

## Lab #10 – Perception of Rhythm and Timing

### EQUIPMENT

- This is a multitrack experimental Software lab.
- Headphones
- Headphone splitters.

### INTRODUCTION

In the first part of the lab we will experiment with stereo effects by adjusting the pan (volume) between the left and right channels. We will then experiment with introducing a small delay (sub millisecond) in the signal on one channel and not the other. We will also explore the effect of a larger (20-30 msec) delay and different amounts of reverb in one channel compared to the other. These effects mimic differences in sounds detected in one ear and the other and can be used as effects in recording and sound processing. The sound file we are edited has identical channels for right (R) and left (L) channels so stereo variations are particularly noticeable once introduced into it.

Electronically generated rhythms often sound mechanical and lacking in liveliness. Meter is often described in terms of absolute intervals like quarter notes and eight notes. However musicians often deviate from exact timing sequences. In the second part of the lab we will experiment with our perception of 'microtiming' variations or deviations from exact intervals (of order 20-50 ms) that would be generated electronically or with a metronome.

The duration of short time intervals is conspicuously underestimated if they are preceded by shorter neighboring time intervals. This phenomenon is called 'time shrinking' and is illustrated in the Figure by Petra Wagner and Andreas Windmann on the right. When introducing microtiming variations.

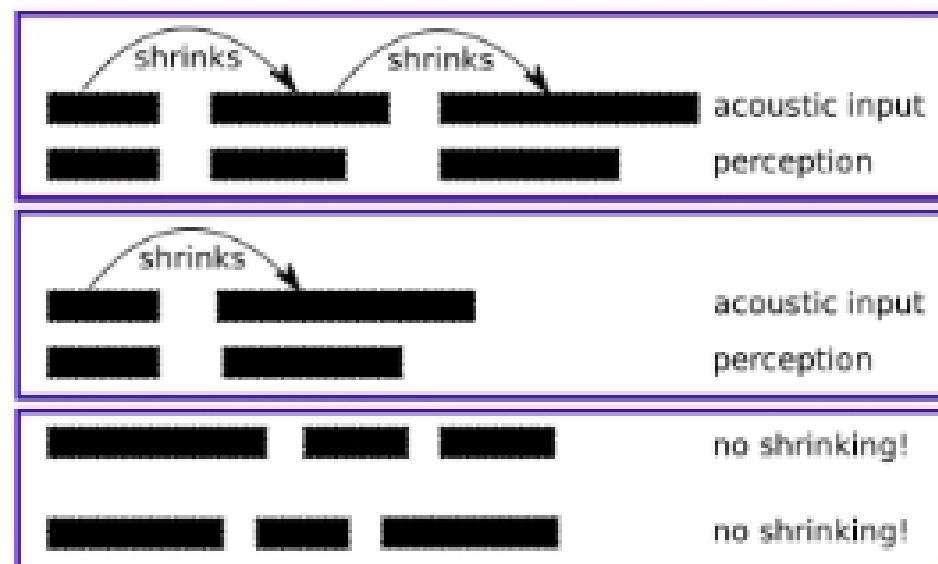


Figure 1: *Schematic overview of time shrinking effects. Time shrinking occurs in decelerating sequences and can propagate across several intervals, but is blocked by initial long intervals and in the presence of strict alternation.*

In the last part of the lab we will examine the sound file of an auditory illusion to see if we can figure out how it causes the perception of an accelerando.

### PROCEDURE

#### A. Stereo and pan

Sounds can be shadowed by our heads or other objects. Hence our ears often do not hear the same volume level. In this part of the lab we will experiment with pan, representing the relative volumen between left and right channels of a stereo recording.

