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NE360/HS361
Lab 6: Due 10-23-13

Abstract:

The purpose of the lab is to explore how interaural time delays (ITD's) can code for sound localization in the horizontal plane. To do this we will look at how artificial tones with differing sounds coming out of each headphone effect our ability to detect directionality, and we will look at the Jefress model of ITD processing.

Results:

In part 1 of the lab we listened to artificially created tones from MATLAB. These tones had properties altered so that the sound produced in both ears (from headphones) are different. This allows us to test how the properties effect sound localization.

In part 1.1 we looked at the affect of changing the phase between the two tones.

- The tone sounds like its coming from the right.
- The phase shift is 2.5e-4 seconds
- If the phase-shift is changed so that the tones are completely out of phase it sounds like the tone was coming from behind
- If the phase-shift is changed so that it would be greater than the absolute value of a negative phase shift from the next peak, then the sound seemed like it was coming from the opposite direction

In part 1.2 we looked at the affect of changing the level between the two tones.

- The tone sounds almost exclusively like its coming from the left. When the amplitude is increased in the right, it still sounds like the tone is coming from the left, but not as strongly. The code segment adjusts the amplitude by a factor of .1 in the line >> `yR = 0.1*sin(2*pi*f*t);`

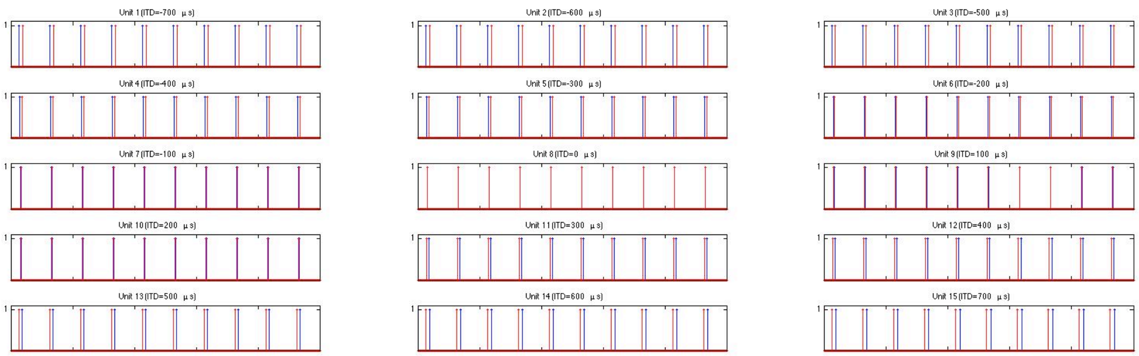
In Part 2 of the lab we looked at the Jeffress model of sound localization. This is a model where two spike train intervals are run through a system of coincidence detectors from either end. The distance from the middle of the system of the activated coincidence detecter encodes for the time delay between the two tones. This time delay is what allows for the localization.

In part 2.1 we looked at the code for an implementation of the Jeffress model (mso.m). This is a simple implementation of the model that works on the interval of -700μs to 700μs in intervals of 100μs. It works off of a 200Hz tone at a variable phase difference.

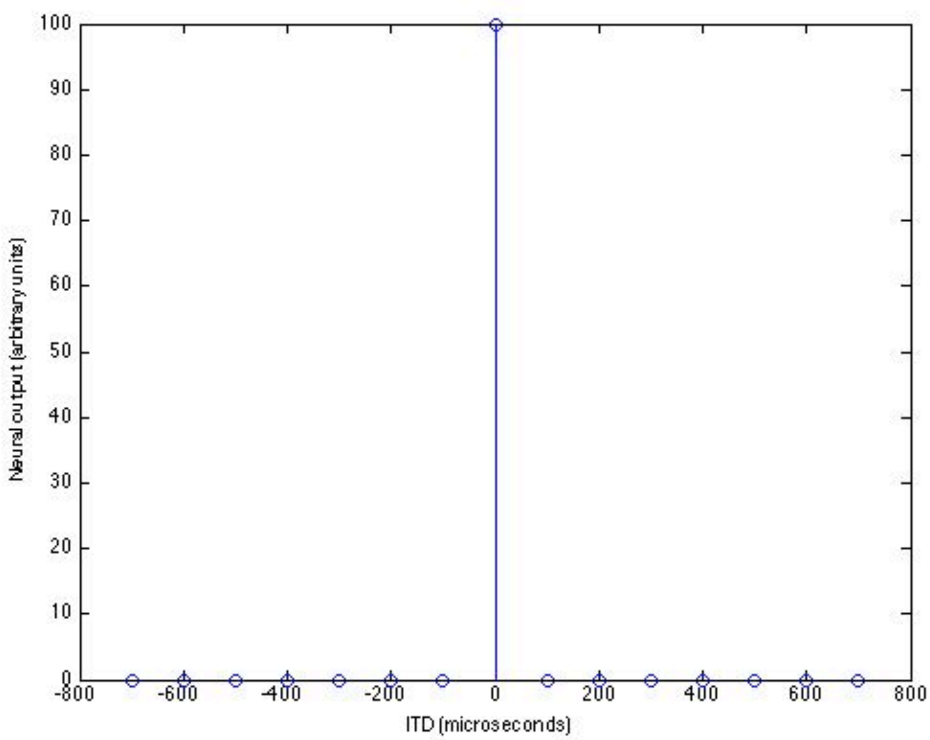
In part 2.2 we explored the mso implementation of the Jeffress model by manipulating the variables in the script.

