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SOFTWARE TOOLS FOR AUTOMATICALLY DETECTING, MEASURING AND CLASSIFYING ANIMAL SOUNDS

PROGRAMSKA ORODJA ZA AVTOMATSKO ZAZNAVANJE, MERJENJE IN KLASIFIKACIJO ŽIVALSKIH GLASOV

RAIMUND SPECHT

ABSTRACT

Software tools for automatically detecting, measuring and classifying animal sounds

Many bioacoustic investigations involve the analysis of large amounts of sound recordings. Reviewing these files manually is often both extremely time-consuming and subject to making mistakes that result from the monotony of that procedure. It is therefore desired to have tools that automate this process. Avisoft Bioacoustics has been working on software tools that accomplish this goal. There are several approaches that are suitable for various analysis requirements. This paper describes the currently available options.

Key words: Animal sounds, bioacoustic analysis, large amounts of data.

IZVLEČEK

Programska orodja za avtomatsko zaznavanje, merjenje in klasifikacijo živalskih glasov

Mnoge bioakustične raziskave obsegajo analizo velike količine zvočnih posnetkov. Pregledovanje zvočnih posnetkov pogosto zahteva veliko časa in zaradi monotonosti postopka lahko pride do napake, zato si od nekdaj želimo imeti orodja, ki ta proces izvajajo samodejno. Avisoft Bioacoustics razvija programska orodja, ki bodo kos tej nalogi. Članek predstavlja programska orodja, ki delujejo bodisi neposredno na oscilogramih ali na spektrografskem prikazu signala.

Ključne besede: živalski zvoki, bioakustične analize, velika količina podatkov.

Address – Naslov

Raimund Specht
Avisoft Bioacoustics <www.avisoft.com>
Breite Straße 20 A
13187 Berlin
Germany
E-mail: raimund.specht@avisoft.com

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There are tools that are applied either directly to the waveform or to the spectrographic representation:

1. Waveform-based analysis of temporal patterns (pulse train analysis)

1.1 Separation by simple (absolute) amplitude threshold comparisons (Fig. 1)

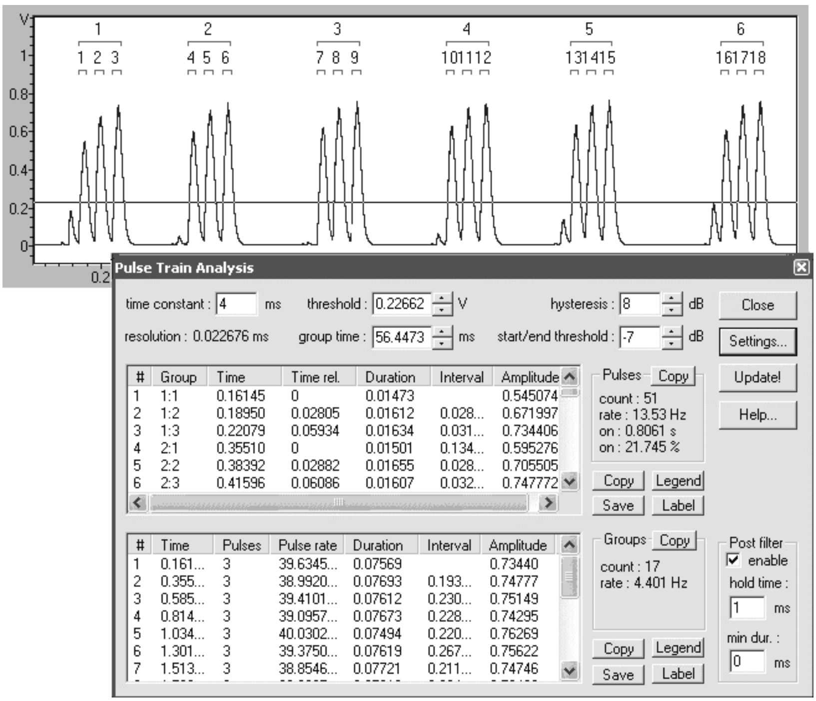

Figure 1: Pulse Train Analysis tool applied to a Field Cricket (*Gryllus campestris*) song.