1. Download the file `williams_loop.wav` from <http://astro.pas.rochester.edu/~aquillen/phy103/WWW/handouts.html> or from the directory <http://astro.pas.rochester.edu/~aquillen/phy103/Labs/forlab10/>

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- Read it in to Audition.
2. On the left top of Audition click on Multi-track and enter multitrack mode.
  3. By right clicking on the sound loop you can drag it into one of the tracks.
  4. Click on the loop play back button so you can listen to the loop played over and over again.
  5. Now click on play to listen to the loop.
  6. You should see two horizontal lines on the loop, a yellow one that is for the volume, and a blue one that is for pan.
  7. Pan adjusts the right and left speaker balance. You may want to listen to the file with headphones.
  8. By clicking on the blue pan line you can change the pan of the whole loop or just parts of it. Try changing the pan of a single drum beat.
  9. How much difference between left and right (in %) is needed to make the sound stand out? Try a few different levels. (Right click will let you remove what is called keyframes or the little yellow diamonds)
  10. Try varying different beats. Is it easier to hear a difference in pan on the low or high pitched drums? When you adjust the volume between left and right does it sound like the drum beat comes from a different location?
  11. Vary the pan from 100% pan on the left at the beginning of the clip to 100% on the right at the end of the clip. See if you can make it sound like the drums are moving across the room.

