NAVIS Tool
User Manual

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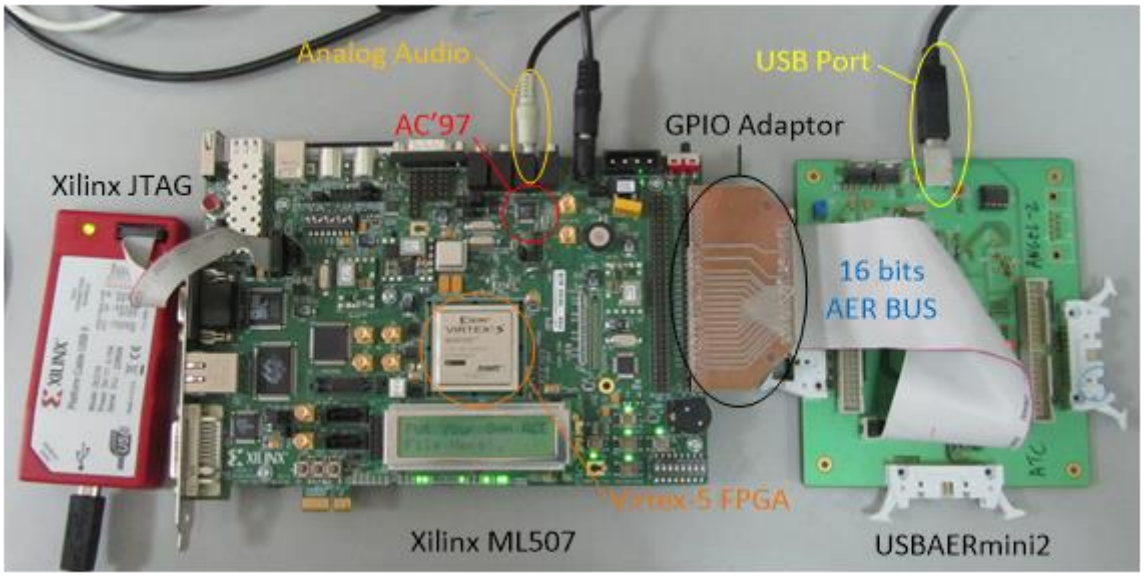
Introduction

Welcome to the Neuromorphic Auditory VISualizer Tool user manual.

This page will be useful for those who have not used NAVIS Tool yet and want to get introduced to it without getting lost. On the following sections you will find the diverse functionalities of this software and how to use them properly in the desktop software application.

To demonstrate these software functionalities a 64-channel binaural Neuromorphic Auditory Sensor (NAS) for FPGA has been used together with an USB-AER interface, as it can be seen on the image bellow.



0. Getting started

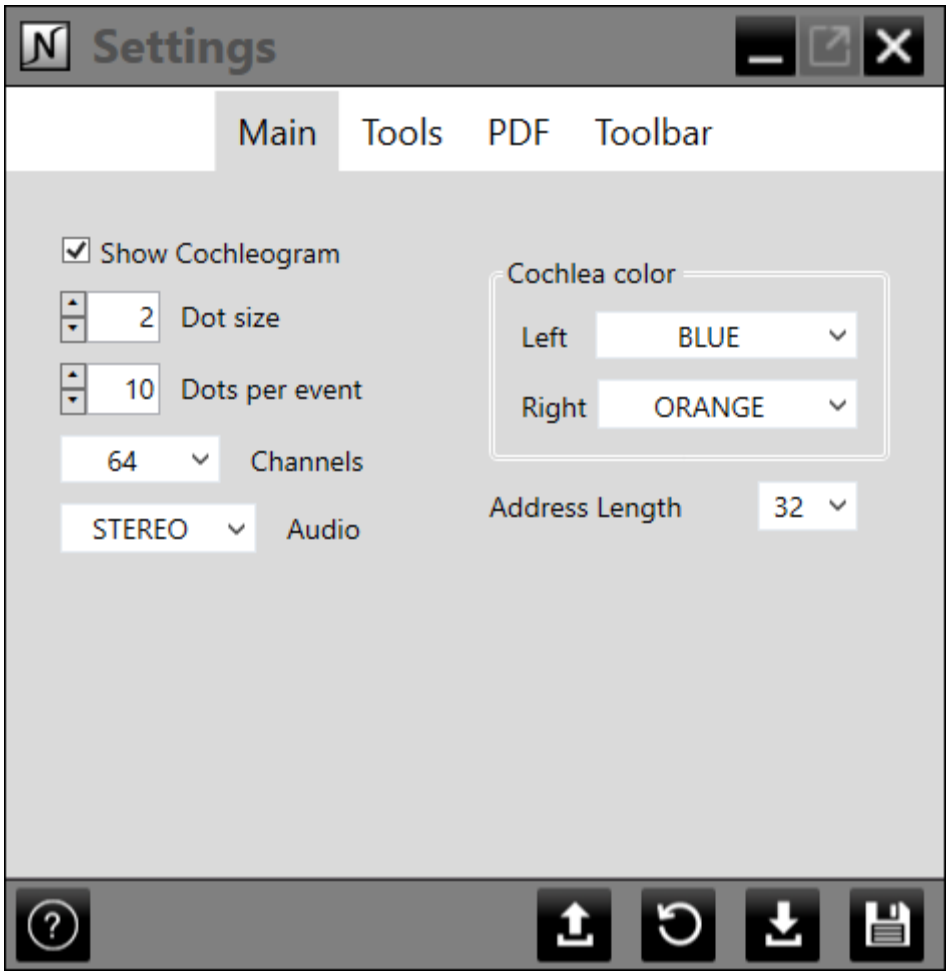
Let's start with the basics: launch NAVIS Tool. The latest build of this software can be found here and, after downloading it, you can double-click NAVIS.exe to launch it. A window will open up and you will see something like the following image.

