Problem 7.1

Record yourself (or your lab partner) saying the following utterances: “the bug,” “the dud,” “the guppy,” “the pug,” “the tug,” “the cut,” “the fuddy-duddy,” “the vuh,” “the thug,” “the the,” “the supper,” “the zup,” “the shutter,” “the zhuf,” “the mother,” “the nun,” “sung a song,” “the one,” “the young,” “the rug,” “the lung,” “the huh.” These utterances will be analyzed in the following problems.

Problem 7.2

Stop Consonants—This problem will use the following utterances: “the bug,” “the dud,” “the guppy,” “the pug,” “the tug,” “the cut.” For each of the six stop consonants, identify the following features:

(a) The approximate duration (in milliseconds) of frication (turbulence produced at the stop consonant constriction immediately following stop consonant release, and therefore exciting only the resonant frequency of the front cavity).

(b) The approximate duration (in milliseconds) of aspiration (turbulence produced at the glottis following stop consonant release, and therefore exciting all of the resonances of the vocal tract, though F1 may be only weakly excited).

(c) The voice onset time (VOT): the total duration (in milliseconds) from the transient until the onset of voicing, including both frication and aspiration. Compare the VOTs of unvoiced and voiced stops. Do unvoiced stops always have a longer VOT than voiced stops? Do all voiced stops have the same VOT?

(d) The approximate duration of the formant transition from previous vowel until consonant closure.

(e) The approximate duration of formant transition from the transient until the end of formant transitions in the following vowel. Note that it is possible for formant transitions to finish before the end of aspiration in an aspirated stop consonant.

(f) Create a DFT spectral slice using a window centered at the transient (right-click on the transient, in the waveform). Identify the frequency of the front cavity resonance: usually the spectrum of a transient rises from low frequencies up to a broad peak at the frequency of the first resonance, and then is relatively flat above that.

(g) Identify the formant loci at the instant of consonant closure: these are the frequencies of the vocal tract resonances at the instant of stop closure (the instant when the lips close or the tongue hits the roof of the mouth), regardless of whether or not evidence of the formants is still available in the spectrogram at that instant (watch the trajectory).
(h) Identify the formant loci at the instant of consonant release: these are the frequencies of the vocal tract resonances at the instant of stop release (the instant when the lips open or the tongue leaves the roof of the mouth).

**Problem 7.3**

**Fricative Consonants**—This problem will use the following utterances: “the fuddy-duddy,” “the vuh,” “the thug,” “the the,” “the supper,” “the zup,” “the shutter,” “the zhuf.”

(a) Estimate the duration of frication in each fricative. Do voiced stops always have shorter duration than unvoiced?

(b) Estimate the duration of the voice bar: the period of glottal excitation from the instant of oral closure until voicing ceases. Compute the “voiced fraction,” that is, the fraction of each duration that is voiced. Do voiced stops always have longer voiced fraction than unvoiced? What is the typical “voiced fraction” of a voiced stop?

(c) Create a DFT spectral slice in the middle of the frication. Estimate the front cavity resonance of each fricative.

(d) Estimate the formant loci at closure and release of each fricative consonant.

**Problem 7.4**

Identify the formant loci of the intervocalic sonorant consonant in each of the following utterances: “the mother,” “the nun,” “sung a song,” “the one,” “the young,” “the rug,” “the lung.” Notice that the formant loci of a glide or liquid may be measured at the center of the consonant, but the same is not true of a nasal consonant.