Experiment HN-14: Senses – The Eye and Ear

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

NMD-Eye

NMD-Ear - ** This lab uses the Ear only **

Spike Sorting Analysis Module in LabScribe

Equipment Setup

1. Find the NMD-Ear model.
2. Plug the connector of the models into the DIN inputs of the IX-TA. Plug the Ear model into channel A5.

Figure HN-14-S1: The NMD-Ear models.

The ear will be connected to channel A5.

Figure HN-14-S2: The IXTA with the NMD-Ear connected.

IX - Sample Lab

Experiment HN-14: Senses – The Eye and Ear

NOTE – This lab uses the Ear Model only

Exercise 1: Ear Model While Playing Different Concertos

Aim: To measure the action potentials of the "ear" when playing different music genres or concertos

Approximate Time: 15 minutes

Procedure:

NOTE: Being completely quiet is essential as any noise will be picked up by the ear model.

1. Place the ear model on the table.
2. Search for these concertos;
   - Mozart: Flute Concerto No. 2
   - Tchaikovsky: 1812 overture end
   - Beethoven: Für Elise
3. Type **Mozart** in the Mark box. Click Record and play the at least 30 seconds of the Flute Concerto. Make sure the computer speakers are picking up the sound. Click the Mark button to mark the recording.
4. Wait 3 seconds after the sound ceases and then click Stop when done.
5. Play a representation of the 1812 Overture (near the end) for at least 30 seconds. Mark the recording **Tchaikovsky**.
6. Wait at least 3 seconds when the recording is over, then click Sop and Save.
7. Repeat with Beethoven's **Für Elise**.
8. Save the file.

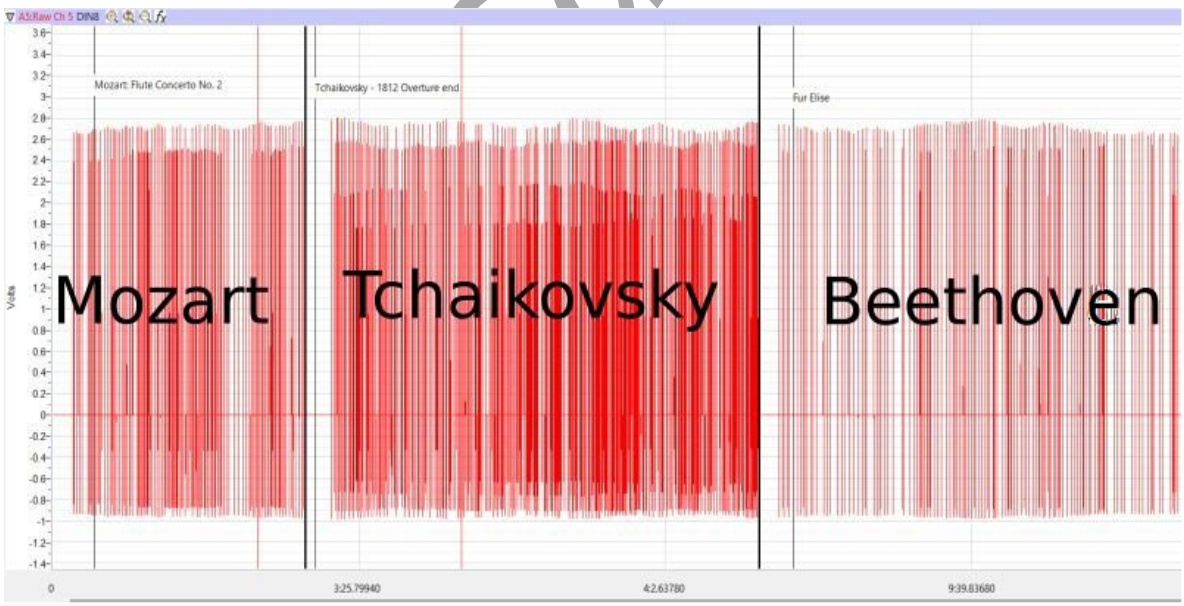

Figure HN-14-L1: Example of the action potential spikes from listening to the Flute Concerto No 2.

Example Lab

Data Analysis:

1. Go to Edit → Preferences → Options and change the Data Display points in the lower right to at least 1,000,000.
2. Use the Double Display Time icons to adjust the display time of the Main window to show most of a section of music on the screen. You may need to click this button a couple of times.

