Lab 5: Sound generation at the larynx: Glottal source
Lecture notes, September 22, 2005

1. Mechanical behavior of the vocal folds

   A. Conditions for vibration:

      i. Approximation of folds
      ii. Vocal-fold tension
      iii. Transglottal pressure

   B. Illustration of opening and closing cycle

   C. Natural frequency of mechanical system = fundamental frequency of voice source. Depends on:

      i. Anatomy of a given individual
      ii. Adjustments of laryngeal muscles

   D. Modal vibration assumes:

      i. Complete closure
      ii. Abrupt closure

2. Glottal volume-velocity waveform

   A. Definition of parameters of glottal waveform

   B. Derivative of volume velocity as effective excitation

      $v(t) * h(t) * r(t) \sim d/dt[v(t) * h(t)] = d/dt[v(t)] * h(t)$

   C. Source spectrum: drops off at 6 dB per octave in ideal case

3. Voice-source characteristics

   A. Sources of variability: F0, waveform shape

      We'll mostly talk about waveform shape

   B. Variations occur:

      i. Across speakers

ii. Within speakers, due to
    a. Speaking conditions (level, emotion, health)
    b. Prosody (variations throughout utterance)
    c. Neighboring speech segments

C. How to measure?

i. Inverse filtering to get estimate of glottal waveform
ii. Measures on speech spectrum

4. Variations of voice-source characteristics

A. Closure is abrupt and complete

i. F0
ii. OQ
iii. SQ

B. Posterior glottal opening

i. Increased losses (B1)

    a. Reduction in amplitude of F1 (A1)
    b. Increased damping seen in waveform

ii. Increased spectral tilt

    6 dB/octave, cutoff frequency depends on size of opening

iii. Increase in aspiration noise at high frequencies

C. Non-abrupt closure

i. Increased spectral tilt

    6 dB/octave, cutoff frequency depends on time delay of closure

5. Coupling between the tracheal and supraglottal cavities