a sound wave you can listen to, this is the associated sine wave.

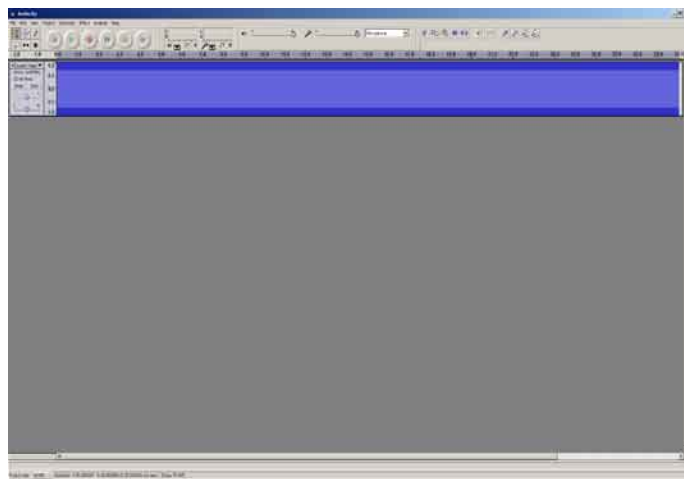


Figure 2. A Sine wave generated in Audacity

This sound will be a constant tone much like a test pattern on the TV or radio, and is pitched middle A on the piano. 440 Hz is concert pitch A. You can play the sound in Audacity by pressing the **Play** button or tapping the **Spacebar** on your keyboard. A lot of audio programs default to the **Spacebar** to activate the play control.

As there is only one sound click on the bottom of the wave file drag it downwards to make it bigger. This will make it easier to see details.

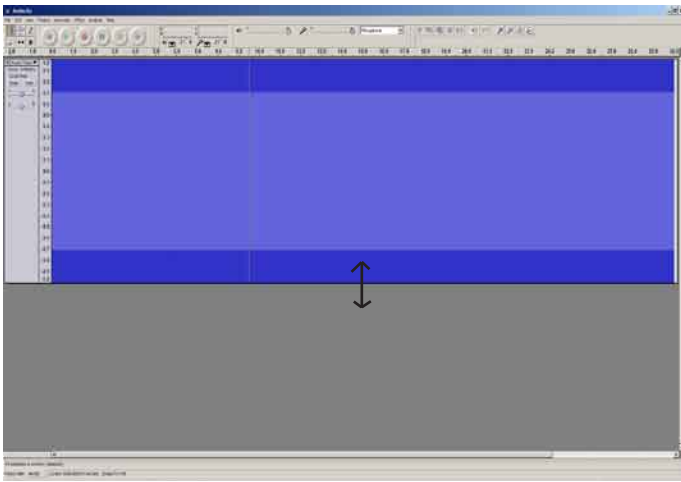


Figure 3. Resizing the wave file window by dragging

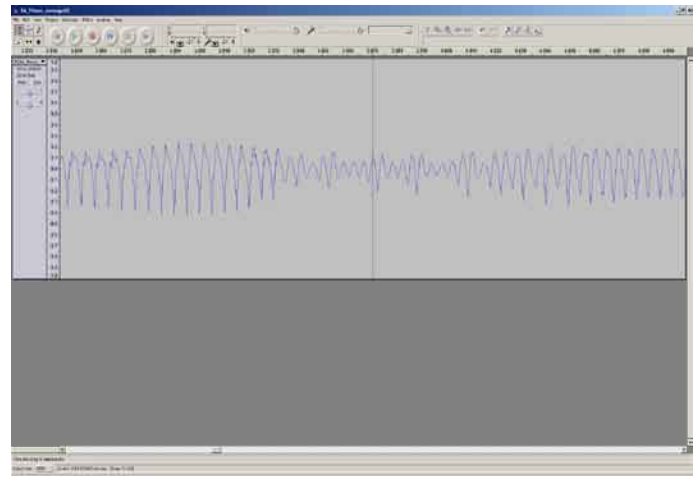


Figure 4. Detail of a complex wave form (speech)

Now click on the **Zoom** button to zoom in on the wave file. Keep clicking until it looks like the image below. It might take a dozen or so clicks. This is the actual shape of a sine wave. A **Square Wave** would be a square pattern and a **Sawtooth Wave** would be triangular. These are very basic tones and so have very simple patterns.

If you continue to zoom in you will get to the level in the following image where you can see the individual samples. The standard sample rate for CDs of 44.1KHz means 44,100 samples per second, so 44,100 of those little steps every second. I haven't counted them myself but feel free to if you have the time. The higher the sample rate generally the higher the quality of sound as it contains more information and can better cope with sounds of higher frequencies. But higher samples rates also mean bigger file sizes as the extra information takes up extra data space.

