CHAPTER 9

A Visualization of Digital Audio: Spectral Analysis

Now that you have an understanding of how to use the Audacity 2 Effect menu to implement algorithmic effects and plug-in filter processing in your digital audio editing, it is time to look at how you should **visualize** the digital audio frequencies that comprise your data sample waveforms.

In this chapter, you'll look at how to visualize waveform frequency distribution using Audacity's **Analyze** menu, along with the **Plot Spectrum** feature, so that you can see exactly what you are doing before and after your digital audio editing "moves," such as the algorithmic processing that you've done in the past several chapters.

You'll look at all the different types of analysis that Audacity can do, including its spectrum analysis features.

Audacity Analyze Menu: Sample Analysis

Audacity's effects and filters aren't the only tools that utilize algorithms; there are also a number of useful audio data analysis tools that use algorithms, which are configured using front-end dialogs, just like the effects and filters featured in Chapters 5–8. There are tools in Audacity's Analyze menu (yes, analysis has its own menu) for contrast (volume) analysis between audio selections, clipping analysis, finding beats, creating label track labels, exporting sample data analysis, and locating silence and the opposite of silence, which are sound samples.

You'll explore several of the most useful tools in the Analyze menu and build on this knowledge in the next few chapters. You'll learn how to generate a **label track** and conform it to vocal samples, how to **export sample analysis**, and how to do **spectral analysis**.

Regular Interval Labels: Automatic Sample Labels

Click the **Analyze** menu at the top right of the Audacity menuing system and look at the eight analysis tools available to do tedious digital audio analysis chores. Select the **Regular Interval Labels** and let Audacity create a label track and insert labels for your vocal subsamples.

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The Regular Interval Labels dialog is shown in Figure 9-1; it allows you to automate a subsample labeling process. Place your first label at 0.0 [seconds]. In the **Label placement method** drop-down menu, use the **Number of labels** option (set it at 4). Set the **Label text** to vocal. Set the **Minimum number of digits** to None. Set a Yes value for both **Add final label** and **Adjust label interval to fit length**, and then click on **OK**.

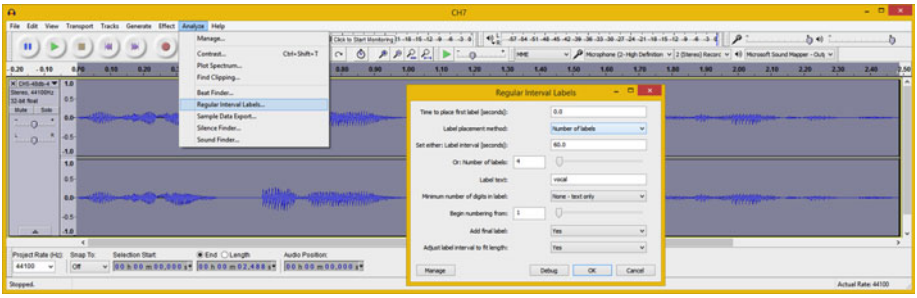

Figure 9-1. *Audacity Analyze menu and Regular Interval Labels*

As you can see in Figure 9-2, Audacity created label data in a **Label Track** underneath the Stereo Track, and labeled each vocal using a generic name, *vocal*, and left a data field ready to edit in the first (leftmost) data field, as shown in white at the bottom left of the screenshot. Backspace over the word *vocal* and type **Digital** to rename this first label.

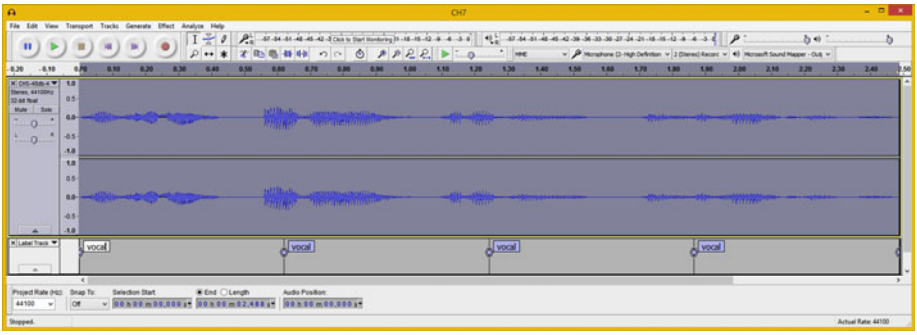

Figure 9-2. *Regular Interval Labels in their own Audacity track*

You can also place your mouse cursor over the dots on the lines that separate these labels, and when they turn white, as shown in the Fundamentals label, click and drag to position the lines where the audio subsamples begin and end, as I have done.