That is the main window of NAVIS. As can be seen, there are two different menus: one on the sidebar and one on the top. The left sidebar menu has some quick action buttons to the user most used functionalities. These can be chosen in the settings, giving the user the ability to customize the application in the way they fell more comfortable. On the other hand, the top menu has all the options and functionalities and cannot be modified.

This is all you need to know about the NAVIS Tool main window. Head to the Settings section on this user manual before loading your first file.

1. Settings

Configuring NAVIS Tool is an important step before loading your first file. You can modify the settings in the settings window, which can be opened if you click on the button with the gear symbol on the left sidebar menu or clicking in File>Settings on the top menu. The following window will open up:



As can be seen, there are four different tabs in the settings window, which will be explained one by one next. The buttons located on the bottom of the window allows the user to load a settings file, save the current configuration to a file, save the current configuration as default and restart the configuration to default values, in addition to display some information about the window.

1.1. Main

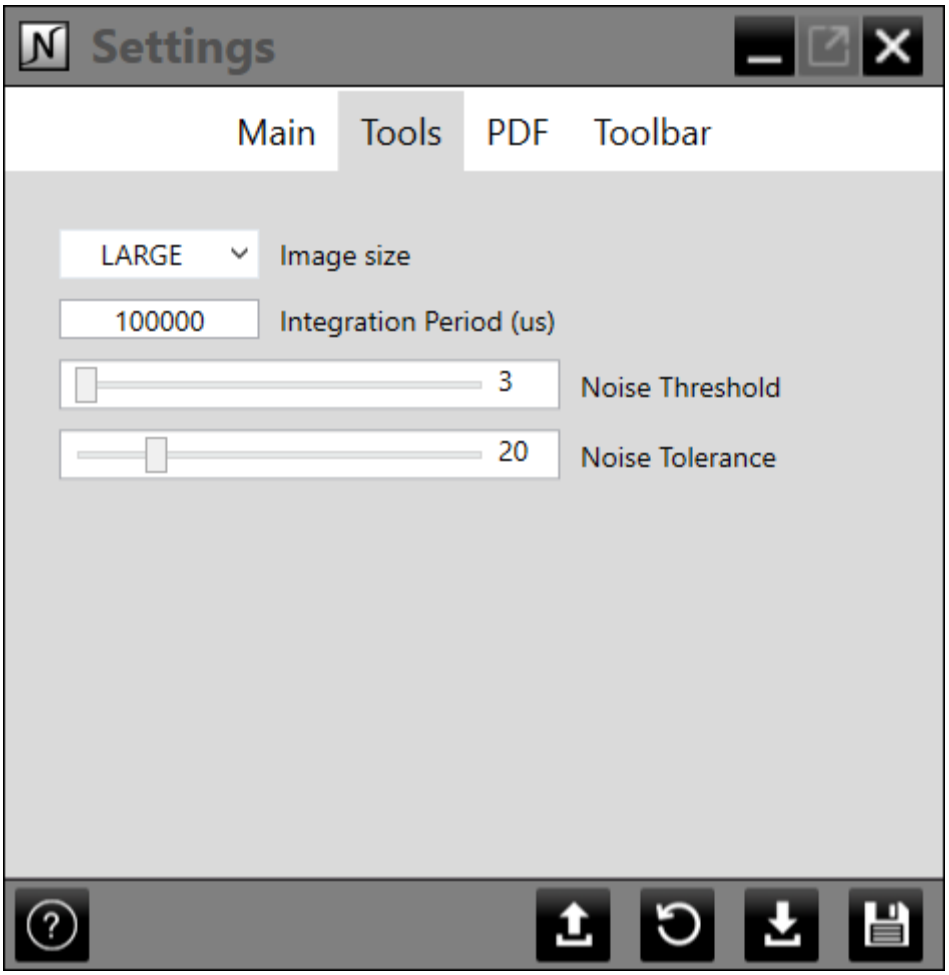
Main is the first of them and it contains settings about the cochlea specification and about the cochleogram that will be displayed in the main window.