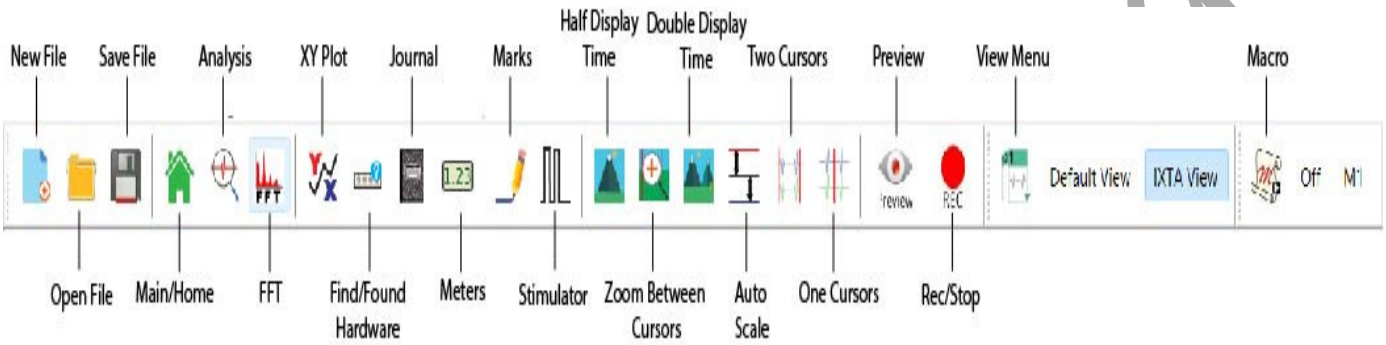

Figure HN-14-L2: The LabScribe toolbar.

3. From the menu options, click Advanced → Spike Sorting
4. This will open the Spike Sorting Analysis module.

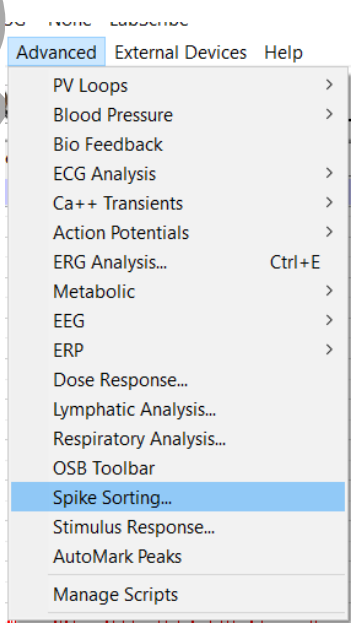

Figure HN-14-L3: Advanced → Spike Sorting

5. Make sure:
   - Spike Channel → Ear
   - Date Range → Complete File
   - Do not change other parameters

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6. Click Find Spikes.

