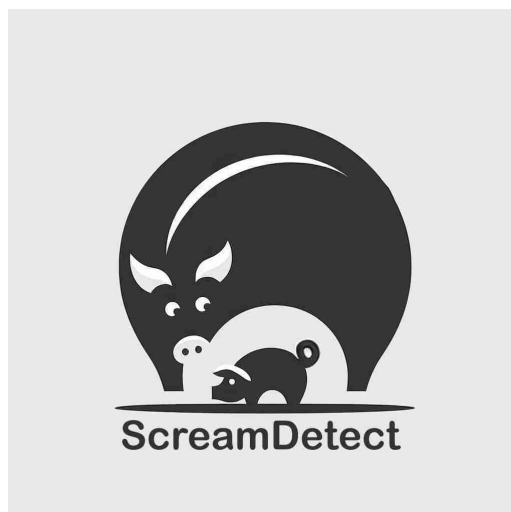# Manual - ScreamDetect

Author: Tjard Bergmann, *University of Veterinary Medicine Hannover, Hannover, Germany*

Contact: tjard.bergmann@tiho-hannover.de, *Institute of Zoology*

Contents

1 User manual ScreamDetect - Automated-Version

1.1 Description

The automated version of ScreamDetect was designed for 24/7 surveillance of pigs. It will analyze in a user defined time intervall the latest video material. Within the videos it will search for screaming events which are highly indicative for pig tail biting events. When the software identifies such an event it will create a time stamp of the incident in a surveillance table (Pig_call_table.xlsx). It will also cut and copy the event from the source video in a user defined timelength (change of the video-snippet-length, see section 5 for details). All results will be saved in an output folder that the user can find in the same directory as the R script location. A new results folder with the name of the analysed video will be created for each analysed video.

The automated version folder contains two primary detector scripts. 1) "Run_ScreamDetect_Single_Time.R" and 2) "Run_ScreamDetect_Automatic_247.R". The first script should be used for testing the setup and creating new reference calls (improve identification success). The second script will be used for surveillance of the pigs (more details on both scripts can be found in 1.4.1 and 1.4.2).

1.2 Dependencies of the automatic version

In order to run ScreamDetect multiple programs need to be installed/setup:

- Install Java (x64) [https://www.java.com/de/]

- Install R (x64) [https://cran.r-project.org/]

- Install RStudio [https://www.rstudio.com/]

- Install Rtools [https://cran.r-project.org/bin/windows/Rtools/rtools43/rtools.html]

- Install ffmpeg [https://ffmpeg.org]

Setup instructions for ffmpeg are described in section 3.

1.3 Setting up the automatic version

ScreamDetect can be downloaded from GitHub (M0rph3u2x/ScreamDetect). To install and setup the automatic version of the detector please download and unzip the "ScreamDetect_Automated247.zip" file on your computer. Be aware that the program expects to be placed within the same directory where the video files are stored either directly or within subfolders(see figure 1).

Figure 1: Correct placement of detector folder

In the next step open the R script "Setup_ScreamDetect.R" with RStudio and execute the script by pressing: Ctrl+A, then Ctrl+Enter.