- If **Show Cochleogram** is checked, the cochleogram for the loaded file will be generated and displayed on load.
- Each event is represented as a dot in the cochleogram. **Dot size** lets the user choose the size of it.
- Aedat files can contain a huge quantity of firing information. Displaying every event in the cochleogram could slow down the application and the user experience. **Dots per event** lets the user set how many events will be represented with one dot on the cochleogram. Higher values will reduce load times.
- **Channels** determines the number of channels of the cochlea that you are working with.
- jAER captures events information with 32 bit for the address and 32 bit for the timestamp. If you are capturing this firing information with a different tool, timestamp may have 16 bits instead of 32. You can select the number of timestamp bits for your file in **Address Length**.
- **Audio** lets the user choose between a stereo or a mono cochlea.
- **Cochlea color** sets the color for the cochleogram chart, dividing the left cochlea and the right cochlea information in two different colors that can be selected using the comboboxes. If you are working with a mono cochlea, you should only modify the left color.

1.2. Tools

Tools allows to configure some parameters that are used by a set of functionalities in NAVIS Tool.

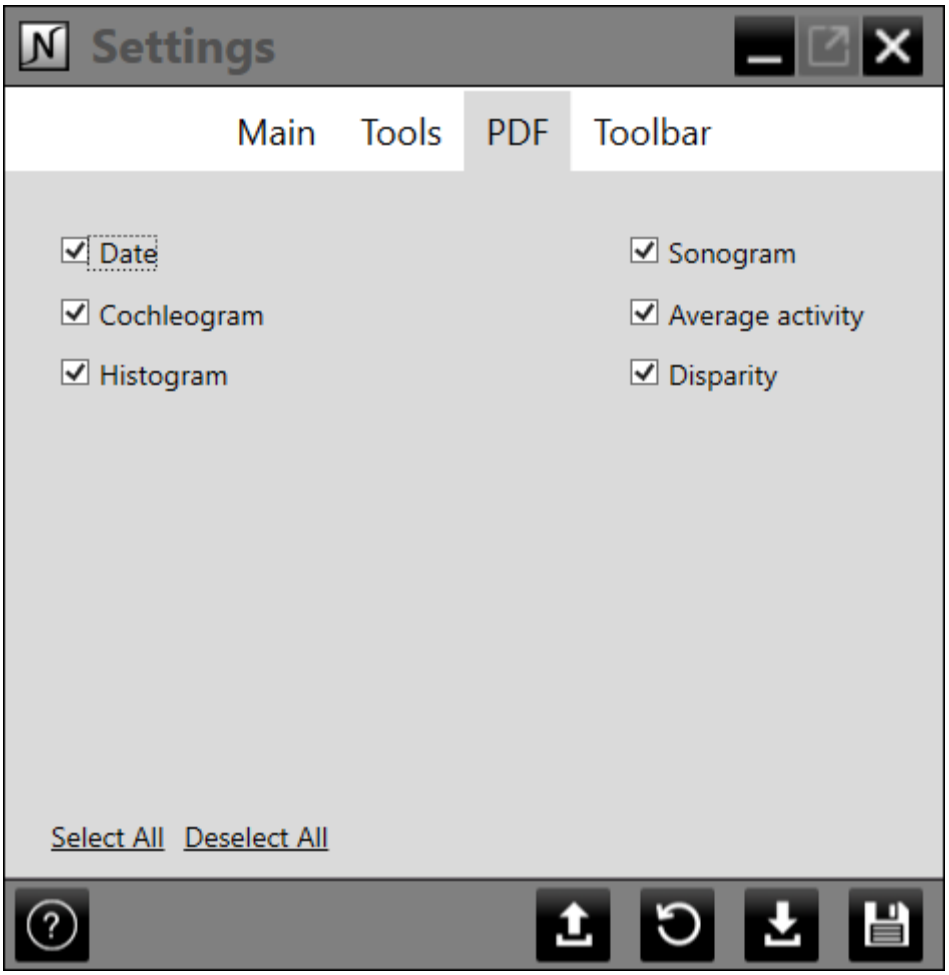
- **Image size** lets you choose between four different sizes, which will be used to generate both Sonogram and Disparity between both cochleae tools.
- As we are working with files with a huge amount of data, the functionalities implemented cannot iterate through the entire event list looking for the events that fired in a specific timestamp. **Integration period** is the smallest time period that this software works with.
- **Noise threshold** and **Noise tolerance** are used for the **Automatic Aedat Splitter tool**. Head to that section of the user manual to know more about them. These parameters are not essential to set right now, they can be modified later after loading the file.



