SCI220 – Foundations of Musical Acoustics
Cogswell Polytechnical College
Fall 2008

Week 11 – Homework
No problem set , lab due 11/13

Lab Assignment:

For a C4 string the typical values are:

Tension, T = 650 N
Unit mas-density, μ = 0.006 kg/m
Transverse wave velocity, v_t = 330 m/s

To calculate the nth frequency of a string, the following expression is used:

$$(1)\ f_n = \quad n\left(\frac{vt}{2\mathrm{L}}\right) = \frac{n}{2\mathrm{L}}\sqrt{\frac{T}{\mu}}$$

We can also use the following formula:

$$(2)\ f_n = \quad \frac{n}{Lr}\sqrt{\frac{T}{d}}\sqrt{\frac{1}{4\pi}}$$

where r is the string's radius and d is the density of the material.
The density of steel is 7.85 x 10³ kg/m³ and for brass 8.4 x 10³ kg/m³

1. Measure the length L of the C4 string.
2. Calculate the frequency of the fundamental tone with formula (1) and measure the strings frequency with a chromatic tuner. Are both frequencies the same? Explain any differences.
3. Calculate the fundamental frequency by using formula (2). Compare both fundamental frequency calculation results.
4. Take an Impulse Response of a two C4 strings by rapidly pressing and releasing the key while the *una corda* pedal (left pedal) is pressed. Do the same for all three strings with the sustain pedal (right pedal).
5. Take an IR for C2, C8. Use all strings.
6. Run the IR analysis code and measure the T60 and describe the characteristic frequency spectrum for each string.
7. Write up your results and discussion.

Facts:

1. The fundamental frequency of C4 is approximately 261.63 Hz.
2. The “typical” length of a C4 string is approximately 62-65 cm.
3. For bass frequencies, the T60 can be more than 15 seconds. In the mid range, 2-3 seconds. And in the higher range half-second or less.
4. Higher frequencies decay faster than lower ones.