The "Setup_ScreamDetect.R" script will install all necessary packages including the detector package. In order to install the detector package correctly it is important that the "ScreamDetect_package" folder with the compiled detector package is located in the same folder as the "Setup_ScreamDetect.R" script. If not, the "Setup_ScreamDetect.R" script will try to download and install the detector package directly from github.
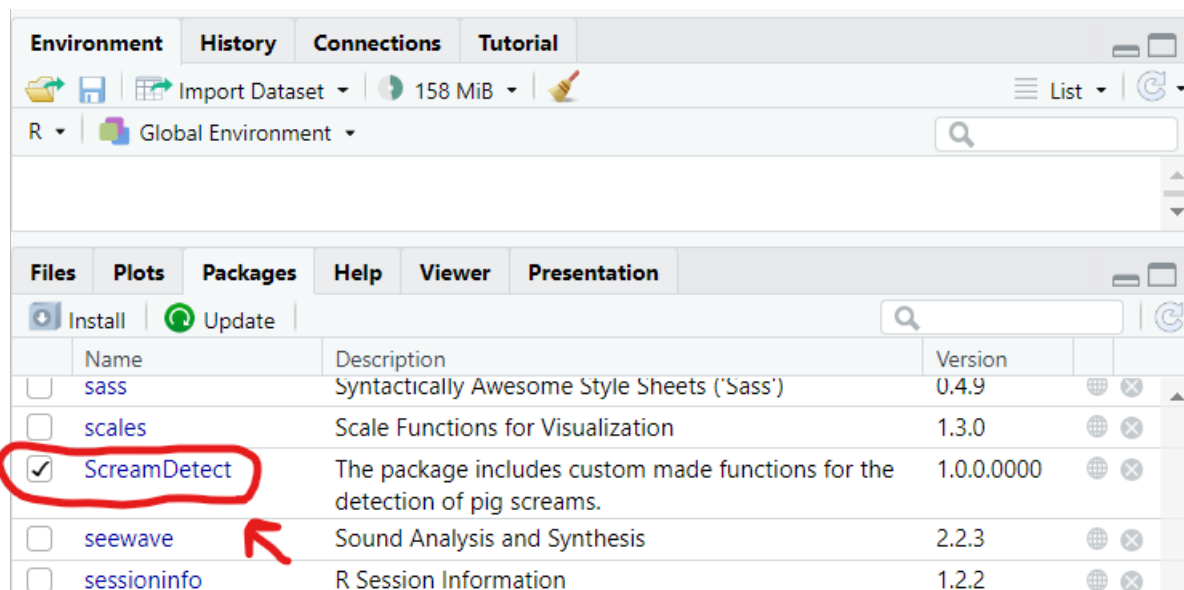
Figure 2: Successfully installed ScreamDetect package

After successful installation of the detector package it should be listed as "ScreamDetect" in RStudios "Packages" list (see figure 2).

ScreamDetect is dependent on several packages which will be automatically installed together with the ScreamDetect package when executing the "Setup_ScreamDetect.R" script. Here is a list of all necessary R packages:

R-Package	Function	Description
base	list.files,sub,file.path,dir.create,print,paste0, format,as.POSIX,Sys.Date,options,dput,dget	Basic data processing functions
fs	dir_ls	Find and list files of a specific type (faster than list.files)
ggplot2	ggplot	Create elegant data visualisations
monitoR	specView	Create spectrogram of call
pacman	installed.packages, installed_packages	Package manager
RDCOMClient	COMCreate	Outlook E-Mail communication
readxl	read_xls	Read Excel Files
rstudioapi	getSourceEditorContext	Get path from RStudio
seewave	spectro, fir	Audiodata analysis
shiny	runApp	Create GUI for data management
shinycssloaders	runApp	Create GUI for data management
stringr	str_replace	Replace data strings
TAF	rmdir	Remove empty folders in output directory
taskscheduleR	taskscheduler_create, taskscheduler_delete	Schedule R Scripts with the Windows Task Scheduler
tuneR	readWave	Audiodata analysis
xlsx	write.xls	Data export to xlsx file

1.4 Running the detector

1.4.1 Single detection run

In order to run the detector a single time, which is useful for testing the setup, analyzing hand-picked files or creating new reference call files execute the R script "Run_ScreamDetect_Single_Time.R" (Open with RStudio, press Ctrl+A, then Ctrl+Enter). It is advised to change some parameters in the "2024-04-17_parameter.csv" file within the parameters folder before executing the "Run_ScreamDetect_Single_Time.R" script (see section 3 for details).

1.4.2 Automatic 24/7 detection loop

When the detector should run in a user defined time interval loop, the detector script will be initiated by an R package called TaskScheduler. The detector script in this scenario is started outside of the Editor RStudio. It is mandatory to manually change the script path to the user working directory, within the R script file "Run_ScreamDetect.R" on line 41 (see figure 3).

```
38 ▾  # 1) Specify directory ------------------------------------------------
39
40   # Set the working directory to the folder where the program is running
41   R.Directory <- "C:/Users/tjard/OneDrive/Desktop/test_new_detector_20240419/Detector/"
42
43 ▾  #------------------------------------------------------------------------
```

Figure 3: Change directory path to your R script location

In order to initiate the detector for a repeated run (time interval can be defined in the parameters table line 22 and 23) start the R script "Run_ScreamDetect_Automatic_247.R" (Open with RStudio, press Ctrl+A, then Ctrl+Enter).