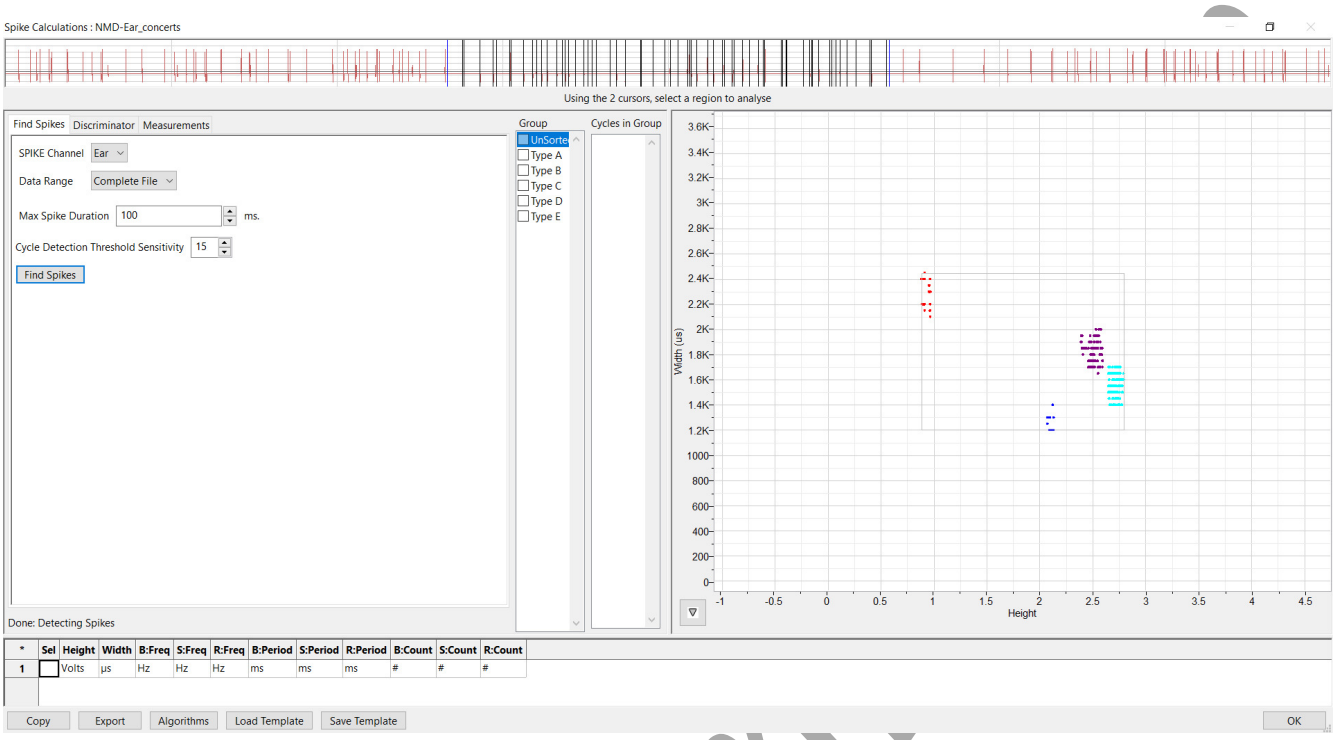


Figure HN-14-L4: Spike Sorting "Find Spikes" window.

7. Once the spikes have been sorted, you should see a graph of colored spikes.
8. Click the Discriminator tab. Click "Current Spike Type".
   - Each of the Spike Types – A through F – will show in a different color
   - When choosing a spike type, a box will show around the spikes on the graph.

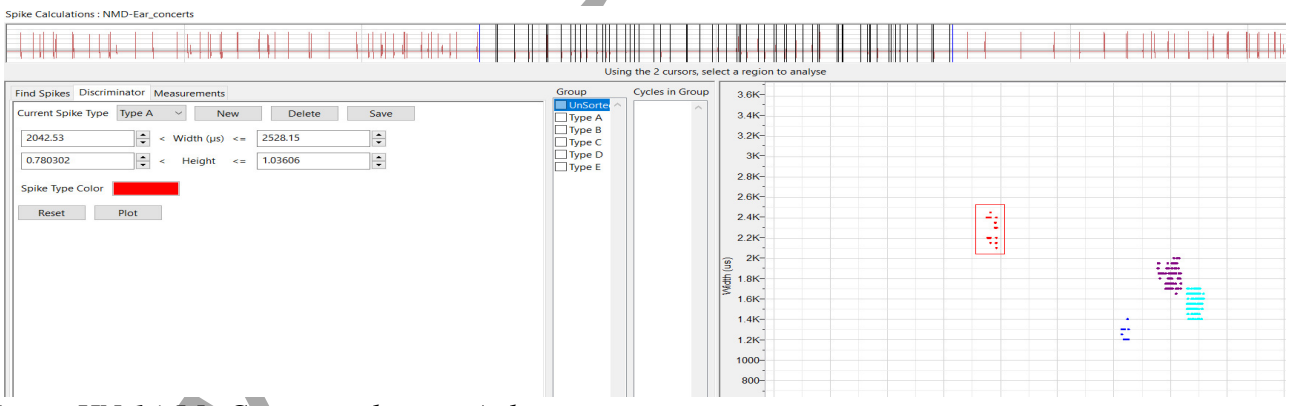
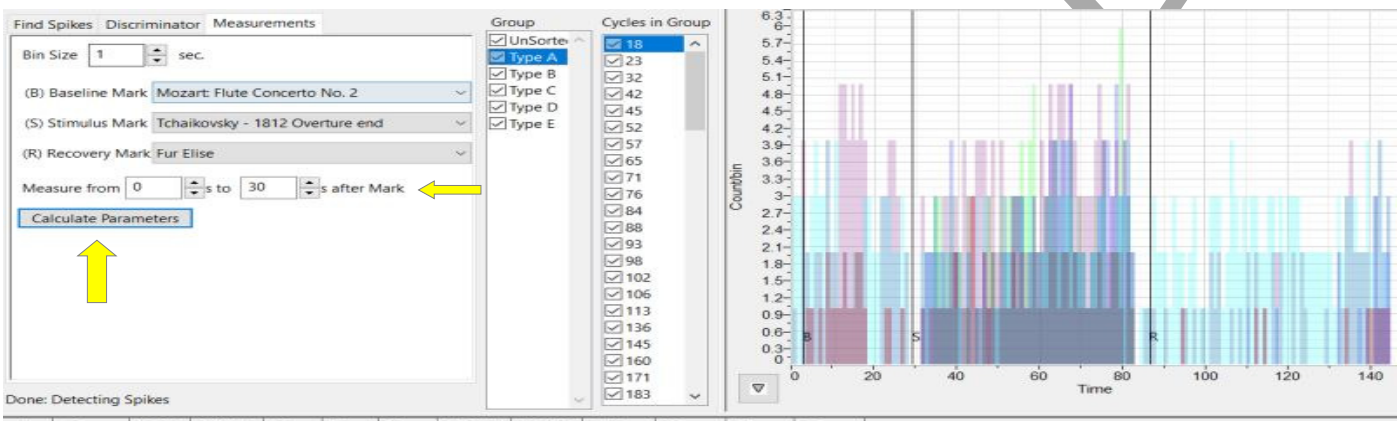


