Music 170 / ICAM 103: Problem set #6 due Nov. 13

Definitions.

(For definitions of formants and spectral envelopes, see the handout from Oct. 30.)

Formulas.

The frequency of a vibrating string (from Rossing P. 63):

$$f = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$$

where n is the number of the partial (1, 2, 3, $\cdots$), L is the length of the string, T is the tension (in units of force), and μ is the linear density of the string (units of mass per distance).

Problems

1. A just intonation scale (starting at C; Rossing P. 179) is tuned so that the "A" is 440 Hz. What frequency does the lower "C" sound at?
2. A mass-on-a-spring vibrates at "A" 440. If we doubled the mass, without changing the spring constant, what new pitch would sound?
3. Suppose a recorded sound has fundamental frequency 100 Hz. and two formants, at 600 and 1000 Hz. If you double the speed of playback, where do the formants now appear? What if you added the signal to itself delayed 1/2 cycle (1/200 second)?
4. A piano string is stretched to 1/2 meter in length, and weighs 10 grams. How much tension must it have to reach middle C in pitch?
5. The top string on a guitar sounds two octaves above the bottom string. If the two strings were made of the same material, and if they were strung at the same tension, how much larger would the diameter of the bottom string have to be than the top one?