1.2 Separation by adaptive (relative) amplitude threshold comparisons

The advantage of this separation mode is its ability to detect both small and large peaks in situations where a fixed absolute (gate function) threshold would fail (Fig. 2).

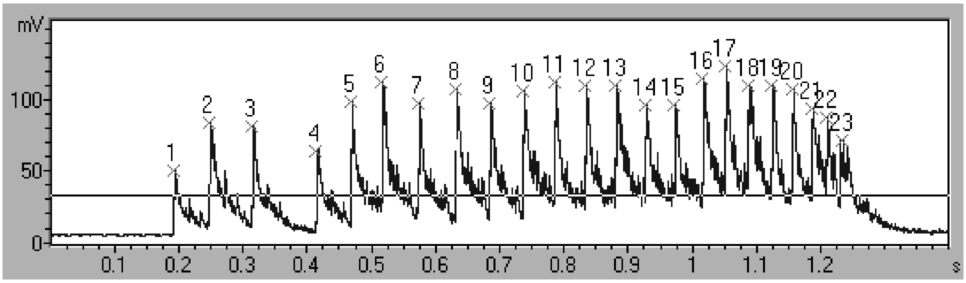

Figure 2: Example of the adaptive peak tracking mechanism.

2. Spectrogram-based analysis of both time and frequency

2.1 Automatic parameter measurements for collecting various time and frequency parameters on automatically detected events with optional subsequent multi-parametric classification (Fig. 3–5)

This tool first detects the sound elements (syllables) on the spectrogram and then logs up the selected parameters.

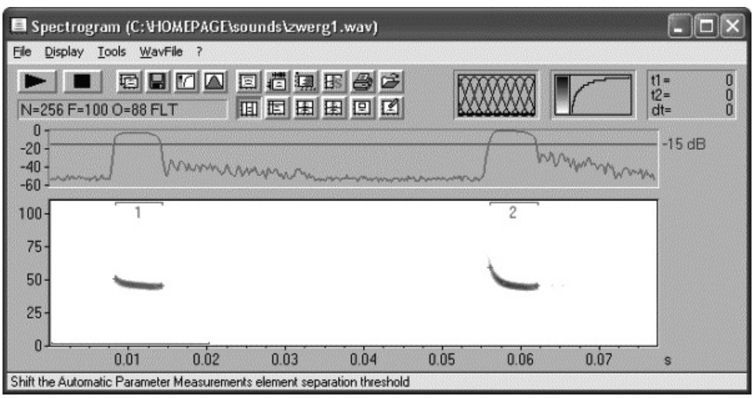

Figure 3: The element detection threshold level can be adjusted interactively. The example shows echolocation calls by the Common Pipistrelle Bat (*Pipistrellus pipistrellus*).