1.3. PDF

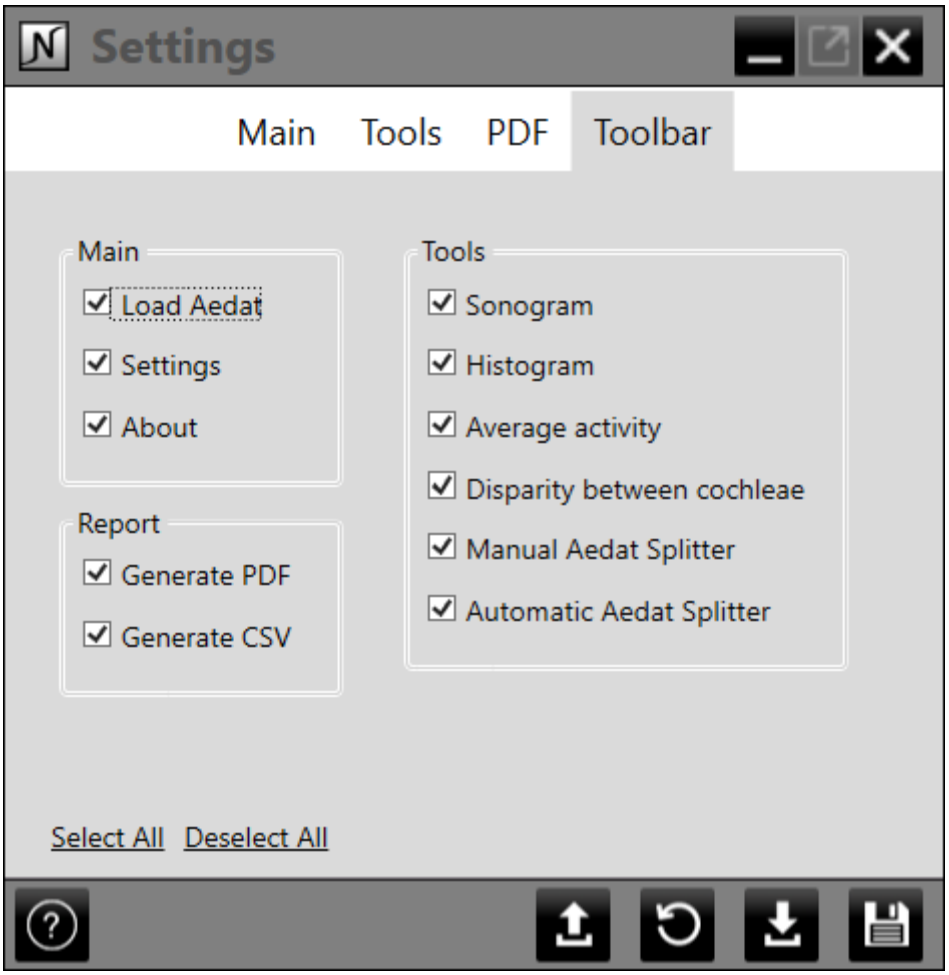
NAVIS Tool has a function that generates a report or summary of the loaded file in a PDF. This window allows to check or uncheck which functionalities will appear on that PDF.

- **Date** when the PDF was generated
- **Cochleogram**
- **Histogram**
- **Sonogram**
- **Average activity**
- **Disparity** between the left and the right cochleae (only if working with an stereo cochlea)



1.4. Toolbar

As we told in the Getting started section of this manual, NAVIS Tool has two menus: the left sidebar menu and the top menu. This window allows the user to select what buttons will appear on the left sidebar menu. If none is checked, the menu will not appear.

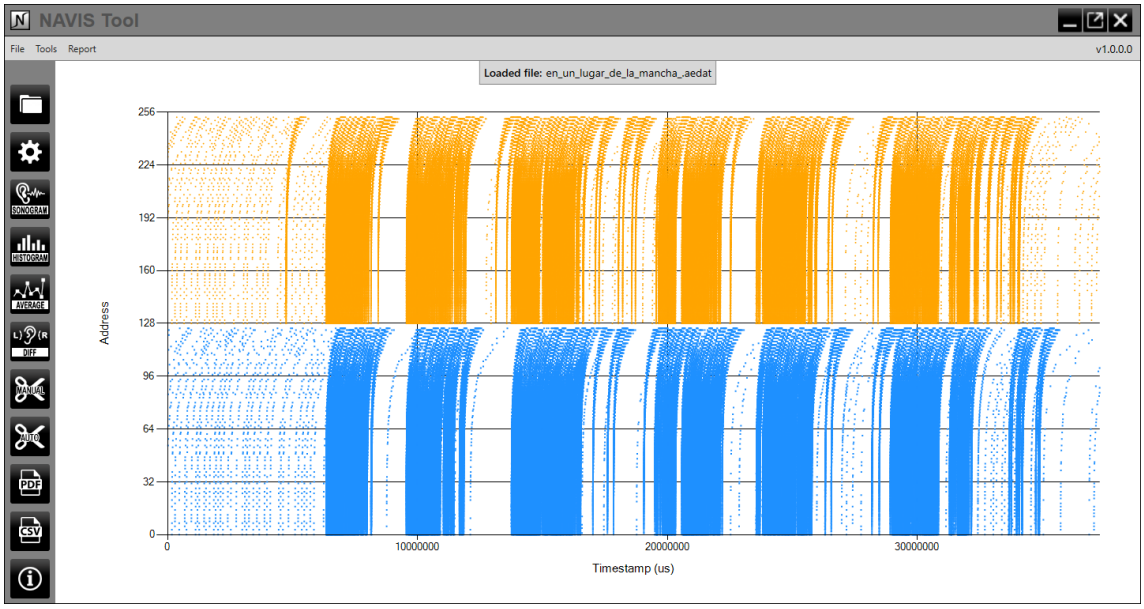


Now, after the NAVIS Tool configuration, you are ready to load your first file. Click on the folder symbol button on the left toolbar or in File>Load Aedat on the top menu. You can also load a CSV file with File>Load CSV; this file should have a different line for each event fired. Each line should have the timestamp and the address values separated with a semicolon.

