CHAPTER 11

The Synthesis of Digital Audio: Tone Generation

Now that you have learned how to composite digital audio tracks using Audacity's Tracks menu, you should also take a look at the Generate menu, which allows you to synthesize digital audio using algorithms ranging from chirps and tones, to different types of noise, or even silence. There are even Generate menu plug-ins preinstalled in Audacity for metronome click tracks, plucked strings, and Risset Drum instruments. You already looked at the synthesis algorithm that generates DTMF Tones, so Audacity is fairly adept at synthesizing audio.

You will look at how to synthesize digital audio samples from scratch using these algorithms, as well as how to find, download, and install third-party generator algorithms to "buff out" your Audacity 2.1 Generator menu, which I'm sure you will want to do. In fact, let's get greedy and do that first!

Installing Nyquist Generate Menu Plug-Ins

Before you learn to use all of these different audio synthesis tone generators in Audacity's Generate menu, let's go to the **Audacity Team Wiki** and download seven of the coolest tone generation plug-ins so that you have enhanced the synthesis capabilities of Audacity 2.1 installation by about 100%. These are located on the **Nyquist Generate Plug-Ins** page at http://wiki.audacityteam.org/wiki/Nyquist_Generate_Plug-ins.

If you scroll down this web page (see Figure 11-1), you'll find a number of different Audacity Generate menu plug-ins that are free to download and install. This is exactly what you're going to do to get all of these cool synths!

W. Jackson, *Digital Audio Editing Fundamentals*, DOI 10.1007/978-1-4842-1648-4_11

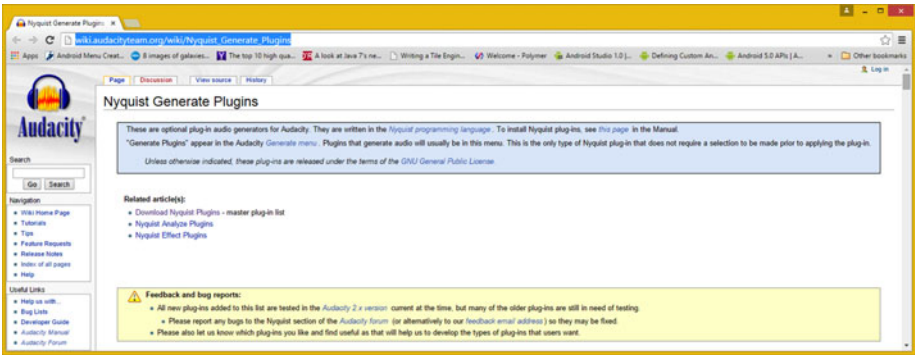

Figure 11-1. *Audacity Nyquist Generate Plugins download page*

As you download each plug-in ZIP file, extract it to the `Nyquest_Generate_Plug-Ins` folder on your hard disk drive. Next, copy the **.ny** files to your **\Audacity\Plug-Ins** folder, as shown in Figure 11-2. I'm using Windows 8, so mine is in `C:\Program Files(x86)\Audacity\Plug-Ins\`.

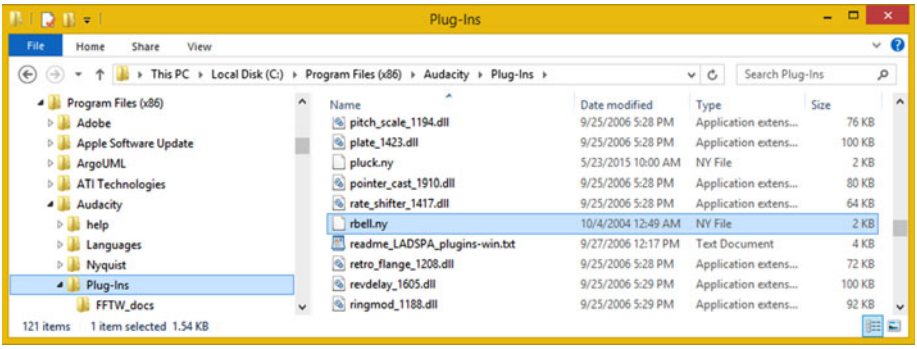

Figure 11-2. *The C:\ProgramFiles(x86)\Audacity\Plug-Ins folder*

Let's download and install seven plug-ins: Risset Bell (to go with the Risset Drum already in Audacity), the Explosion effect generator, KLSTRBAS, Tuning Fork (to go with the Metronome Click Generator), Oxygene Surf Generator, Harmonic Noise engine, and PWM (pulse-wave modulation).