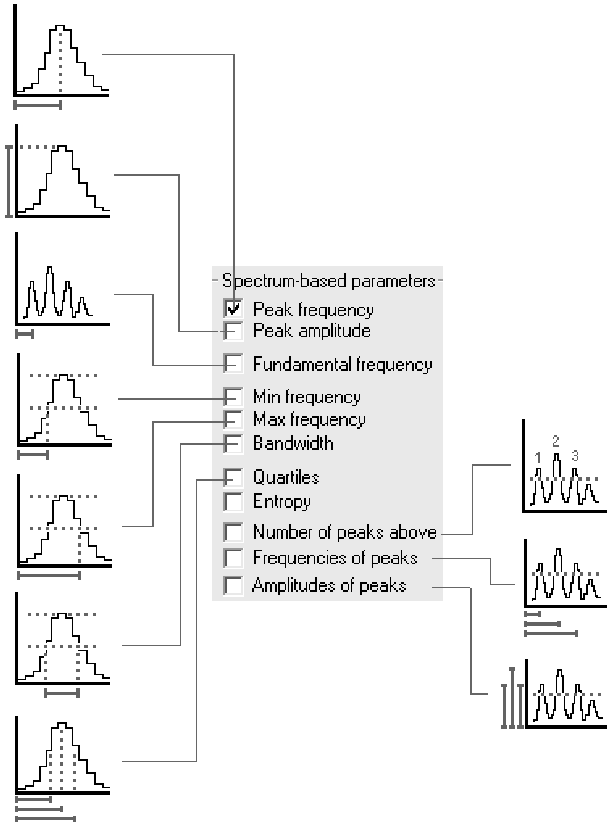

Figure 4: Available spectrum-based sound parameters.

The above spectrum-based parameters can be taken from the spectrogram at various locations within each detected element.

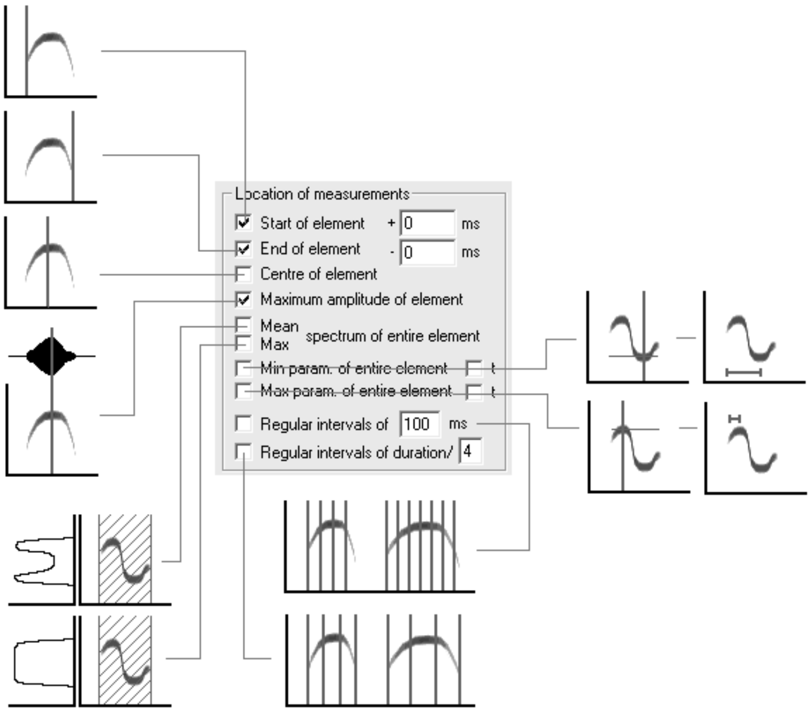

Figure 5: Available locations at which the spectrum-based parameters can be taken.

Secondary analysis options include group analysis (for characterizing series of sound elements or pulses that are separated by significant breaks) and statistics on the acquired measurements.

Depending on the quality of the sound recordings and the structure of the vocalizations, the implemented automatic analysis tools might not always work satisfying. It is therefore possible to edit the automatically determined results or to run the analysis in a semi-automatic way (Fig. 6).

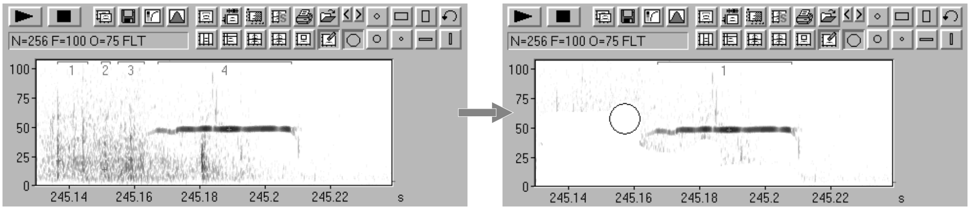

Figure 6: Disturbing noise components can be removed manually. The example shows an ultrasonic Black Rat (*Rattus norvegicus*) call.

There are a few alternative approaches for scanning simple (more or less pure-tone) sound elements (Fig. 7).