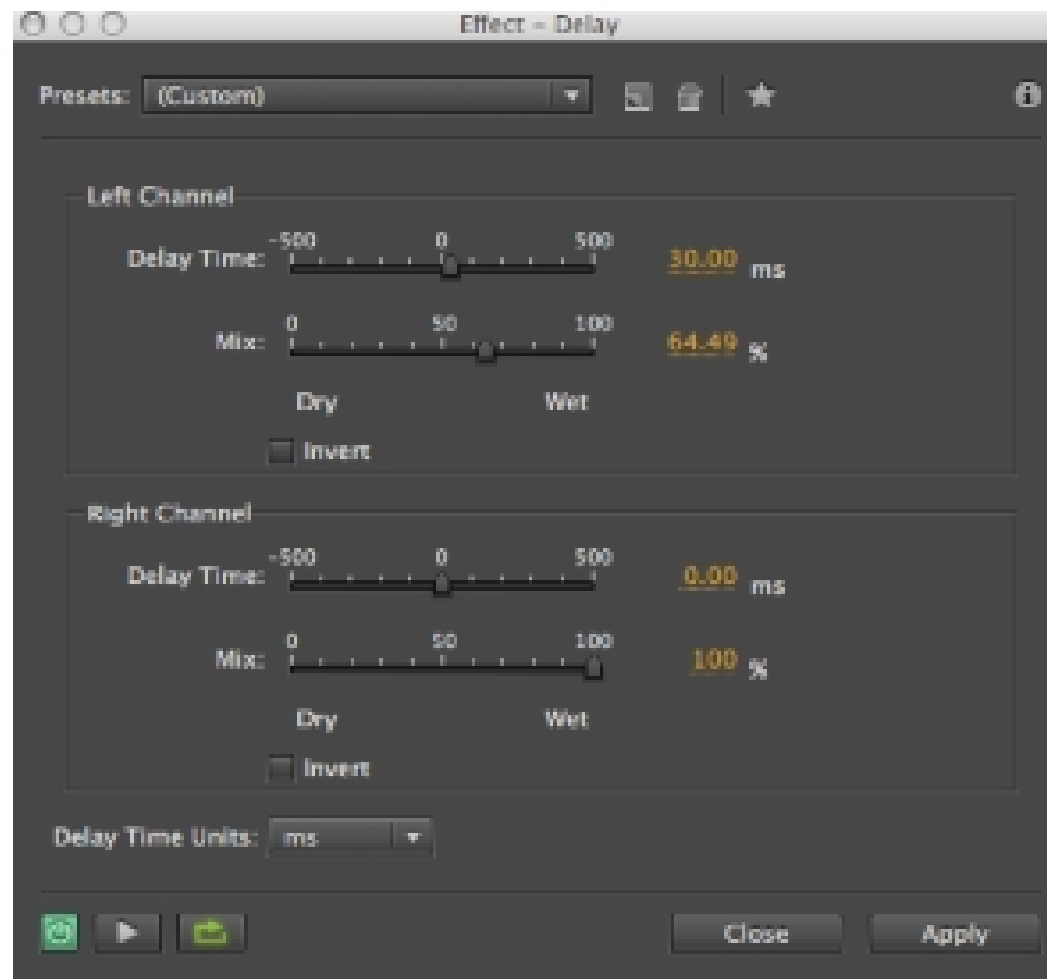


### **B. Stereo and Delays**

The speed of sound is approximately 340m/s. Consider the time it takes a sound wave to travel about 15 cm or the width of a head.  $15/(340*100) = 0.00044s = 0.44$  milliseconds. Conceivably one ear could hear a sound that is delayed by about 0.4 milliseconds compared to the sound heard in the other ear. Very small delays introduced between R and L channels do affect the way we perceive the sound. I find that small delays or changes in reverb make the recording sound more alive and as if it were recorded in a live room with live instruments. The sound file we are using has identical channels for R, L so stereo variations are particularly noticeable.

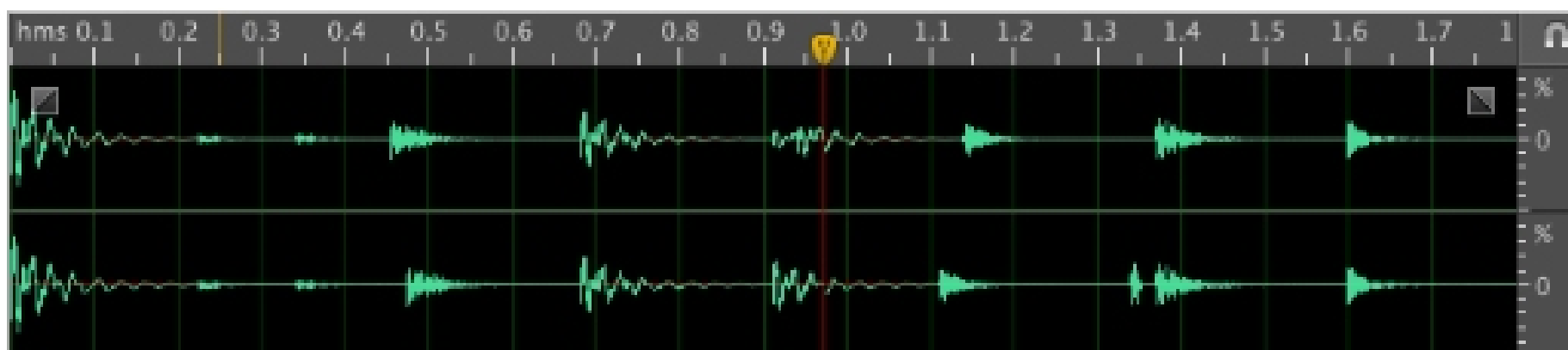
1. Go into waveform view. Select a region around a single drum beat. To introduce a delay into one channel and not the other choose Effects, Delay and Echo, Delay ....

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On the left is a delay effect box that allows you to set a delay time in right or left channels. If the Mix is 100% wet then the entire signal is delayed. Otherwise a delayed signal is added to the original.

2. Set the mixes to 100% or 'Wet'. This delays the entire signal. Otherwise a delayed signal is added to the original. Delay one channel (left or right) of a single drum beat by 0.5 ms or so. Can you hear a difference at that drum beat compared to the rest when the loop is played repetitively? Does the delay change the perceived location of the sound?
3. Is it easier to hear a delay in the bass drum beats compared to the treble ones? Sound localization may preferentially depend on the low frequencies. Neuron firing rates are observed to depend on phase only at low frequencies.
4. How do larger delays such as 20-30 msec affect the perception of the sounds?
5. Below is an image of the file with various delays introduced, including some drier ones that change the signal shape.



6. Make a sound file like the one above with various delays in it. When you listen to it do you perceive a change in rhythm or beat? I find that quite large variations in each channel can be introduced without changing the perception of a precise beat.
7. Read in the unedited sound file again.
8. By clicking on R or L on the right hand side you can selectively edit only the Right or Left channel. Try introducing reverb into a single channel at a single drum beat. (Click on Effects, Reverb, Reverb.) The key parameter to adjust is the decay time. How does introducing reverb into a single channel affect your perception of the sound in context with the other beats? Is it more noticeable on a low pitched drum beat rather than a high drum beat?

### C. Perception of Microtiming Delays and Advances