Once these have been decompressed (unzipped), and copied into your Plug-Ins folder, launch Audacity, which finds the new Nyquist Audio Generator Plug-Ins and adds them to the Manage menu option in the Effect and Analyze menus, as well as the Generate menu.

Any menu that allows you to add a third-party algorithm features the **Manage** menu option. All three menus access the **Plug-in Manager: Effects, Generators and Analyzers** dialog, which is shown in Figure 11-3.

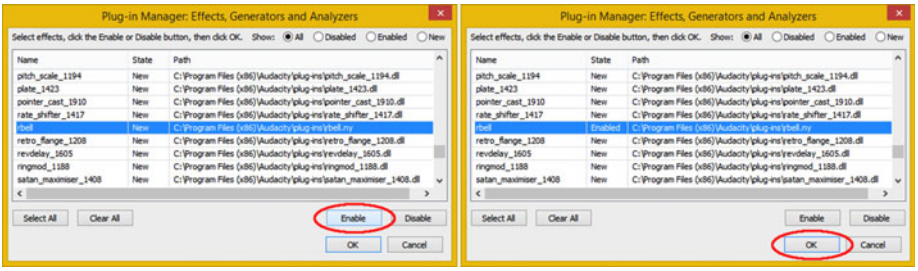

Figure 11-3. *Plug-in Manager: Effects, Generators and Analyzers*

Find the Risset Bell plug-in that you just decompressed and copied. Select it (see the left screen in Figure 11-3) and click **Enable** so that it shows in your Generate menu (as seen in the right screen in Figure 11-3). Click the **OK** button and close the dialog.

When you look at the Generate menu, Risset Bell is now right next to Risset Drum; these two siblings are reunited in sonic harmony forever. This is shown highlighted in Figure 11-4 in the left of the screen. Generate plug-ins that are DLLs and come with Audacity appear at the top of the menu and Nyquist tone generators are on the bottom.

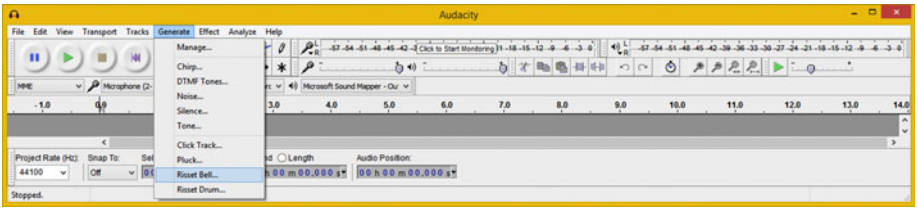

Figure 11-4. *Risset Bell Generator is now on your Generate menu*

Now you're ready to look at more than a half dozen of the 15 audio synthesis plug-ins installed on the Generate menu. If you plan to use Audacity for digital audio synthesis, there are many more of these plug-ins—so see if you can make your Generate menu as long as the Effect menu! You can also install third-party spectral analysis tools if you are into visual analysis (covered in Chapter 9).

Audacity Synthesizer: The Generate Menu

For the duration of this chapter, let's get some practice using these useful and impressive Nyquist digital audio synthesizer plug-ins. You'll look at how to create a new empty Stereo Track, how to use seven of the audio synthesis options, and see what these synthesized waveforms look like. I find this area of Audacity and digital audio editing a lot of fun, so I hope that you find it the same.

Virtual Surf Waveforms: Oxygene Surf Generator

The first thing that you need to do is create a Stereo Track so that there is somewhere for the synthesized audio to live. I normally use a Mono Track for sound effects, such as the Fire and Explosion generator, but some of these effects require a Stereo Track, such as the Oxygene Wave generator. All of them utilize a Stereo Track if it is present; I opted to use a Stereo Track so that you can see the Generate plug-ins that support it. If a Stereo Track is supported, the Left and Right Channel data samples will look different; if only Mono Tracks are supported, the Left and Right Channel data is identical.