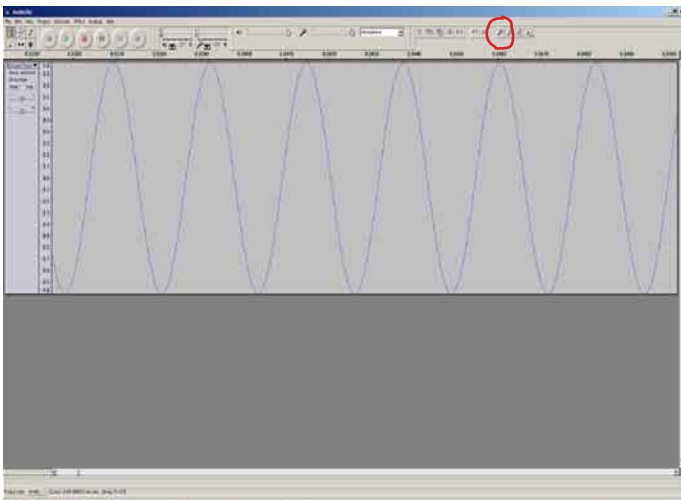


Figure 3. The Zoom function and expanded sine wave.

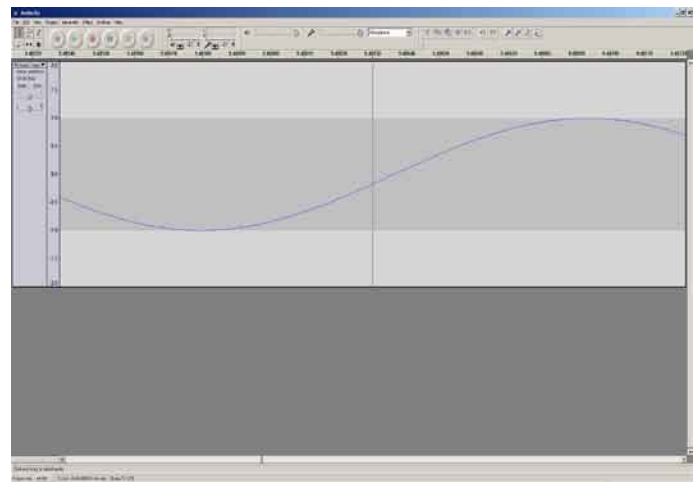


Figure 5. Individual samples within a sine wave

Zooming in this close on a recording of a car engine, someone talking, or any more complex sound would look far more irregular as the sounds are far more complex. Most sounds we hear are made from a collection of many various wave patterns combined. When wave patterns are combined the shape changes as each wave contributes to the final pattern. Combining a square wave pattern and a sine wave pattern would result in a square wave shape with rounded edges.

If you switch to the pencil tool you can actually click and drag each of the samples to different positions however I wouldn't recommend this. Manipulating individual samples will usually only destroy how a sound works, but it's interesting to understand the process. Have a listen to your sound now and you can probably hear some clicks in it. Take note of the time where you changed the samples, then zoom out and play your sine wave.

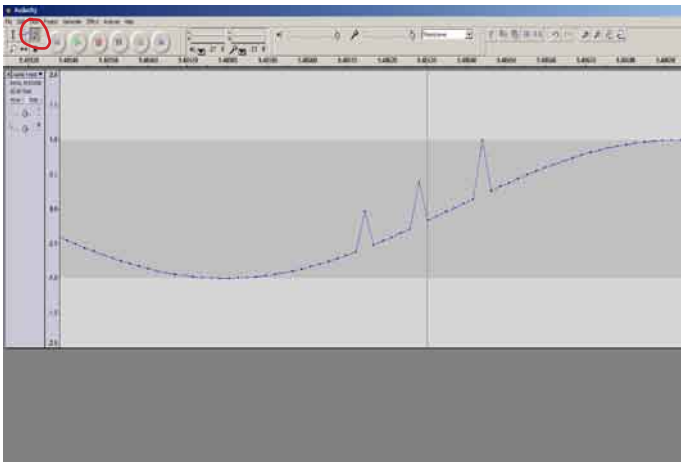


Figure 6. Pencil tool and per sample editing

You should be able to hear clicks at the time you changed the samples. Significantly displaced samples is often the cause of clicks, pops and other unwanted sounds. Various things can corrupt a signal and result in sample information that is not desirable. Some programs have functions that can search through and try and fix these problems by removing or realigning them. As I said, it really isn't practical to do it yourself this way.