- The charts produced in figure 1 represent the firing of output cells (coincidence detectors). When the red and blue (right and left ear signals) overlap, it indicates that the coincidence detector will fire.
- When the phase angle is set to 0, Unit 8 (with an ITD of 0) would fire, because this is the only graph where the lines overlap.

Spike Train Data

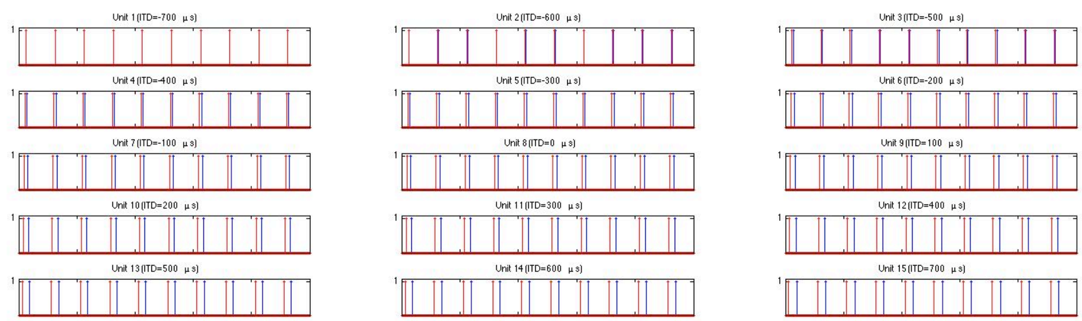


Firing Test

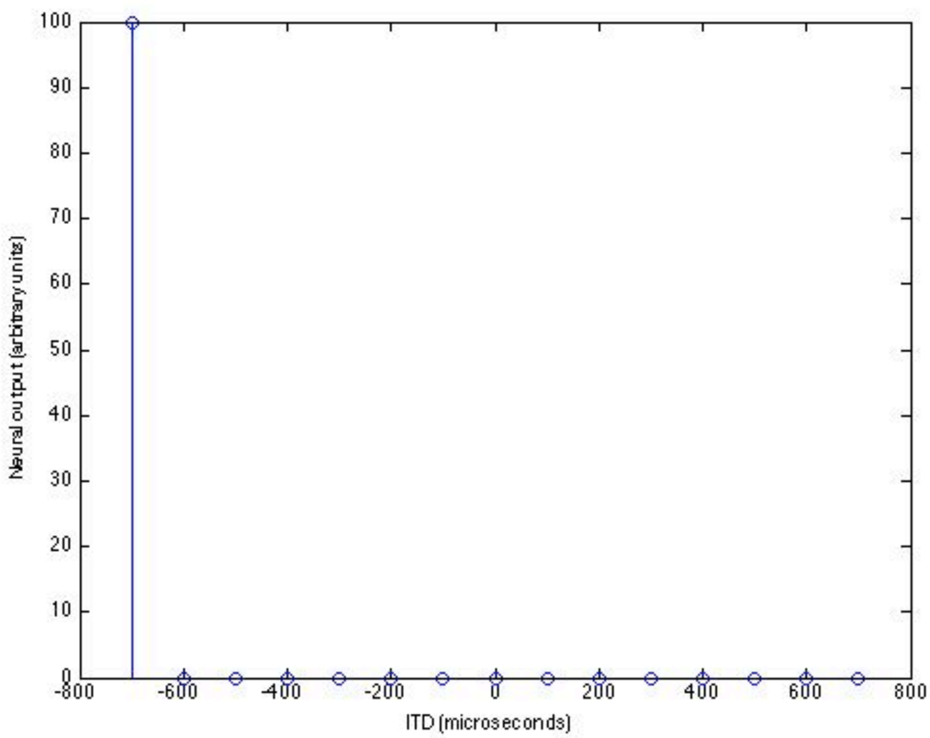


- setting myPhase to 0.14*2*pi will create a spike train with an offset of about 700μs