Launch Audacity 2.1 and use the **Tracks ➤ Add New ➤ Stereo Channel** menu sequence to add an empty Stereo Track to your new digital audio synthesis project (see Figure 11-5).

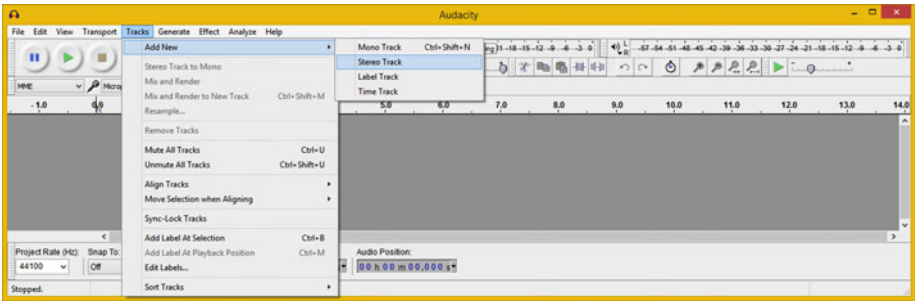

Figure 11-5. *Add a track using Tracks ➤ Add New ➤ Stereo Track*

Next, select the **Generate** menu. Notice that it's now much longer because you doubled the number of tone generator synthesizers.

Let's start with a more relaxing Generate menu synthesizer—the David R. Sky Oxygene Surf generator. If you like Surf generators, there is also the **LFO Surf** generator by David R. Sky, which is more generic (no pun intended).

Select the **Generate** menu and the **Surf [Oxygene]** option, which opens the Surf [Oxygene] dialog (see Figure 11-6).

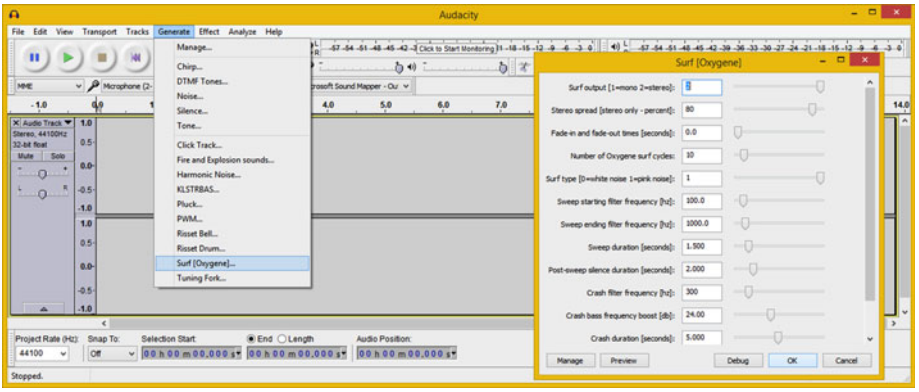

Figure 11-6. *Select the Generate ➤ Surf [Oxygene] menu sequence*

I used the stereo **Surf output** option, with an 80% spread, 0 fade effect, 10 cycles, pink noise generation, 100 Hz start frequency and 1000 Hz ending frequency, 1.5 second sweep duration, 2 seconds of post-sweep silence, a 300 Hz **Crash filter frequency**, 24 decibels of **Crash bass frequency boost**, and a **Crash duration** of 5 seconds.

As you can see in Figure 11-7, the Oxygene Wave waveform synthesis signature is very unique and different across the two channels. Use the **play** button to preview crashing ocean waves!