Now go up to the **Edit** menu and chose **Undo Sample Edit**. It should remove the last sample change you made. Another way to do this more quickly is **Ctrl +Z** this command is the default undo command for most programs and is really useful. Make sure you **Ctrl +Z** for each change you made. This should return you to the original sine wave sound. Now zoom right out again so you can see just the continuous blue block of the sine wave. Whether zoomed right in or right out you can see that all the wave shapes and the resulting blue block that makes up the waves are all the same height. In representing sound waves, the height of the wave form represents amplitude (how loud it is). This sine wave is all one volume so its height doesn't change. Let's change that. Make sure you are back on the **Selection Tool** and completely zoomed out so that the entire wave is visible. Now click and drag to select the end part of the sine wave. A corresponding area of the time line should turn grey to indicate the selection. See figure 7. If you press play now you will only hear the area that is highlighted. This is useful if you want to focus on a small area of a larger sound. Now you are going to change how the sine wave finishes.

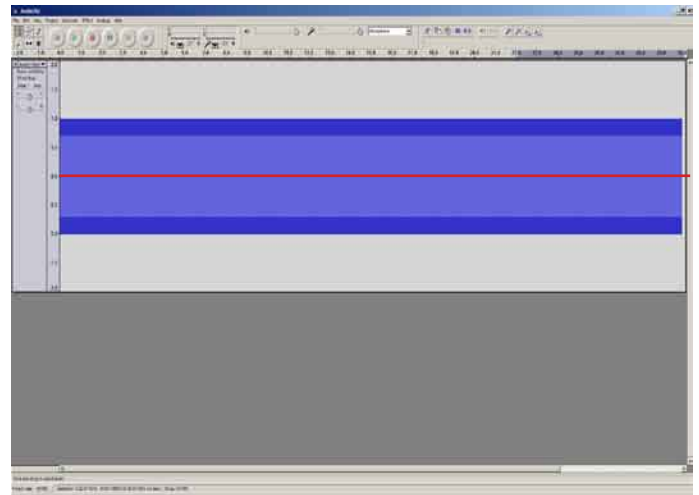


Figure 7. Selection Tool, selected area and zero point line

Go to **Effect/Fade Out** and select it. The end of the sine wave has now changed. Visually it's become all pointy, this is because the amplitude is reducing from its maximum down to zero over the amount of time selected. Another important note about sine waves is. The bottom of the wave form is not zero. The central horizontal line down the middle of the wave shape is zero. A sine wave alternates up and down from a negative value to a positive value of amplitude.

The line in the center of the wave shape is the zero point and is very important. The sine wave now has each wave shape reduce little by little over the time specified until it has reached zero in the middle. If you want to understand this better, zoom in on the sine wave and follow how each curving wave shape gets smaller and smaller as it fades to zero in the middle. This is exactly how ripples in a pond behave. If you drop in a stone the ripples at the centre will be the biggest and as they get further out they will get smaller and smaller until there is just flat water again.

Congratulations you created a fade out. Hit **Ctrl Z** to undo your fade and practise selecting different amounts of the sound file and applying a fade over different times. You can apply a fade from the very beginning of the sound over its entire 30 second length, or you could apply a very short fade over a fraction of a second. You can also apply a fade in the middle as well. While you're experimenting try the **Effect/Fade In** function as well, it will fade a wave in over time from zero amplitude to its maximum. See if you can copy the following pattern with your sound file.

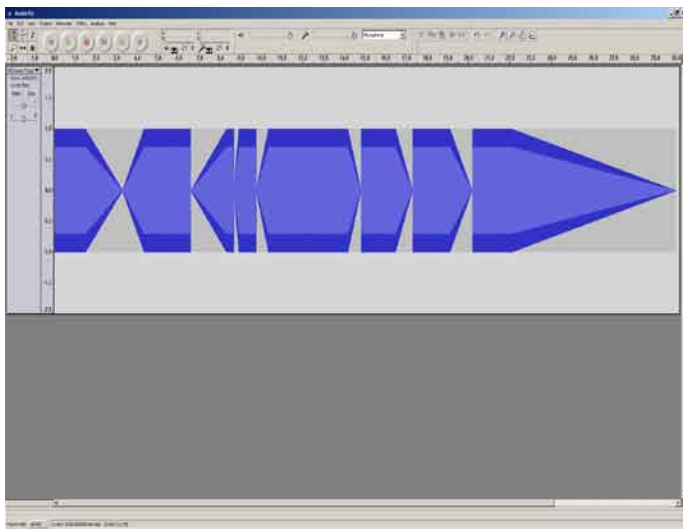


Figure 8. Wave file with various fade ins and fade outs

As you listen back to your pattern you will hear the volume going up and down, you will probably also hear some nasty clicks in the sound file. This is because of badly placed samples in the sine wave. This is a good time for a rule. Whenever possible, if cutting or pasting audio data, or creating fades of any sort, it's important to try and match the edit point to the zero crossing points referred to before. When a wave form is at zero there is no output, so cutting and pasting will join seamlessly. Whereas if cut halfway through, a wave pattern is like unplugging music while it is still playing; It will often go pop or click. Figure 9. indicates the **Edit/Find Zero Crossing** function. When you drag select an area of a wave file and then apply the find zero crossing function it will automatically move the edges of the selected area to the nearest zero crossing points. This is one of the most useful tools in audio editing as it will create clean edits with no clicks or pops.