As you can see in Figure 9-3, once you name and position all of the label indicators, you have a great guide for your project, so that others can see what the sample data relates to.

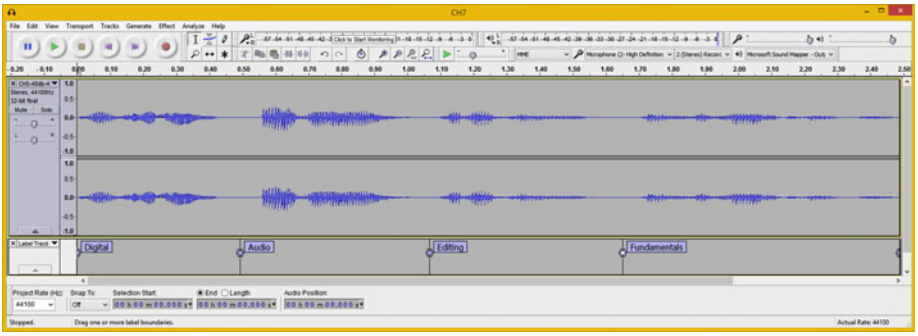

Figure 9-3. *Name and Position label indicators for each sample*

Not only can you drag the dots, which position the lines and arrowheads, but you can also drag each directional arrowhead to define the exact range of the subsample area. I have done this in Figure 9-4 so that you can see how these labels center their text label portions (or try, at least) once you fine-tune their range using the < and > arrowhead icons at the end of each label range in the Label Track.

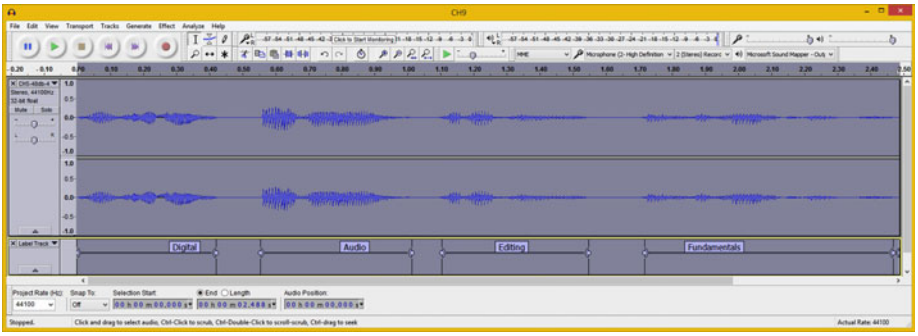

Figure 9-4. *Use label arrowheads, to show sample waveform spans*

Next, let's look at **Sample Data Export**, an Analysis menu function that exports sample data analysis based on the parameters that you give the algorithm.

Sample Data Export: Export Sample Data Analysis

Select the **Analyze** drop-down menu and then select the **Sample Data Export** option (see Figure 9-5). This opens the Sample Data Export dialog, where you can specify the number of samples, the measurement scale, the file data format, the header information to include in the file, the header text, the stereo channel data layout, the file name, the output folder, and the options to show messages and overwrite the data analysis files.

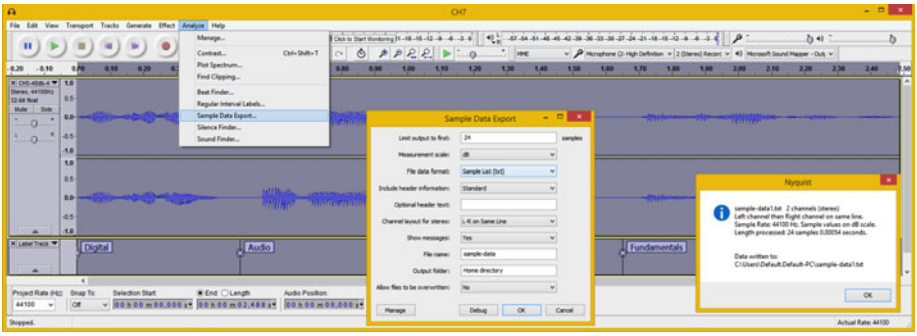

Figure 9-5. *Audacity Analyze menu and Sample Data Export dialog*

I decided to generate 24 data samples using decibels in a Sample List text data format that could be parsed (processed) with code (Java, JavaScript, etc.). I used Standard header information and displayed stereo sample analysis data on the same line. I set **Show messages** to Yes and **Allow files to be overwritten** to No. I named the file **sample-data** and used the default Home directory output folder, which for Windows is the Users folder.