After loading a file, the rest of the functionalities will be accessible.

2. Cochleogram

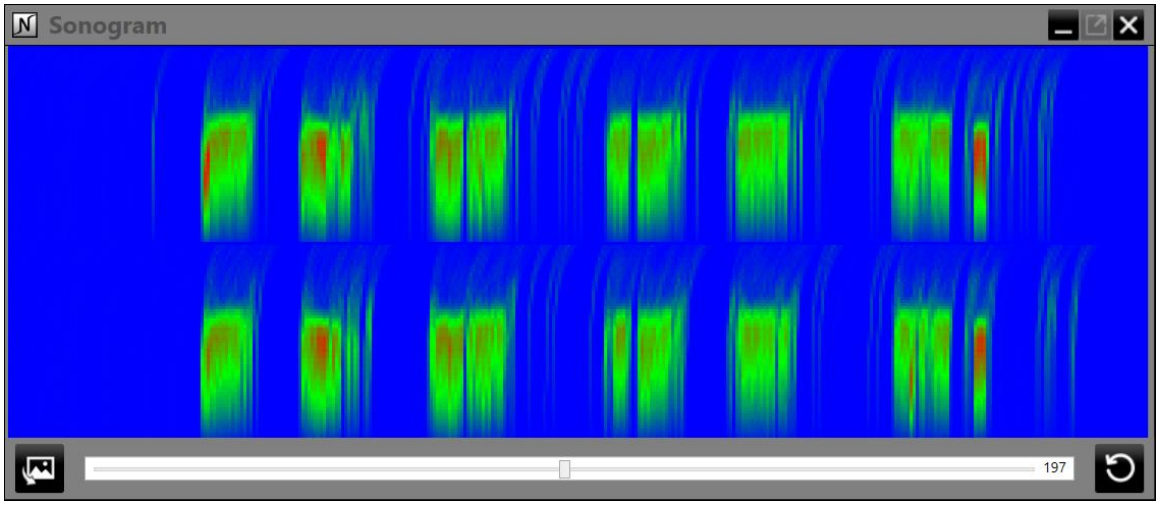
After choosing the file to be loaded, the internal data storage process and the subsequent cochleogram calculation and representation in the main window are launched. The output can be seen in the next image, where the X axis represents time (µs) and, the Y axis, the AER address for each cochlea channel. Each dot is an event that has been fired in a particular AER address at a specific time. The picture shows the AER events fired for both cochleae: the left one at the bottom and the right one on top. Focusing on one cochlea, lower addresses belong to the events of higher frequency channels.



3. Sonogram

The image represents the spike rate of both left and right cochlea in a color map, where X axis is time, Y axis is the cochlea channel, and the color is the spike rate of the channel in a particular time period (Integration period, which can be set in the settings).

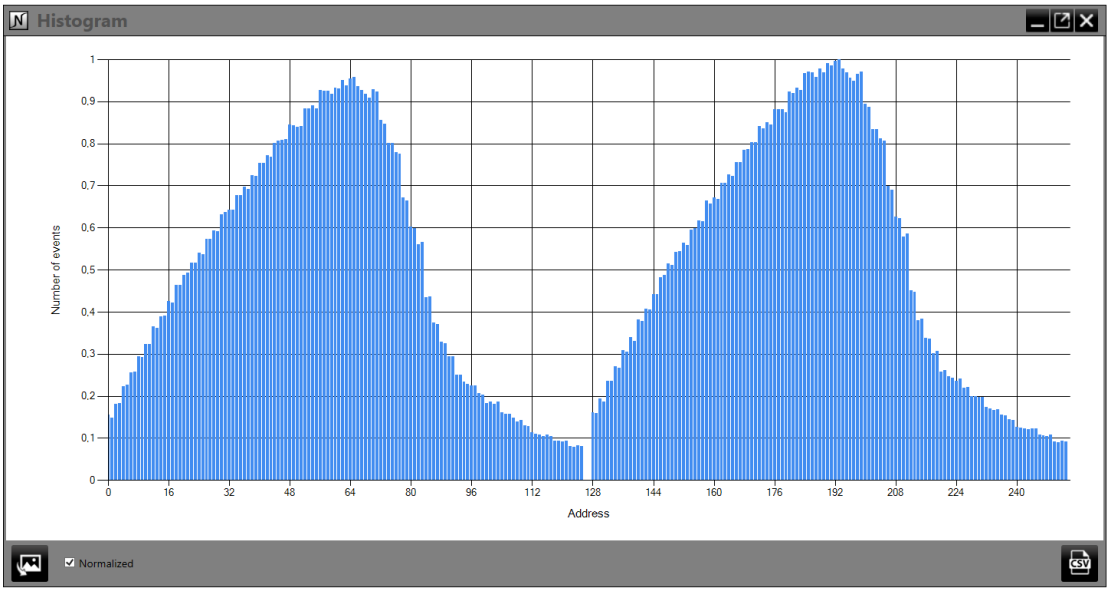
Red represents the highest spike rate and blue the lowest one, green being in the middle. Although the highest spike rate is a value that cannot be changed (197 in the image), the scrollbar gives the user the opportunity to swap the maximum value set as red to a different one. The user can also save the image to a PNG file or reset the scrollbar to its default value.