Figure HN-14-L5: Current spike type A shown.

9. Click the Measurements tab.

Sample

- Measure From is 0 → 30 seconds.
- Click the down arrow just to the left of the graph – click View Histogram
  - B = Mozart Flute Concerto No 2
  - S = Tchaikovsky 1812 Overture - end
  - R = Mozart Für Elise
- Click Calculate Parameters
  - Parameters shown include: the frequency of the spikes, the period, and number of spikes for each tone or music type..



*	Type	Height	Width	B:Freq	S:Freq	R:Freq	B:Period	S:Period	R:Period	B:Count	S:Count	R:Count
1		Volts	µs	Hz	Hz	Hz	ms	ms	ms	#	#	#
2	UnSorted	0.000	0.000	-	-	-	-	-	-	0	0	0
3	Type A	0.940	2300.000	0.825	1.137	0.054	1.212	0.880	18.363	20	29	2
4	Type B	1.819	1100.000	-	2.021	-	-	0.495	-	0	49	0
5	Type C	2.123	1300.000	-	1.675	-	-	0.597	-	0	42	1
6	Type D	2.539	1750.000	2.773	2.573	0.655	0.361	0.389	1.526	72	75	19
7	Type E	2.723	1500.000	2.575	1.549	2.165	0.388	0.646	0.462	71	46	64

Figure HN-14-L6: Spike Sorting Measurements tab showing the histogram and calculated parameters using 3 different small sections of concertos.

Questions

1. How does the ear process sound?
2. How do the vibrations of the sounds cause you to hear different tones?
3. The tympanic reflex helps prevent damage from loud sounds. How does the tensor tympani work to protect one's hearing?
4. How do the ossicles help to amplify the sound that reaches the tympanic membrane?
5. Where in the ear are different frequencies sensed (basilar tuning)?
6. How do the hair cells in the auditory cortex work to distinguish sounds?

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Exercise 2: Ear Model While Playing Different Music Genres

Aim: To measure the action potentials of the "ear" when playing different music genres or concertos

Approximate Time: 15 minutes

Procedure:

1. Click File → New to record data for a new genre of music.
2. Repeat Exercise 1, this time using a specific genre of music: Rap, Emo, Rock, Jazz, etc...
3. Play a representation of one genre for at least 30 seconds. Mark the recording appropriately and Save the data file.
4. Repeat with 2 other music types.

Data Analysis:

1. In the drop down menu in the Measurements tab, choose the different music types you used in the Mark choices.
2. Repeat the same data analysis and see if you notice any differences in the spike types and how they are represented.

Note: you can also play different individual instruments such as: violin, tuba, and clarinet for comparisons as to what the "ear" will hear.