Click the **OK** button to generate the sample data analysis in your Users folder in the `sample-data.txt` file. I took a screenshot (see Figure 9-6) of my Windows Explorer file management utility, which shows the `C:\Users\Default.Default.PC` folder for my workstation and a `sample-data.txt` analysis file.

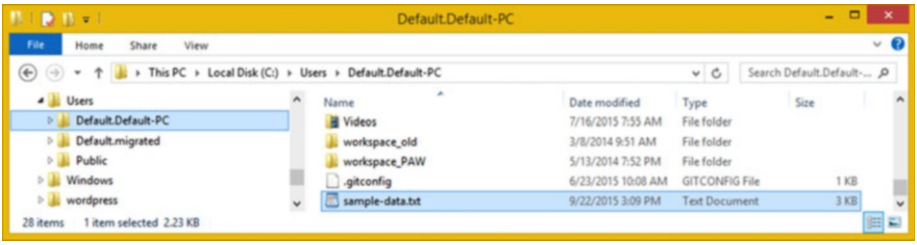

Figure 9-6. *Find your sample-data.txt file in your Users folder*

I right-clicked the **sample-data.txt** file and selected the **Open with Notepad** (the Windows text editor) option to review the sample analysis data (see Figure 9-7). As you can see in line 18 of the file, there is a decibel spike of 90 for the right channel, where your decibel level is almost twice the normal 45. This is the type of data visualization that the tool provides, along with sample analysis data that can be used in advanced ways in your programming applications.

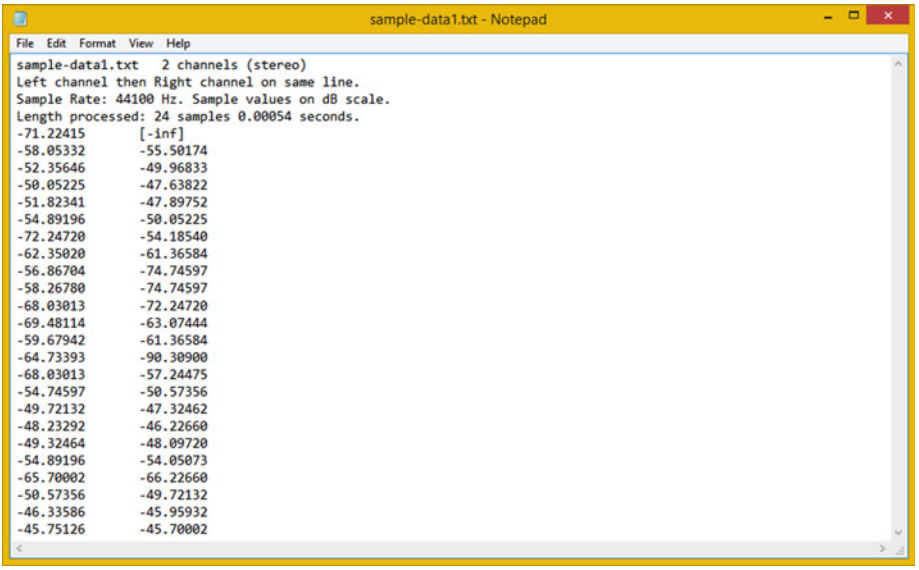

Figure 9-7. *View your sample-data.txt file in your text editor*

Next, let's look at how you can visualize an audio frequency spectrum that exists inside the audio data sample.

Frequency Spectrum Data Analysis Tools

As you have seen in this book thus far, it can be very difficult to do digital audio editing techniques using only your ears, unless you're one of those few people who have exceptional hearing abilities. For this reason, I have showed you tools or work processes that allow you to visualize sample editing data using file size data, waveforms, and sample data analysis tools. The next Audacity data visualization tool that you are going to learn about is exceptionally powerful, as it allows you to create and view a graph representation of a sample frequency spectrum.

Spectral Analysis: Audacity's Plot Spectrum Dialog

There is a **Plot Spectrum** tool in the Analyze menu that allows you to see the frequency spectrum using algorithm and frequency sampling resolution options. I recommend that you spend some time playing with the **Analyze ➤ Plot Spectrum** function (shown in Figure 9-8) on your own as well, after going through some of the options presented in this chapter.