4. Histogram

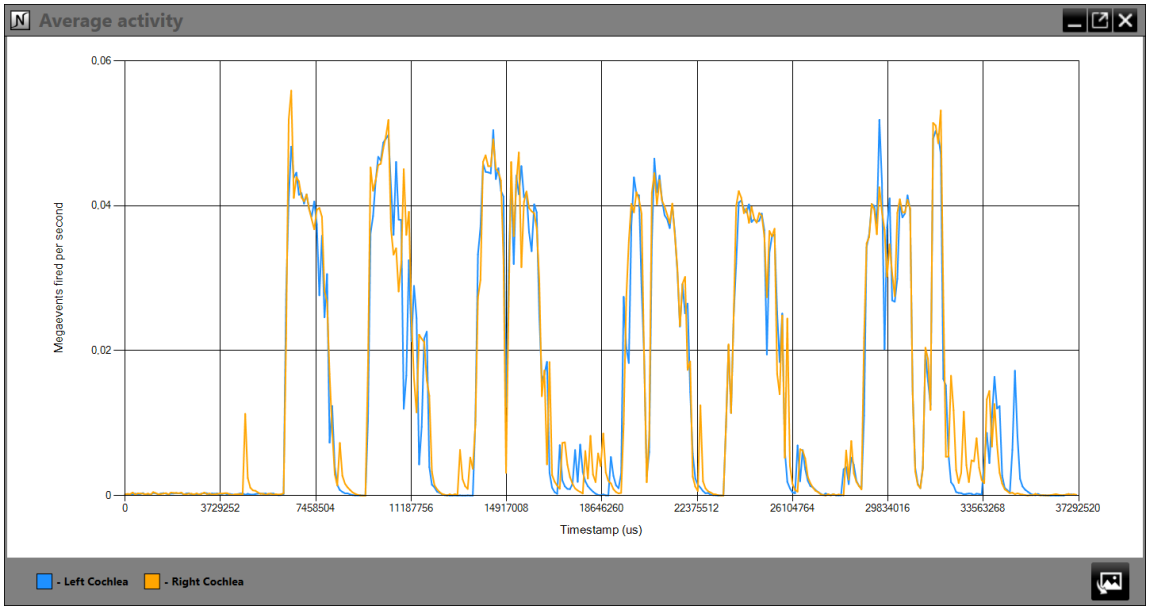
For certain applications it is important to know which cochlea channels are the ones that fire more events. The histogram is the appropriate chart to measure this information. The image shows the result of the histogram for the aedat file that we have been using in this manual. The X axis represents the 256 possible addresses, while the Y axis is the number of events fired.

The checkbox with the label "**Normalized**" allows the user to choose if the histogram is normalized or not, this is, in a percentage value of the highest number of fired events on the Y axis. The user can also save the image as a PNG file or save the histogram information (number of events fired for each address) in a CSV file.



5. Average activity of the cochleae

It is really important to know the activity of the cochleae in terms of number of AER events fired per second in a particular time period. This tool provides this functionality, generating a 2-axis chart that can be seen in the image below, where the X axis represents time (timestamp, µs) and the Y axis is the number of megaevents (10^6 events) fired per second. The user can also save the image as a PNG file.



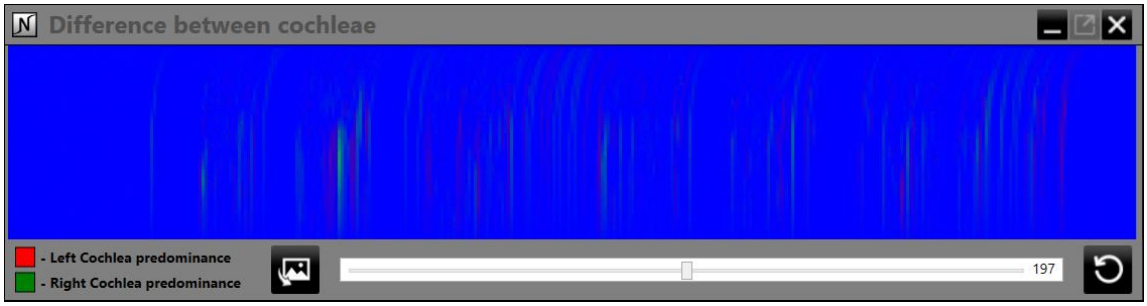
6. Disparity between both cochleae

NAVIS Tool allows the user to know the difference between the left and the right cochleae, so that the predominant one in a particular time period can be identified. This will be extremely useful in echolocation tasks because it will give us information about from where the sound is coming.