1.4.3 Test setup of automatic 247 detection loop

Before running the "Run_ScreamDetect_Automatic_247.R" you should test the correct setup of your system. In order to do that perform a single testrun with the "Run_ScreamDetect_Automatic_247.R" by changing the parameters:

- a. Open the parameter table in the subfolder "parameters"

- b. Change "Load all mp4 files for detection" from "no" to "yes"

- c. Change "Testrun Detector" from "off" to "on"

- d. Run the "Run_ScreamDetect_Automatic_247.R" script (in RStudio press Ctrl+A, then Ctrl+Enter)

After activating the testrun in the parameter setting the detector will perform a single run analysis of your data. If the resulting output is without error, deactivate the "Testrun Detector" option and set the "Load all mp4 files for detection" back to "no". Now you are ready to go for an automated run.

1.4.4 Optimizing the detector efficiency

The user can customize many parameters for better detection of pig screams. The parameters are defined in the "parameter" folder. The user can choose which file format is used to define the parameters either as "csv" or "xlsx". Delete the format that is not used in the folder or the script will prioritize the csv format. If multiple files with different dates are stored in the folder the file with the most recent date is selected. For more information on the available parameters see section 5.

2 User manual ScreamDetect - GUI-Version

2.1 Description

The GUI-Version of the ScreamDetect software is a stand-alone version of the automatic ScreamDetect software. It can be run from any location on the users computer. In contrast to the automatic ScreamDetect software it always processes all provided video recordings in a single session. When running the software a GUI window will pop up with all customizable parameters (can also be adapted in the automatic version). The data is directly processed and all observed detections of potential pig screams are saved in an output folder.

2.2 Dependencies of the gui version

ScreamDetect GUI is dependent on other software:

- Install Java (x64) [https://www.java.com/de/]

- Install R (x64) [https://cran.r-project.org/]

- Install RStudio [https://www.rstudio.com/]

- Install ffmpeg [https://ffmpeg.org]

Setup instructions for ffmpeg are described in the section 3.

The GUI-Version is also dependent on a number of R package that are not present with the core R installation. This is not a problem as all necessary packages will be installed automatically when running the "ScreamDetect_GUI.R" script. The

following R packages will be installed when running the Detector:

R-Package	Function	Description
base	list.files,sub,file.path,dir.create,print,paste0, format,as.POSIX,Sys.Date,options,dput,dget	Basic data processing functions
fs	dir_ls	Find and list files of a specific type (faster than list.files)
monitoR	specView	Create spectrogram of call
pacman	installed.packages, installed_packages	Package manager
rstudioapi	getSourceEditorContext	Get path from RStudio
seewave	spectro, fir	Audiodata analysis
shiny	runApp	Create GUI for data management
shinycssloaders	runApp	Create GUI for data management
stringr	str_replace	Replace data strings
TAF	rmdir	Remove empty folders in output directory
tuneR	readWave	Audiodata analysis
xlsx	write.xls	Data export to xlsx file

2.3 Setting up the gui version

The GUI-Version of ScreamDetect can be downloaded from GitHub (M0rph3u2x/ScreamDetect). To install and setup the gui version of the detector please download and unzip the "ScreamDetect_GUI.zip" file on your computer.

In order to correctly run ScreamDetect GUI the main R script "ScreamDetect_GUI_V1_2024.07.15.R" and the functions script "screamdetect_gui_functions_240715.R" must be placed in the same folder.
Important: The path to the folder must be avoid of emtpy spaces:

- False: "C:\Users\tjard\OneDrive\Desktop\ScreamDetect GUI Folder"

- Correct: "C:\Users\tjard\OneDrive\Desktop\ScreamDetect_GUI_Folder"

When running the main script (open the script in RStudio and pressing Ctrl+A, then Ctrl+Enter) the scream detector is dependent on five folders. All these folder must be present (except the "output" folder) in order to analyse videos for pig screams:

1. **input:** The user can put any number of mp4 video files in this folder. All videos will be analysed in succession.

2. **output:** This folder will be automatically created by ScreamDetect and is the only folder that is not required to be present when the pig scream detection software is run. After data analysis completion this folder will contain folders labeled with the name of each analysed video. Each of this folders will contain an Excel table with a list of all detected calls and video excerpts of the detected calls (extracted from the source video).
Notice: If a folder for a video is missing it means that no calls where detected in this video.