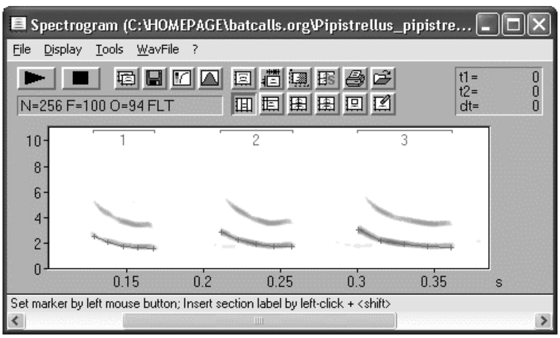

Figure 7: Fundamental frequency contour extraction.

The acquired time and frequency parameters can further be used to identify element types (Fig. 8):

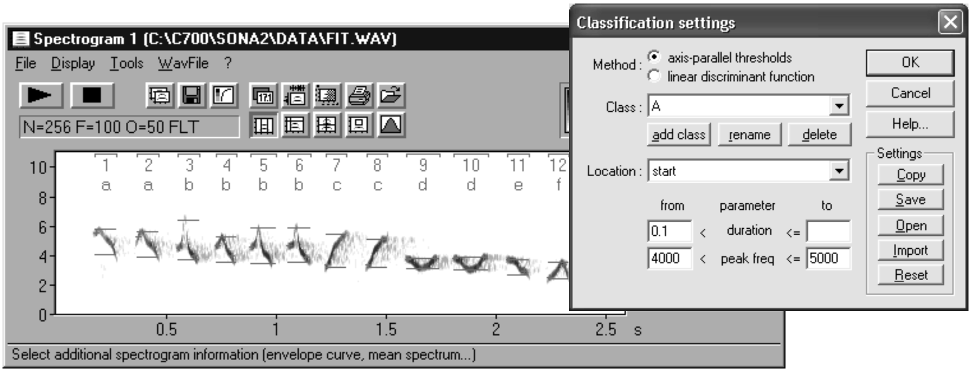

Figure 8: Simple syllable classification in a Willow Warbler (*Phylloscopus trochilus*) song.

2.2 Template spectrogram comparison (using cross-correlation) for identifying and labeling certain spectrogram patterns either continuously over the entire file or limited to automatically detected sound events (Fig. 9).

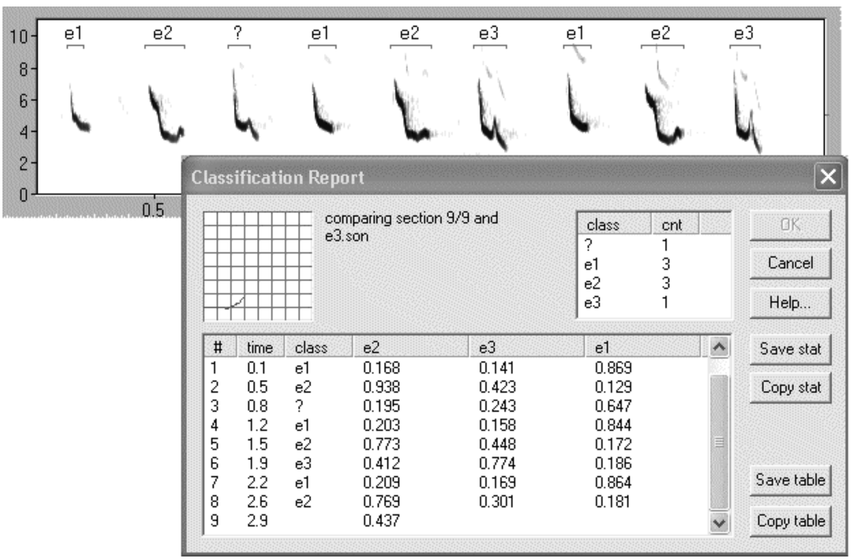

Figure 9: Syllable identification in a Chiffchaff (*Phylloscopus collybita*) song by means of template spectrogram comparison.