Blue represents the lowest spike rate. Red represents the right cochlea predominance, while green represents the left cochlea predominance, both measured in spike rate difference. Full green or red values represents the highest spike rate. Although the highest spike rate is a value that cannot be changed (197 in the image), the scrollbar gives the user the opportunity to swap the maximum value to a different one

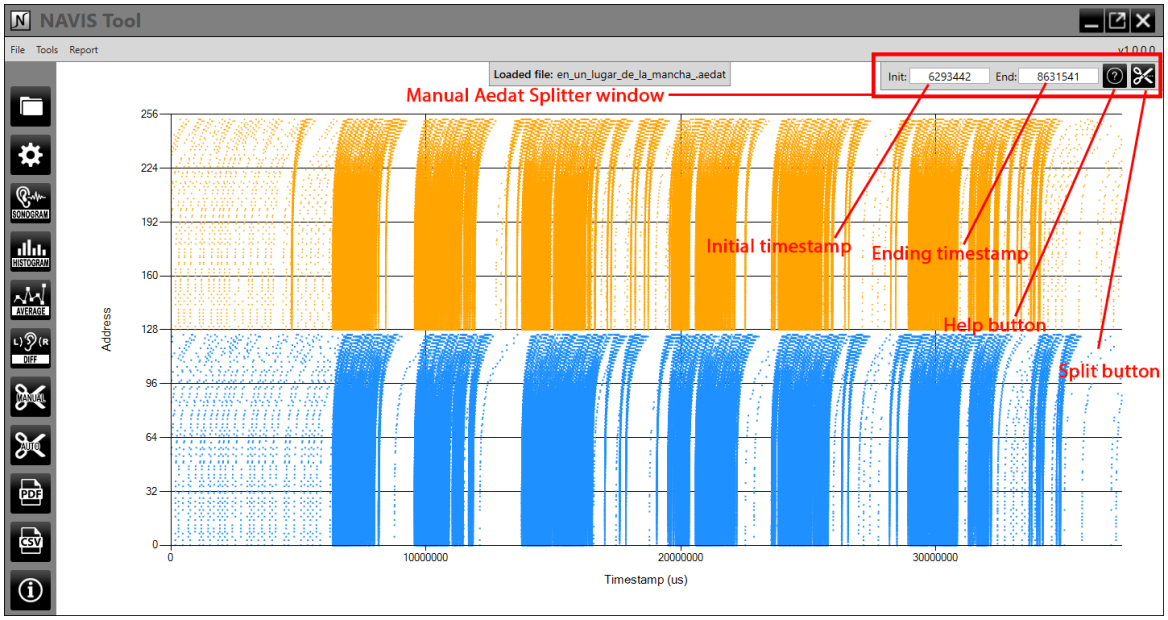
The user can also save the image to a PNG file or reset the scrollbar to its default value.

This tool will only be accessible if the loaded file corresponds to a stereo cochlea.



7. Manual Aedat Splitter

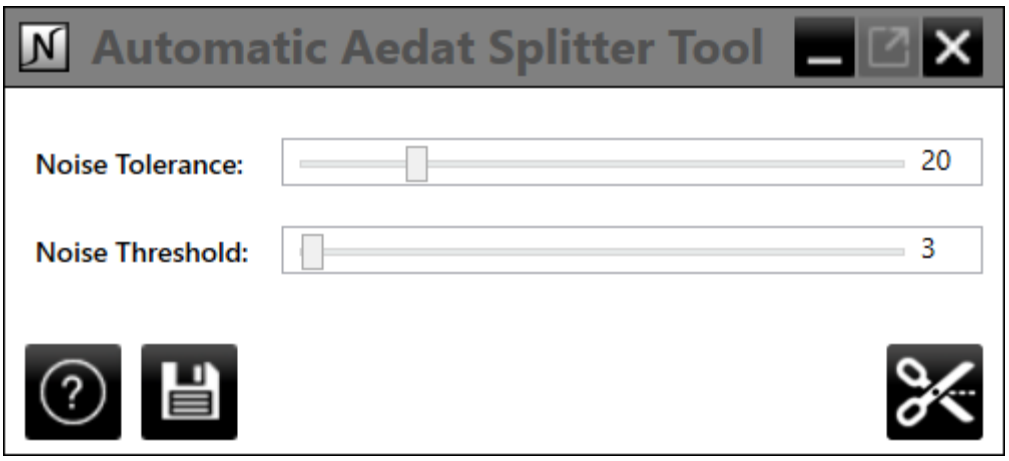
Manual Aedat Splitter is a tool that allows us to manually extract a specific section of the original aedat file and save it as a separate. A tab with two textboxes will open up in the main window, letting us choose the range of time that we want to take from the original aedat file. The first and last timestamp can be specified manually in the textboxes or just by clicking on the cochleogram (double-click with the left mouse button to select the initial timestamp and double-click with the right mouse button to select the ending timestamp). Once these two values are chosen correctly press the split button to save it.