3. **reference calls:** This folder contains by default two different example calls with a samplerate of 16 and 48k. The reference calls can be used by the user (optional) to estimate the peak loudness threshold of a pig scream.

4. **settings:** This folder contains all customizable parameters that will be loaded into the R script when it is run. The parameters are saved as csv and xlsx file. Only the parameters of the latest file will be loaded into the ScreamDetect GUI program. **Important:** If parameters are available in both formats (csv/xlsx), csv will be priorized by the program. If you prefer working with xlsx files delete all csv files in the settings folder.

5. **shiny:** This folder contains the R script that is responsible for creating the GUI interface when ScreamDetect GUI is run.

3 Setting up ffmpeg

Software Source: `https://ffmpeg.org/download.html#build-windows` **Windows-Build :** `https://www.gyan.dev/ffmpeg/builds/`

Detailed instruction example with pictures:
`https://de.wikihow.com/FFmpeg-unter-Windows-installieren`

Detailed instruction video example:

`https://www.youtube.com/watch?v=t973zd4s6R4`

Installation/setup instructions:

1. Download the ffmpeg build zip file (ffmpeg-5.0.1-essentials_build.zip)

2. Unpackage Zip-File (ffmpeg-5.0.1-essentials_build.zip)

3. Rename folder: ffmpeg-5.0.1-essentials_build ->ffmpeg

4. Copy folder "ffmpeg" into "C:\Program Files"

5. Right click on "This PC->Configuration" OR Windows Symbol bottom task strip ->Configuration ->System ->Info

6. Click on "Advanced system settings"

7. Click on "Environment variables..."

8. Click on "Path" (upper window) ->Edit

9. Click on "New"

10. Enter "C:\Program Files\ffmpeg\bin", press "Ok"

Warning: The new software loading path might only be accessible after rebooting the computer!

4 Setting up reference calls

Reference calls are example calls of different intensities. They are used to determine the loudness threshold which will be used to identify screams in a recording. For our setup we used an audio sampling rate of 16 kHz and 48 kHz. For ideal results it is recommended that reference calls with the same sampling rate as planned recordings are used. As each environment has its own accoustic challenges (background noise, different animals and pen sizes, etc.) it is recommended that users create their own reference calls. In order to do that, there are two options:

1. If the planned recordings use 16 or 48 kHz the user can start with the available reference calls (Second parameter "Reference calls" = on).

2. If the planned recordings have a different sampling rate then 16 or 48 kHz it is necessary to deactivate the second parameter ("Reference calls" = off).

In order to create new reference calls, better adapted to the evironment, set the eleventh parameter "Create audio reference filter (on/off)" to "on". In addition activate the twelfth parameter "Load all audio files for detection" (yes). Now, if any calls are detected they will be saved as audio files(*.wav) and can be copied as new references in the "reference_calls" folder. Delete the default reference calls before adding your own calls and perform an audio check on all new reference calls (some might be undesired background noises). Only keep reference recodings that sound like pig screams. You can either keep the default labels of the reference calls (e.g. call_1.wav) or adapt them similar to the default recordings. The detector will test the sampling rate of each reference call and will only use reference data with the same sampling rate as the video file that is currently scanned for pig scream events. **IMPORTANT:** After identification of suitable reference calls set the parameter 11 to "off" and 12 to "no".

5 Description of detector parameters

Parameters are setup values that the user can change in order to customize the detector to personal requirements. It is best practice to use the provided parameter tables as a template and save the new tables with the current date. The detector will always use the table with the most recent date.

5.1 Keywords

Keywords can be applied to reduce identification time of mp4 files. Keywords should be strings that are a part of the folder names. Multiple keywords can be used to narrow down the location of mp4 files. If more than one keyword is used, it is necessary to separate the keywords with an underscore ("_") symbol. E.g. for the keywords "Kamera" and "AM—PM" write: Kamera_AM—PM

5.2 Reference calls (on/off)

If "on" the peak loudness value for a pig scream will be calculated based on the reference audio files (stored in "reference_calls" folder)

5.3 Reference type (min/mean/max)

Reference focus can be on "min", "mean" or "max" [dB]

- min : The quietest call in the reference database is used as threshold for call detection

- mean : The mean noise ratio of all calls in the reference database is used as threshold for call detection

- max : The loudest call in the reference database is used as threshold for call detection

5.4 Loudness threshold (%)

Only calls with a dB value above the threshold are listed (amplitude of audio data is measured). If reference calls are used they define the peak loudness value (= 100 %). Without reference calls the loudest event in the recording will be set as the peak loudness value (using reference calls will provide better results). A user loudness threshold value of 80 % means that all recorded sounds with a dB value of 20 % below the peak loudness value or higher will be detected as potential calls.

