Ultrasonic Vocalizations
Automated Call Classification

SONOTRACK™ A sound idea!

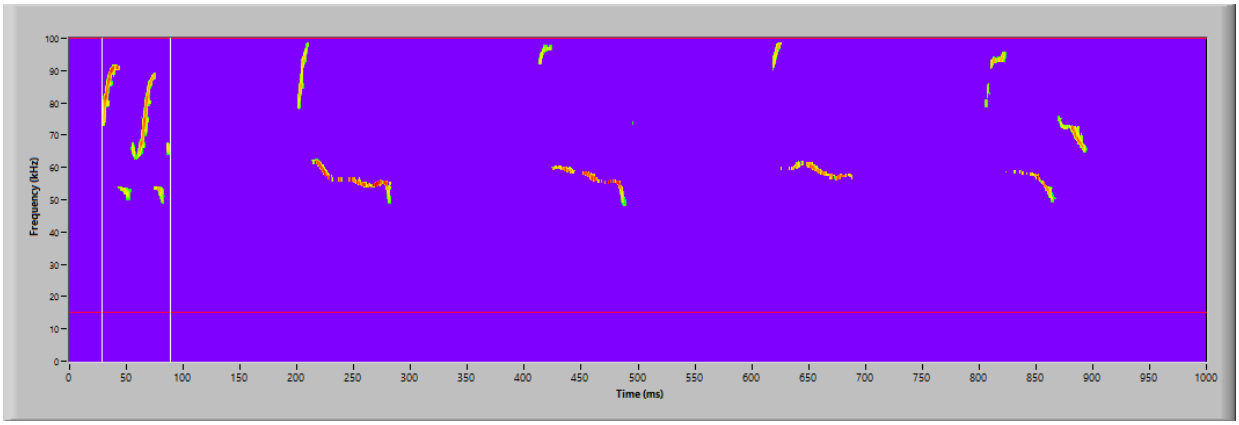
Ultrasonic Vocalization in animal research

Many laboratory rodents emit ultrasonic vocalizations. Currently, it is known that Rats emit 3 main types of ultrasonic vocalizations, dependent on the animal's age, its environmental conditions, and its affective state. Mice produce a variety of ultrasonic vocalizations during nonaggressive interactions, amongst others during mating behaviors, but these vocalizations are not indicators of negative or positive affect.
Understanding the types and functions of ultrasonic vocalizations emitted by laboratory rodents may enable researchers and animal care personnel to use vocalizations as an indicator of an animal's behavior and emotional state.

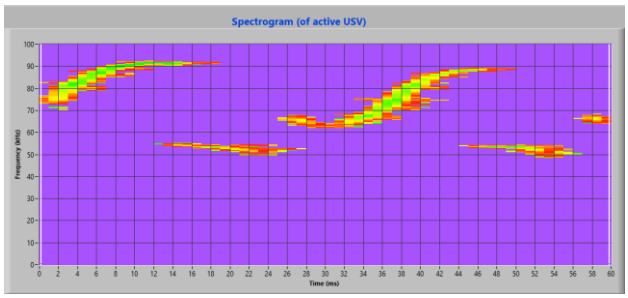
Classification of USV in mice

Equipment to record and playback USV of mice has been around for quite some time already, including the possibility of automatic detection of sounds and calls in the ultrasound range. Up to now such equipment has not provided the possibility of fully automatic classification of the calls. Researchers have to scroll through thousands of spectrograms to properly identify and classify the USV into the correct categories. Even short recordings of up to 20 minutes may contain over 1000 ultrasound calls. As a result analysis of long recordings and larger number of animals in preclinical studies is practically impossible and has limited full spread use of USV as a research tool.

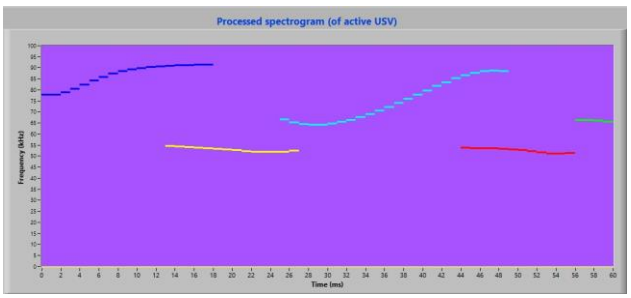
Metris offers now an add-on application for SONOTRACK that classifies USV of mice into 15 distinct categories. The application has been tested extensively using USV experts of renowned institutes around the world.
The software automatically detects the different types of calls in the USV recordings as further explained below:



Step 1: USV automatically detected within the spectrogram and selected bandwidth (red lines)



Step 2: Selection of USV and calculation of key acoustic parameters of the USV

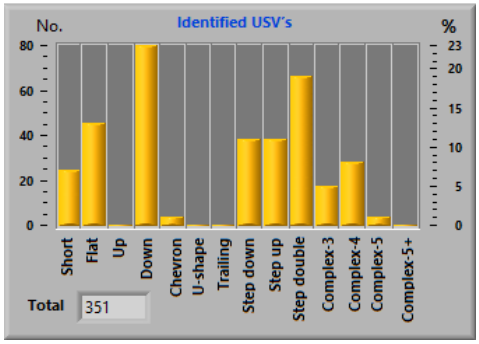


Step 3: Reduction of echo and conversion to an artificial representation of USV

Main parameters per component (of active USV)

Component	Start time ms	End time ms	Duration ms	Freq. start kHz	Freq. end kHz	Freq.Min kHz	Freq.Max kHz	Freq. Avg kHz	Power Max dB	Power Avg dB
Base-1	0,00	18,00	18,00	77,73	91,41	77,73	91,41	84,57	4,40	-13,23
Base-2	25,00	49,00	24,00	66,60	88,28	64,16	88,77	76,46	-4,54	-13,85
Base-3	56,00	60,00	4,00	66,31	65,53	65,53	66,31	65,92	-15,11	-18,48
Base-4	13,00	27,00	14,00	54,49	52,44	51,86	54,49	53,17	-2,52	-12,94
Base-5	44,00	55,00	11,00	53,91	51,37	51,27	53,91	52,59	5,89	-9,79

Step 4: Determine USV Type and calculate bioacoustics parameters per component of the USV



Step 5: Create result summary and bar chart

The current version of the SONOTRACK USV Classification software for mice is able to recognize the following USV types and calculate various bioacoustics parameters.

USV Categorization			Bioacoustics Parameters
Main Category	**USV type**		**Per USV**
1 element USV	Short		Start time (relative to start of recording)
	Flat		End time (relative to start of recording)
	Up		Duration (of USV)
	Down		
	Chevron		**Per component of the USV**
	Reversed Chevron (U-shape)		Start time (relative to start of USV)
2 element USV	Trailing		End time (relative to start of USV)
	Step Up		Duration (of component)
	Step Down		Frequency at start
3 element USV	Split Down		Frequency at end
	Split Up		Frequency minimum
	Complex-3		Frequency maximum
4 element USV	Complex-4		Frequency average
5 element USV	Complex-5		Power max
5+ element USV	Complex-5+		Power average
			Power at maximum frequency
			Power at average frequency