8. Automatic Aedat Splitter

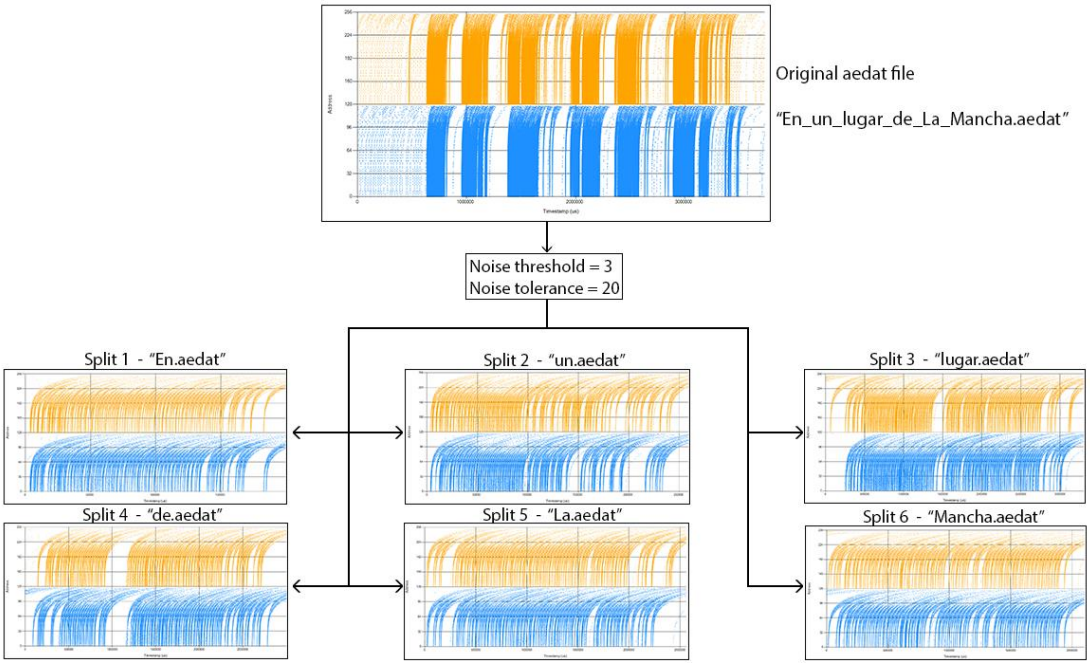
In addition to being able to split the aedat file manually (Manual Aedat Splitter), NAVIS Tool has another function that allows to split the file automatically based on the activity level of the cochleae.

Two new parameters are needed for this purpose. These can be modified before executing the process and will add some control over it. The first one is called **Noise Threshold** and it's the percentage value from the total number of events fired in the aedat file that an integration period needs to have to be considered as sound instead of noise from the transition between two words. The **Noise Tolerance** tells for how many consecutive integration periods it is needed to detect a higher number of events than the percentage from the total (Noise Threshold) to be considered as a real sound instead of noise. Then, when a time period with not enough firing rate is detected, if the process has previously passed through Noise Tolerance consecutive times or more detecting sound, a new split is created, otherwise this information will be taken as noise and will be omitted in the results of this function.



These two parameters can be configured in the Tools tab on the settings window or in the window that shows up when clicking on the Automatic Aedat Splitter window.

The image shows the output of this function for the aedat file that we have been using in this manual.


Original aedat file
"En_un_lugar_de_La_Mancha.aedat"
Noise threshold = 3
Noise tolerance = 20
Split 1 - "En.aedat"
Split 2 - "un.aedat"
Split 3 - "lugar.aedat"
Split 4 - "de.aedat"
Split 5 - "La.aedat"
Split 6 - "Mancha.aedat"

9. Other functionalities

9.1. Generate PDF

This tool allows to generate a PDF with a report or summary of the loaded file. It includes charts and information about the cochleogram, histogram, sonogram, disparity between cochleae and average activity. These five outputs can be either selected to appear in the PDF or not in the PDF tab on the settings window.

9.2. Generate CSV

Generates a CSV with the aedat information (a list with the timestamp and address for each event). This file has a different line for each event fired. Each line shows the timestamp and the address values separated with a semicolon. An example can be seen in the next image:

```
Timestamp;Address
0;235
2278;191
9101;204
9103;229
12518;54
15170;85
15932;192
15934;195
21240;98
21242;127
22001;58
22755;209
27309;232
```

9.3. Stereo to mono

After loading a stereo aedat file, you can convert it to a mono aedat file using this function, saving this information in a different file. It only saves the information of the left cochlea.

About

This software was created by Juan P. Dominguez-Morales under a GPL license.

Email: jpdominguez@atc.us.es

NAVIS Tool GitHub page: https://github.com/jpdominguez/NAVIS-Tool

You can find aedat sample files in https://github.com/jpdominguez/NAVIS-Tool/tree/master/NAVIS/AedatSampleFiles