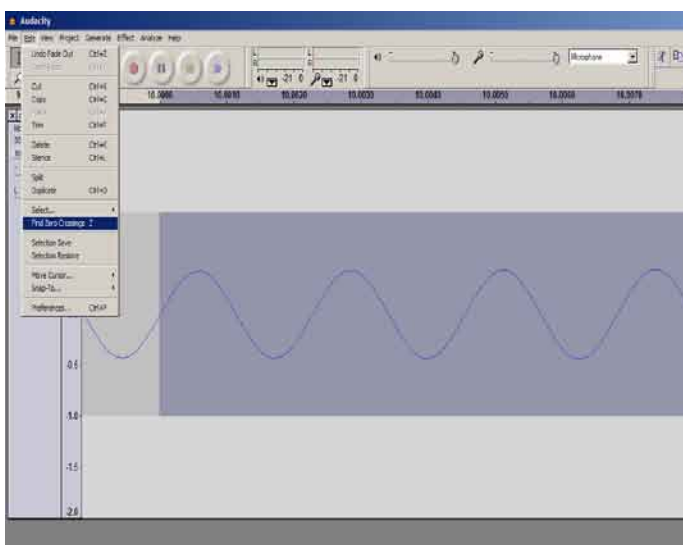


Figure 9. The Find Zero Crossing tool

Keyboard Shortcuts

I want to stop for a second to mention keyboard shortcuts. As I said before, to undo an action go through the **Edit** menu and select **Undo**, or just use **Ctrl +Z**. **Ctrl +Z** is called a keyboard shortcut and it makes editing much faster. The function **Edit/Find zero Crossing** is linked to **Z** as a keyboard shortcut. When processing a lot of audio material keyboard shortcuts are brilliant for speeding up workflow and just generally making things more efficient. In fact in any area whether it's audio editing, 3D graphics, word processing or even programming, experienced users will use keyboard shortcuts as much as possible, and it can often be the difference between being really good at what you do or just average. Try a few out and see how much difference they make. Many programs allow the user to set up keyboard shortcuts, and it's usually the first thing I do when I install a new program because it makes life so much easier.

Returning to the tutorial; **Copy/Cut** and **Paste**. These functions work exactly the same as in any other program. Select an area of a sound file (find the zero crossings) and then **Copy** or **Cut** the selected area. You can then **Paste** that selection to a new area of the sound file. Usually you will not need to **Copy** and **Paste** within the one sound file, but you will probably find it useful to **Copy** a section of one sound file and **Paste** it into another. Or perhaps you only want a small section of one sound file. You can either select and **Delete** all the unwanted material, or you could **Copy** the section you want to use and **Paste** it into a new blank sound file to start fresh. Some audio editing programs allow you to "copy to new". This automatically creates a new file and adds the material you selected to it. I use this function dozens of times every day as it's an excellent way to work with the material you have selected without destroying the original by deleting sections. You can, of course, **Delete** material by drag selecting and using **Edit/Delete** to remove the material you have selected.

You will notice that with Audacity that if you **Cut** a selected area the program will remove the material and close the gap that the material occupied thus rearranging the sound file. If you want to be able to cut the middle out of a file and leave the hole remaining, there is a way to do this. Drag and select a region around the middle of the sound file. Use the **Edit/Copy** function instead of the **Cut** function. You have now put the selected region into the memory so you can **Paste** it somewhere else later, but before you **Paste** it you need to create a hole. Select the **Generate/Silence** command, it will pop up a window that allows you to indicate how long exactly you want the silence to be, by default it will have a value displayed that exactly matches the selected area, so in this case all you need to do is press **Generate Silence**. It has now replaced the sound in the selected area with silence. With this method you can also make the hole longer or shorter by redefining the length of silence generated. Now you can either leave the area silent, or **Paste** different material into it and the sound material you copied can be pasted somewhere else as needed.

By using the simple selection of fades and **Copy** and **Paste** you can produce some interesting effects and radically change existing sound files. This tutorial started with a generated sine wave, but any of the steps could be reproduced with any sound material and will result in different final sounds. The cleverest sound designers use their ears, their imagination and a selection of basic editing tools and to create interesting and effective sound effects. You don't need lots of fancy tools to make good sounds. Try working through some of these basic tools with some different source sounds and see what can be created. Later tutorials will include information on other sound editing tools such as pitch and time manipulation.