Spike Train Data 700μs Offset



Firing Test 700μs Offset

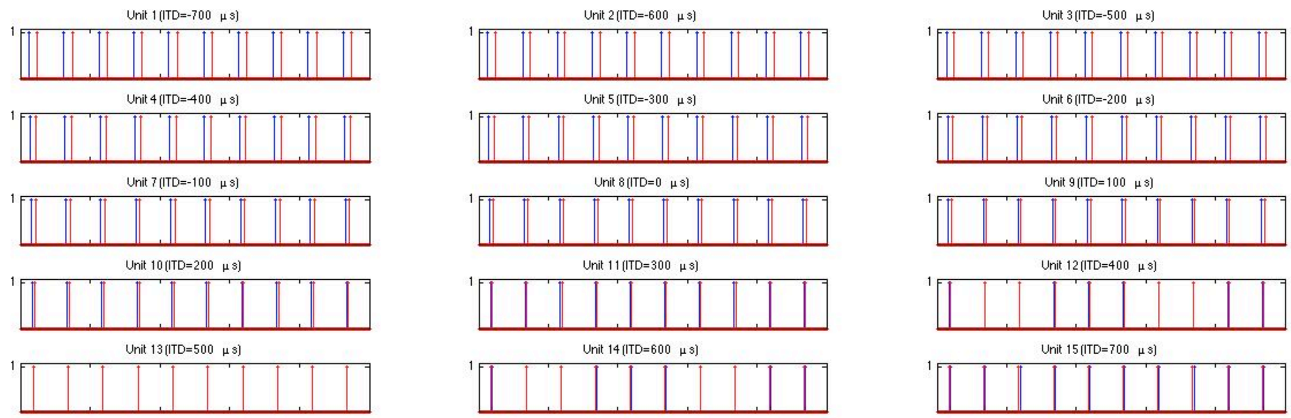


- The sound sounds like it is coming from the left and slightly behind my head, which makes sense, since a 700μs ITD corresponds to ruffly a 100 degree offset.

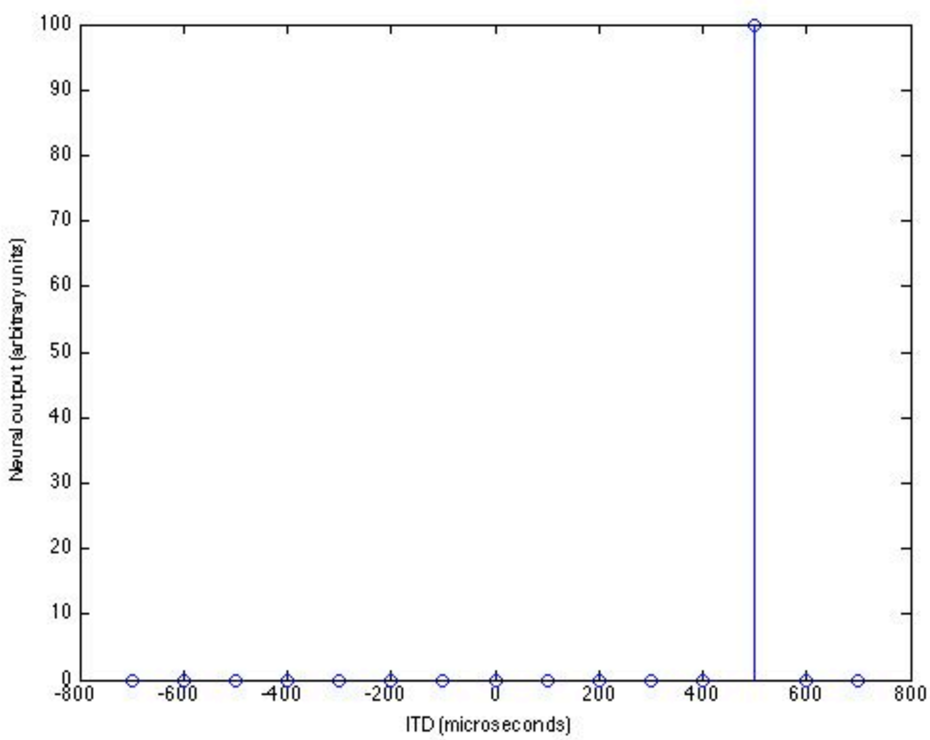
myPhase	.1*2*pi	.04*2*pi	.02*2*pi	-.04*2*pi	-.1*2*pi
ITD (μs)	-500	-200	-100	200	500

- -.08*2*pi, it sounds like to is 50degrees off of center

Spike Train Data 400μs Offset



Firing Test 400μs Offset



myPhase = `-.1*2*pi`	pSpike = .3	pSpike = .6	pSpike = .8
Max ITD (μs)	12	34	75

Part 3:

1)

2) $30^o = 0.0239$ estimated = .024
$60^o = 0.0446$ estimated = .048
$90^o = 0.0600$ estimated = .062

Conclusion:

In the lab we explored how sound localization works through altering the properties of a pure tone, and we experimented with the Jeffress model. Localization works by a function of volume and phase shifts between the tones encoded by the right vs. left ears. Since the auditory nerve does not encode phase, the Jeffress model is used do describe the mechanism in the medial superior olive that uses ITD's to determine the phase shift of the tones.