SCI220 – Foundations of Musical Acoustics
Cogswell Polytechnical College
Fall 2008

Week 9 – Homework
Problem set due 10/28, lab due 10/30

Problem set:

1. What are the wavelengths of the first three natural modes on a string of length L = 0.6 m? (remember, the wavelength is for the transverse string vibration not for the resulting sound in air)
2. If the velocity of transverse waves on a string of length L = 0.3 m is v_t = 240 m/s, what is the fundamental frequency f_1 of its fundamental mode?
3. Suppose you have a string of length L = 0.5 m on which waves travel at speed v_t = 150 m/s. What is the frequency f_5 of its fifth mode? Regarding the mode as a standing wave, what is the wavelength λ_5?
4. If a string with linear mass density μ = 0.002 Kg/m is placed under tension T = 180 N, with what speed v_t will it carry transverse waves?
5. If a string of linear mass density μ = 0.006 Kg/m and length L = 0.75 m is subjected to tension T = 540 N, what is the frequency f_1 of its fundamental mode?
6. Suppose you have a piano bass string of length L = 2 m and linear mass density of μ = 0.06 Kg/m, and you want it to vibrate with fundamental frequency f_1 = 30 Hz. How much tension must you apply?
7. Lets say that a piano's bass string has length L = 1.5 m and that the hammer of a piano has a width of W = 3 cm. Calculate the harmonic number that will not be excited?
8. Suppose you pluck a guitar string that sounds the note G2. Now you touch your finger slightly on the string at L/4 down from the nut. Which modes of vibrations will survive? Why?

Lab Assignment:

1. Go to these web pages and read them first:
   http://en.wikipedia.org/wiki/String_instrument
   http://en.wikipedia.org/wiki/Vibrating_string
2. Now, go to http://www.falstad.com/loadedstring/ and you will see a java applet automatically open.
3. On the applet, go to the “Display phases” menu and change it to “Display modes”.
4. Next, click on the “Log View” toggle to the the harmonic magnitude in a log scale.
5. Click on the “Stopped” toggle and pluck the string exactly exactly in the middle. See what modes are showing graphically and the look at the log scale and see what modes are shown and which are absent. Write down your results. Slow down the Simulation Speed so you can observe the string shape change.
6. Do the same for plucking at 1/3, ¼, and 1/5 of the string length.
7. Now change “Display modes” to “Display Left + Right” and observe the string shape when you pluck at ½ and ¼ of the string length. Explain what is happening.
8. Finally, try different values for loads, tension, and damping. Explain what each does to the string.

9. You can use this link as an aid for your write up. It has a detailed explanation of the formulas in use: http://hyperphysics.phy-astr.gsu.edu/hbase/waves/string.html