

Adjusting spectrogram parameters and display in Raven Pro

A concise guide

Although the initial default spectrogram that Raven displays when you open a sound file is often acceptable, it can usually be improved. In many cases, you can get a better image by using spectrogram parameters different from the defaults. Adjusting brightness and contrast settings can also make a big difference, as can simply changing the vertical and horizontal scale. This document provides tips on how to make these adjustments.

These are basic guidelines to get you started, not religious injunctions. You may want to deviate from the suggestions here for specific reasons. The point is to pay attention to how the spectrogram looks and think about whether it could be improved.

Spectrograms are like shoes— one size does not fit all! The “best” settings will depend on the nature of the sound, the background, how you want to use the spectrogram, and your personal preferences.

1. Listen

Listen carefully to your sound. Depending on the frequency range or modulation rate, you may find it helpful to listen to the sound played back slower or faster than normal. Particularly for mid- to high-frequency bird sounds, slowing playback down to $\frac{1}{4}$ or $\frac{1}{10}$ normal speed will often reveal details of structure that you can't hear at normal speed. If you're using spectrograms to describe details of sound structure, the spectrogram should show visually all of the details that you can hear.

2. Adjust the vertical and horizontal scale (zoom)

If your sound only occupies part of the frequency band of the spectrogram, zoom in to that band. Why waste part of the image space showing nothing but background? Zoom in time so that you could potentially see all of the details you can hear (at whatever playback rate is most informative).

3. Adjust brightness and contrast (preliminary)

(Comments here and below are written in reference to grayscale spectrograms. However the same principles apply to all of the other colormaps as well.)

You have a limited range of grayscale values available to you between white and black. If you know that all of the signals of interest in your recording are well above the background noise level (as you would usually see in targeted recordings made with a parabolic reflector or a highly directional mic), use the brightness / contrast sliders to adjust the image so that the background is mostly white and only the highest-intensity parts of your signal are black. If you're searching for very faint signals (for example trying

to detect distant calls of a target species in a soundscape recording), adjust the brightness and contrast sliders so that the background is light gray; this will ensure that faint signals remain visible. You can do a more careful adjustment later, after adjusting spectrogram parameters (see below).

4. Adjust window size (preliminary)

Using the window size slider in the toolbar, try window sizes both shorter and longer than the default. The goal here is to find a window size that lets you see what you can *hear* when you listen to the sound at an informative speed, and gives an acceptable tradeoff between sharpness in time and frequency.

TIP: If the signal you have open is very long and Raven is slow to make changes to the spectrogram when you change the window size, copy a smaller piece of it (e.g., a single call, song, or syllable) and paste it into a new window. Use this smaller piece to experiment with spectrogram settings more quickly.

5. Turn smoothing off

Turn off spectrogram smoothing (using the button in the toolbar, to the left of the brightness slider). This will enable you to see the individual cells of the spectrogram (if you're zoomed in enough), which is helpful in the following steps to refine the spectrogram parameters.

6. Adjust spectrogram parameters

6.1 Adjust Frequency Grid Spacing

Remember that Frequency Grid Spacing is determined by DFT Size, which is always a power of 2 (e.g., 256, 512, 1024, etc.). Larger DFT Size results in finer Frequency Grid Size, which determines (a) the vertical dimension of the boxes in an unsmoothed spectrogram, and (b) the precision of frequency measurements. By default Raven chooses the smallest DFT Size that is \geq the Window Size parameter (in samples). This may result in coarser Frequency Grid Spacing than you want, either for spectrogram image quality or measurement precision. You can adjust the Frequency Grid Spacing to be as fine as you want, but remember that finer grid spacing yields a spectrogram matrix with more cells in it, so it will take longer to recompute, and you might run out of memory. Play around with different settings to find what works.

6.2 Adjust Hop Size

Remember that Hop Size is the width of the boxes in an unsmoothed spectrogram and determines the precision of time measurements. By default Raven displays Hop Size in Samples; switching the units to normal time units (ms or s) is generally more useful. By default Raven determines the Hop Size based on 50% Overlap of the Window Size. Consider using a higher Overlap (e.g., 75% or even higher) to get a better image and more precise measurements.

7. Final adjustment of Window Size

7.1 Lock Hop Size and Frequency Grid Spacing

Remember that by default Raven automatically adjusts the Hop Size and Frequency Grid Spacing in response to changes in Window Size (Hop Size based on the specified percent Overlap of spectrogram windows, and Frequency Grid Size is based on the DFT Size which must always be larger than the Window Size). In order to prevent the Hop Size and Frequency Grid Spacing you chose above from changing in the next step, click the Lock icons next to Hop Size and DFT Size. Again, finer resolution means a larger spectrogram matrix that may be slow to compute or may run out of memory.

7.2 Adjust Window Size one last time

What you're looking for here is the (subjectively judged) best tradeoff you can find between smearing in the time and frequency dimensions. If you decide you need to change it drastically from the value you selected in step 4 above, you may want to unlock the Hop Size and Frequency Grid Spacing, and just repeat all steps starting at step 4.

8. [optional] Final adjustment of brightness and contrast

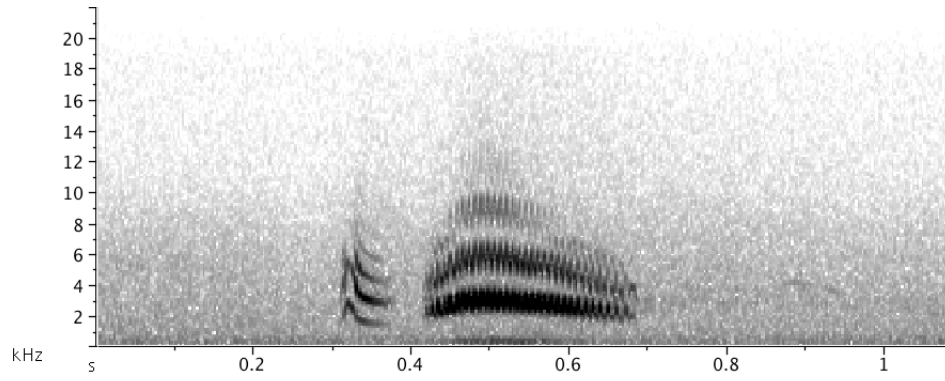
To get finer control of the brightness and contrast of the spectrogram image, right-click on the spectrogram image and choose Configure Brightness and Contrast. In the dialog that appears,

1. Adjust the Floor setting to either exclude or retain faint, distant sounds, bearing in mind the distinction mentioned earlier between situations where the signals of interest are well above background, and cases where they may be faint (barely above background).
2. Adjust the Ceiling so that only the highest-intensity (darkest) parts of your signal are black.

9. [optional] Turn smoothing back on

If you turned spectrogram smoothing off earlier while adjusting spectrogram parameters, you may want to turn it back on again after you've made all of the other adjustments above. Try it both ways (on and off), and see which you prefer.

BEFORE:



AFTER:

