

Assigned: Tuesday 2001-02-20 (**updated 2001-02-21**)Due: Tuesday 2001-02-27
Dan Ellis <dpwe@ee.columbia.edu>**Background reading:**

In Gold & Morgan, read chapters 19, 20 and 21 (filterbanks, cepstrum and LPC) and chapter 29 (speech synthesis).

Reading assignment:

“Applying the Harmonic plus Noise Model in concatenative speech synthesis,” Yannis Stylianou, IEEE Transactions on Speech and Audio Processing, 9(1), 21-30, Jan 2001. This is a recent and successful approach to modeling the speech signal that deals separately with the lower part of the spectrum, best modeled as a set of harmonics, and the upper spectrum, which is more satisfactorily modeled as noise. Add a summary to your web page.

<http://www.ee.columbia.edu/~dpwe/courses/e6820-2001-01/papers/Styl01-hnm.pdf>

Practical assignment:

This week we use the Matlab Auditory Demonstrations produced at Sheffield University:

<http://www.dcs.shef.ac.uk/~martin/MAD/docs/mad.htm>

Follow their instructions to install the whole set. Remember to edit the file `madroot.m` in the `putonmatlabpath` directory to hold the path to the root of the demos, then, within Matlab, `cd` to that directory and type `madstartup`. Then try following demos, in each case working through the related description page on the web site above.

- **streamer**. This allows you to investigate the two-tone streaming phenomenon as a function of tone repetition time and frequency separation. Set the “Cycles” menu to 10 before you start. Then experiment with the full range of pitch separations at a given repetition time. If the high tones have a steady rhythm, seemingly separate from the low notes, you are perceiving them as a separate stream. Map your thresholds at different repetition times, and save a printout of the result (“print” from the Matlab prompt should work).
- **detuning**. This demo shows the effect of harmonic mistuning on pitch. Try to match the pitch of the mistuned harmonic complex against that of the pure tone by clicking at different vertical positions at a given horizontal position (mistuning). The tuning differences are very small, so you have to listen carefully. Make a plot of your results.
- **ti**. This demo allows you to investigate the ‘restoration’ of sounds behind noise maskers in a variety of conditions. Work through the suggestions in the documentation page.

Because we didn’t get to it in the lecture, please also look at `vowelExplorer` for examples of the separation of synthetic vowel pairs based on pitch differences. You might also enjoy `sws` for some more examples of sinusoidal speech replicas.

Problems:

From the chapter-end exercises in Gold and Morgan:
Problems 14.1, 15.6 and 17.6.