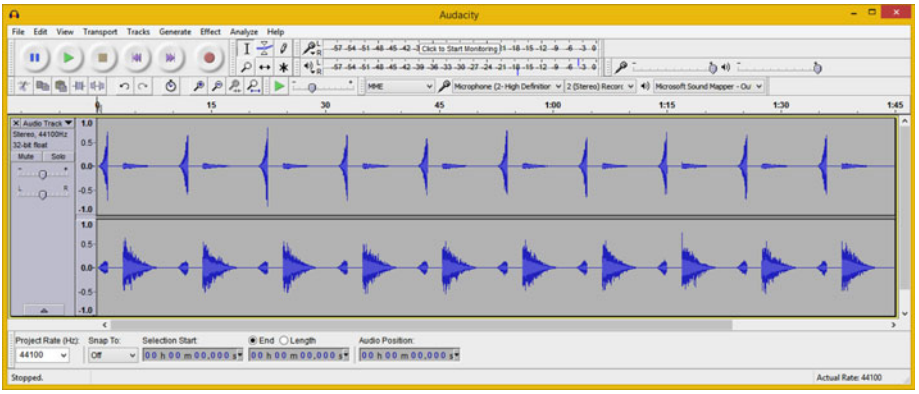

Figure 11-7. *Preview the Oxygene Wave Stereo Track audio sample*

Next, let's take a look at a more useful tone generator, **Click Track**, the virtual metronome for Audacity.

A Virtual Metronome: The Click Track Generator

If you're recording your instrument and not your voice, Audacity has a useful Click Track (metronome) tone generator that comes preinstalled. You can utilize it to make sure that you are on a beat. It allows you to set the Tempo in BPM (beats per minute), the beats per measure (usually 4), the number of measures, the Click Track duration, and the metronome tone duration in milliseconds. You can also specify start time offset, click sound, click resonance, and click pitch, all of which you can see in the Click Track dialog shown in Figure 11-8.

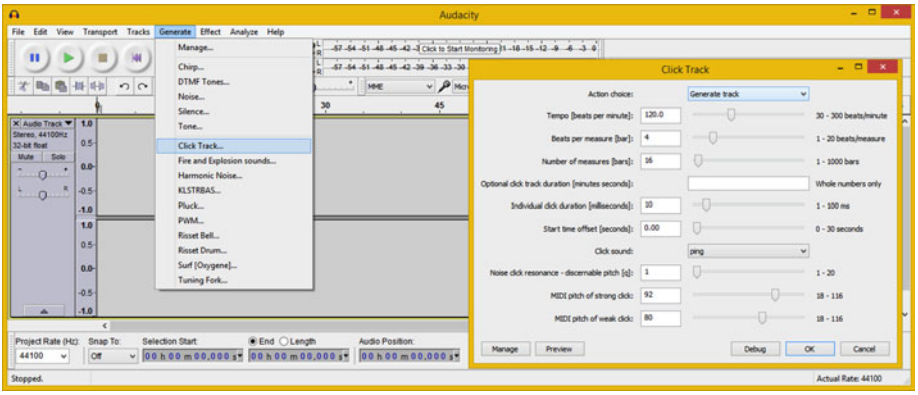

Figure 11-8. *Select the Generate ➤ Click Track menu sequence*

I accepted the default setting values and clicked the **OK** button to generate the Stereo Click Track shown in Figure 11-9. Click the **play** button to preview the metronome click track now.

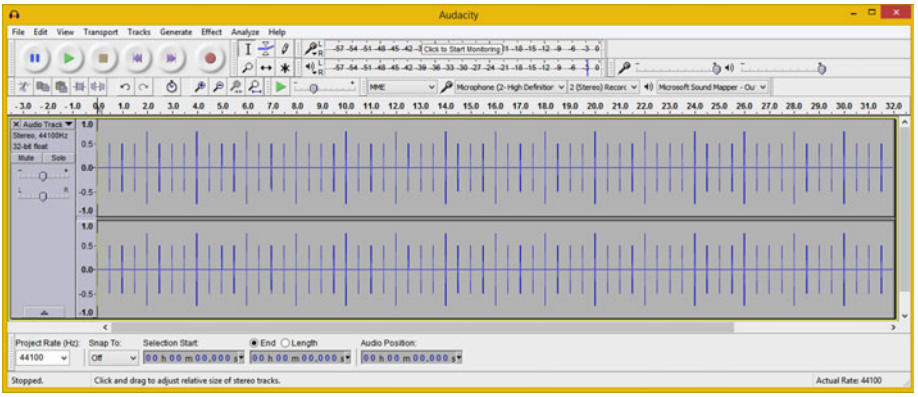

Figure 11-9. *Preview the Stereo Click Track audio data sample*