Tutorial for Acoustic Analysis using Raven

This tutorial is designed to familiarize you with the basics of computer-based sound analysis. It will take you through many of the basic steps of sound analysis using some pre-recorded sample sounds. It should not be a big leap from completing this tutorial to conducting your own analyses of natural sounds.

We will be using the computer program Raven, which is produced by the Cornell Lab of Ornithology. Raven v. 1.3 is currently loaded on 27 iMac computers in PLS 1121. Please note that this computer lab is a shared resource; please be considerate of others working in the room while working with sounds.

I. Basics controls for Raven 1.3:

1. Opening Raven: Double click on the Raven icon on the desktop or in the dock to start the application. You will see a small application window that can be expanded by clicking in the appropriate button on the top of the window.

2. Opening files: Under the <File> menu go to <Open Sound Files> and select the 2000Hz.aif file in the Examples folder. Click OK on the next dialog window to open the entire sound.

3. Default views: You will now see two panels open with representations of the sound. You can again expand these views to fill the window by clicking on their top left button. What are these? Their names are indicated in the pane on the left labelled <views>. Only one of these views is active at a time- the active view is highlighted in the views window and has a blue bar on its left edge.

4. Playing the sound: You can play the sound by pressing either of the two triangular buttons on the right top of the window. (Note you can move the play control buttons to a different location on the screen to make them more accessible.) Try inputting a different number into the "Rate" box and see how the sound changes. Why?

5. Position marker: The magenta lines are position markers. If they aren't visible, they are probably lurking on the axes of your views. Move the magenta marker by clicking and dragging and watch what happens to the numbers on the bottom left of the window.

6. Selecting, expanding, contracting: The five buttons on the bottom right of the control panel allow you to expand or contract a selection. Select a section of the waveform (the top window) by dragging with the cursor or clicking once then shift-clicking again at a second spot. Now try out the horizontal controls along the bottom of the window. Expand until you can see the shape of the carrier wave. What shape is it? Try playing your selection.

7. Changing spectrogram size: Now click on the spectrogram panel and try the vertical controls on the bottom right side of the window.

8. Simple selection measurements: On the lower left corner of the window are two buttons that say <Layout> and <Linkage> and a third button with an arrow. Click on the arrow and choose <Selection> in the resulting popup window. The pane above the arrow should switch to one showing the beginning, ending and delta (duration) Time measures and the high, low and delta Frequency measures for your selection. Now expand the waveform until you can see ten peaks. Highlight ten peaks with a new selection and see the resulting delta time measurement. If you divided this measurement by 10, does it correspond to the expected period for a wave with a frequency of 2000Hz?

9. Sound views: The first button on the top left of the window with a microphone icon is for recording sounds. The next button is for creating a sound file window that you can use to place pieces of sound that you cut from other files. The third group of buttons contains four buttons that allow you to create new windows for the waveform, spectrograms and spectra. You already have waveform (diamond button) and spectrogram (horizontal bar button) windows open. Clicking on the other buttons opens new windows which you can close by going to the Layout pane with the lower left button and then clicking in the appropriate boxes next to the type of window. We will next explore these buttons with a real animal sound.

II. Playing with an animal sound

10. Spectrogram controls: Go to 'open' under the 'File' menu and choose one of the animal sounds (careful with the whale calls: they are long recordings and will take a long time to process. Play the sound a few times at regular speed and slow speed to help your ear get a feel for the sound (this can be very helpful). Click on the spectrogram window, find the slider controls on the top right of the window, and change each slider to see how brightness, contrast and Fourier frame size alters the image. Select <color scheme> under the <View> menu to try different color schemes.

11. Slice Spectrum: The two buttons next to the Spectrogram View button create different flavors of spectrums. Click on the spectrogram slice button (blue vertical bars) and a new window will open. It shows the distribution of amplitude by frequency in the spectrogram in a window centered around your magenta vertical position marker. Move the marker around- does the spectrum change?

12. Selection spectrum: Now click on the selection spectrum button (red vertical bars). Click OK to accept the default values. This opens a new window that gives a spectrum calculated from the section of the waveform highlighted by your red marker lines. You may get a message that the active selection is too short to compute a spectrum; this means there are not enough points to do the Fourier analysis. You can simply increase the size of the selection. How does this spectrum compare window to create a spectrum?

13. Time and Frequency domains: It's time to explore the time and frequency domains in the spectrogram. Make a new spectrogram by clicking on the spectrogram view button and in the dialog window altering the FFT size to 32 samples. Then make another new spectrogram with FFT size of 1024 samples. You can do this either with the slider button or by entering a value into the "size" box. What is going on with the spectrogram view when you change the FFT size?

14. Comparing Time and Frequency domains: Use the cursor to highlight a portion of one note of your vocalization. Use the cursors to measure the main frequency(ies). Make a spectrum of this section and record the peak frequency(ies). Compare it to a slice of the spectrogram when the magenta marker is located in a different not. Now examine the period of the waveform in these sections. Do all your measurements correspond? Try this again for a different note. See any differences? Do you see any evidence of AM or FM? What shape is the carrier wave?

III. Practice makes perfect

15. More practice: Open a different sample call and repeat steps 10-14.

16. Record yourself: Click on the microphone button to record a sound. In the Configure new recorder window just click okay. When you are ready to say something witty click on the little green triangle at the bottom of the box, say it, then click it again. A new waveform and spectrogram of you voice will appear with the default views.

17. Human sounds: Examine the shape and period of the carrier wave. Make a spectrum and a spectrogram of your own voice. Try to pick out acoustic landmarks of each word you said. Check out how the formants change through a word. Be glad you are studying animal sounds and not human speech. Save your sound in the examples folder as an AIFF file.

IV. Advanced features for measurements

18. Measurement window: Go to the bottom of the window and drag the tiny little toggle upward so the selection table becomes visible. It will show measurements from all selections. You can include more measurements by going to <choose measurements> under the <View> menu. Select delta time, delta frequency, and max frequency.

19. Active and inactive selections: Highlight a new selection in either the spectrogram or the waveform. Now hit enter and this selection becomes active, and you can make new selections. You should now see two or three colors of lines in your waveform and spectrogram panel- red ones that outline your active selection, cyan ones that highlight your inactive selections. You will also see numbers corresponding to these different selections in the bottom measurement panel. Use the selections to delimit two or three different notes in your animal sound and compare the measurements. Do they make sense?

20. Measuring animal sounds: You now know the basics of measuring animal sounds. Your further development will require spending time with the sounds you want to analyze and deciding what sort of measurements make sense given the sounds. As you will have already seen, there is a great diversity in the form of animal calls and there are many different types of measurements that can be made from them.

V. Hints for Raven use

21. The speed of processing will improve if you close non-active windows.