Exercise 3: Ear Model using Pure Tones

Aim: To measure the action potentials of the "ear" when using playing single frequency tones.

Approximate Time: 15 minutes

Procedure

1. Place the ear model on the table.
2. Search for pure tones in the frequencies of:
   - 200, 350, and 750 Hz
   - 1.5, 3, and 60 kHz
3. Type **200Hz** in the Mark box. Click Record and play the 200Hz sound through the computer speakers. Click the Mark button to mark the recording. Play the sound for 5-10 seconds.
4. Wait 3 seconds after the sound ceases and then click Stop when done.
5. Type **300Hz** in the Mark box. Click Record and play the 300Hz sound through the computer speakers. Click the Mark button to mark the recording. Play the sound for 10 seconds. Wait 3 seconds after recording and then click Stop.
6. Repeat step 3 using the other frequency sounds.
7. Click Stop and the end of recording.

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8. Select Save As in the File menu, name the file and save the data file.

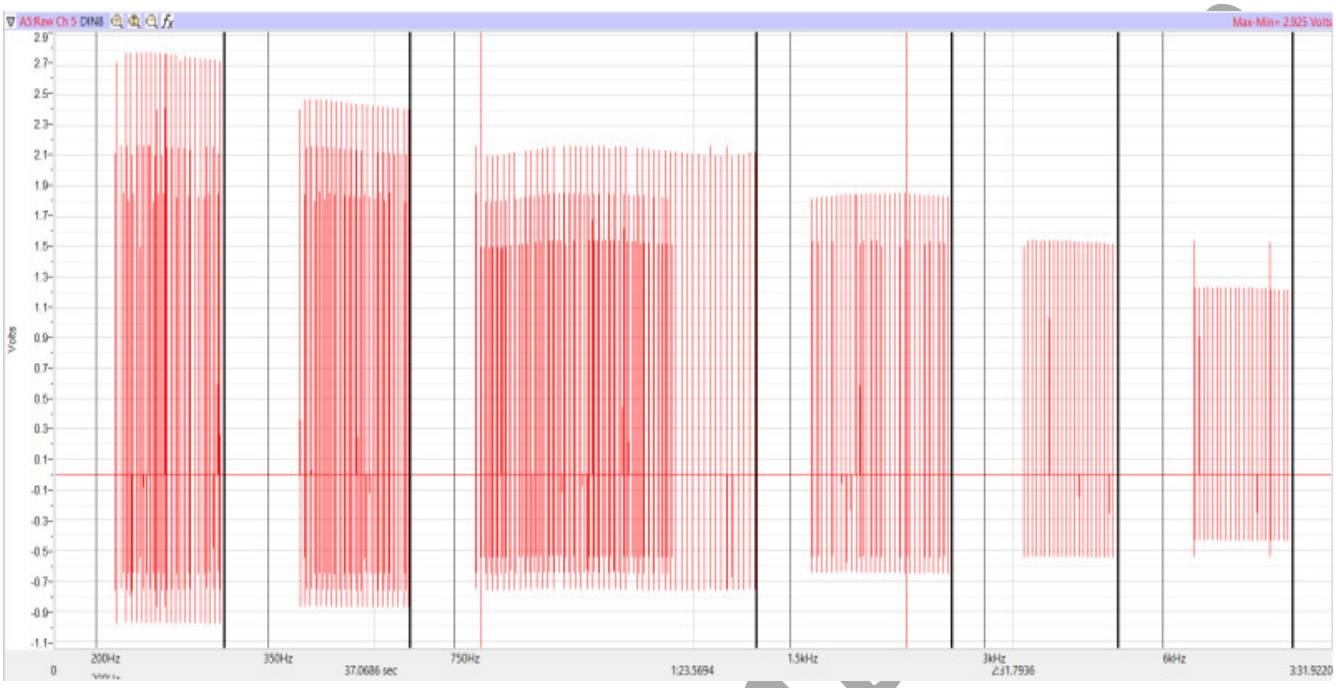

Figure HN-14-L7: Recording of the Ear with the different tones played for approximately 10 seconds.

Data Analysis:

1. Repeat the same data analysis from Exercise 1.
2. In the drop down menu in the Measurements tab, choose the different tones you would like to compare in the Mark choices.
3. Change the time to 0 → 10 seconds.
4. Determine any differences in the spike types and how they are represented between the different frequency tones.

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