

## Sound Analysis Workshop

The Lab of Ornithology's Bioacoustics Research Program (BRP) periodically offers a 5-day introductory-level Sound Analysis Workshop. The workshop is intended primarily for biologists interested in analysis, visualization, and measurement of animal sounds. The workshop covers basic principles of spectrographic analysis and measurement of digital audio recordings, and specific tools and techniques in Raven Pro, a sound analysis application program developed by BRP. The outline below summarizes the major topic areas covered in a typical workshop. The detailed content of the workshop may change slightly, depending on the interests and needs of the participants.

Daily sessions include lectures, demos, and hands-on exercises using the participants' own recordings. Guest presentations by researchers from Cornell and elsewhere illustrate diverse applications of analysis principles and techniques discussed in the workshop. Small class size (presently capped at 12) ensures a high level of individual attention for participants.

Participants are expected to provide their own Windows or Mac laptop.

Cost of the workshop is \$1050 for students, and \$1400 for all others. The fee includes tuition, course materials, lunch for five days, a one-year license for Raven Pro and a hard copy of the Raven Pro User's Manual. (Students may renew the Raven license for as long as they remain students.)

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### Day 1

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- **Introduction to digital audio**
  - > digital sampling
  - > sample rate, bit depth
  - > recording artifacts: amplitude clipping and aliasing
- **Introduction to spectrographic analysis**
  - > time-domain and frequency-domain representations of sound
  - > spectra and spectrograms
  - > time-frequency tradeoff in spectrograms
- **Introduction to basic operations in Raven**
  - > opening sounds
  - > waveform and spectrogram views
  - > navigating within sounds
  - > window layout: multi-line displays, showing and hiding views, paged windows
- **Introduction to selections and measurements**
  - > basic measurements
  - > exporting measurements to Excel and other programs

- **Decibel measurements**

- > what are decibels? why are they confusing?
- > the importance of dB reference value; pitfalls to avoid using dB
- > why do we use decibels?
- > contexts for dB units: recording levels, sound level measurements, signal-to-noise ratio

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**Day 2**

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- **Spectrogram parameters**

- > Window Length, 3 dB bandwidth, and the time-frequency sharpness tradeoff
- > DFT (FFT) Size and frequency grid resolution (measurement precision)
- > Window Overlap, Hop Size, and time grid resolution (measurement precision)
- > Window Function, bandwidth, and spectral sidelobes

- **Measurements**

- > measurements based on rectangular selections
- > robust measurements of duration, bandwidth, and energy distribution
- > frequency contour measurements

- **Automated signal detection in Raven**

- > limitations of automated detection
- > types of detection errors
- > the band-limited energy detector: how it works, limitations, how to use it, practical tips

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**Day 3**

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- **Quantitative comparison of sounds**

- > spectrogram cross-correlation: how it works (theory); how to do it in Raven; limitations
- > comparison based on extracted features (measurements): overview of common statistical approaches

- **Rapid review of automatically generated selections**

- > selection review and annotation

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**Day 4**

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- **Whole-group review and questions, and other special topics as needed**

- **Small-group and individual consultation sessions**

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**Day 5**

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- **Small-group and individual consultation sessions**

- **Wrap-up and revisit opening questions**