5.5 Time gap between calls (ms)

Defines minimal gap time between two measurements above threshold in ms. If the gap is above the threshold the next detected measurement will be interpreted as a new call event. Important to calculate on/offset values.

5.6 Minimal call duration (ms)

Defines the minimal call duration that a call must have in order to be detected as a valid call event. Filters out intense short noises.

5.7 Minimum duration of detected call video (ms)

Defines the minimal length each call event video must have (in ms). The duration should be above 3000 ms (30 seconds) or the videos will be to short to identify the biting pig.

5.8 Band-Pass Filter (on/off)

Defines if a bandpass filter is used ("on" or "off"). A bandpass filter below and above the call frequency reduces background noise and makes it easier to correctly identify calls.

5.9 Lower cut-off frequency (kHz)

Delete audio frequency below threshold from audio data.

5.10 Higher cut-off frequency (kHz)

Delete audio frequency above threshold from audio data.

5.11 Create audio reference filter (on/off)

Create control pictures and audio files. The audio files can be used as reference files for the loudness threshold.

5.12 Load all mp4 files for detection (yes/no)

If this parameter is set as "yes" all mp4 files independent on their time stamp are loaded. This setting is advised when new reference calls are created in a new experimental setup. It is important to deactivate it when the detector is run 24/7.

5.13 Scream frequency threshold

Number of valid screams per video that need to be detected in order to send a warning to the user by email.

5.14 Create activity plot (on/off)

An activity plot is an overview diagram showing the number of detected screaming events in relation to time (hours and days). If "on" is selected the plot will be created in the output folder. Each camera will get a plot.

5.15 Create activity plot for a specific time period (on/off)

If this parameter is turned off (off) the activity plot will be created using all data available in the output folder. If you are interested in getting an activity plot for a specific time frame, turn this option on (on) and define start and end dates in the next two parameters.

5.16 Start date for activity plot

Define the starting date for the activity plot. The date must be formatted as "Year—Month—Day", e.g.: 20220323.

5.17 End date for activity plot

Define the ending date for the activity plot. The date must be formatted as "Year—Month—Day", e.g.: 20220327.

5.18 Switch for erasing data (yes/no)

This parameter will erase older output data if set on "yes". The expiration date for deleting data will be defined in the next parameter.

5.19 Erasing date (all datafiles before the date are deleted)

In order to erase older output data an erasing date must be provided. The erasing date will allow the program to actively delete any output data that was recorded before the date. Important, the erasing date will focus on the time stamp date in the name of the file.

5.20 E-Mail receiver

Define email receiver for warning messages. Receiver can be more than one address (e.g. "user1 recipient.com, user2 recipient.com")

5.21 Testrun (on/off)

If testrun is activated (on) the Task_Scheduler will run the detector only once to test if everything is setup correctly. If no error occured during the testrun the setting should be changed to "off". Changing the setting to "off" will switch the Task Scheduler to run the Detector periodically based on the setting in "Time window" (Taskscheduler Interval 1 & 2).

5.22 Taskscheduler Interval1

The Taskscheduler Interval1 setting defines the rough interval in which the detector software is executed. It can be set to WEEKLY, DAILY, MONTHLY, HOURLY, and MINUTE.

5.23 Taskscheduler Interval2

The interval2 setting will define the fine interval in which the detector is run. If the interval1 is set to HOURLY the interval2 value defines the hourly interval. With interval2 for example set to 2 the detector will be executed every two hours.

The interval2 also defines how far in the past the program will search for recently added video files. Each video file has a time stamp and the program will compare the present time with the time window. A value of 1 means a window of one hour (if interval1 is set to HOURLY). ScreamDetect will always exclude video files with a time stamp of the ongoing hour to not analyse still recording files. This means if the time is 8:34 and the time window is 1 the time frame for recent files will be set to a time frame between 7:00:00 and 7:59:59. With a value of 2 it will be 6:00:00 to 7:59:59. Decimal values for the time window are not allowed. If Interval1 is set to "HOURLY" the interval2 setting must be between 1-23.