E6820 Speech & Audio Processing & Recognition **Homework 3**

Assigned: Thursday 2001-02-01 Due: Tuesday 2001-02-06

Dan Ellis <dpwe@ee.columbia.edu>

Background reading:

Read the chapters in Gold & Morgan from the section on acoustics i.e. chapters 10, 11, 12 and 13. Some of this is just background material – in particular, I guarantee you won't get any exam questions on holography! – and much of the rest (wave equation, acoustics of tubes) we will go over in class. It will help, however, if you've at least seen it beforehand.

Reading assignment:

"Physical Modeling using Digital Waveguides," Julius O. Smith III, adapted from *Computer Music Journal* 16:74-87, 1992, http://www-ccrma.stanford.edu/~jos/pmudw/ .

This is a rather more detailed treatment of the method sketched in Gold & Morgan of using separate digital delay chains to model the two travelling wave solutions to the one-dimensional wave equation. You should read it mainly to get a general idea of the approach, rather than worrying over the details. The paper shows how the same principles can be used to model a range of instruments, and while these practical aspects aren't central to our course I think it's a good read anyway. As before, add a summary to your web page.

Practical assignment:

The matlab script `pluck1.m` (available on the web site) is an implementation based loosely on Smith's C-code. The basic usage is:

```
x = pluck1(len, count, b1);
```

where `len` is the length of the two digital waveguide delay lines in samples, `count` is the number of output samples to generate (and hence the duration of the sound), and `b1` is a parameter controlling the lumped 'loss' filter at the bridge reflection. The output value `x` is a waveform sequence (sampled at one end of the string) which can be listened to via `soundsc(x)`.

Starting with `len` = 20, `count` = 16000 and `b1` = 2, try some different values for `len`. How does this affect the sound? Now try changing `b1` e.g. to 10. How does this affect the sound? Can you generate some spectrograms to support your subjective impressions? What happens if `b1` is made smaller than 2, e.g. `b1` = 0.1? Feel free to look at the code if you want to find out how `b1` is used and why it might behave in the way you have observed.

Project:

You should be working towards generating a specific plan for your term project. On the web page concerned with the term projects, I have expanded the description of what is expected and how it will be assessed, as well as offering some advice on how to structure a good project. I plan to contact each of you individually to give you feedback on your preliminary project descriptions from your websites. Please continue to add any new thoughts or ideas you have, and I will check back.