24.963 Linguistic Phonetics
Fall 2005

Measuring vowel duration:
- Make measurements by examining waveform and spectrogram in combination.

We aim to measure vowel duration from the release of the constriction of the preceding consonant to the formation of the constriction of the following consonant.
The cues for identifying these time points depend on the manner of the relevant consonant.

<u>Onset consonants</u>

Stops
The stop release should be easy to identify from the release transient – a 'spike' in the waveform, and the sudden appearance of high frequency energy in the spectrogram (below).
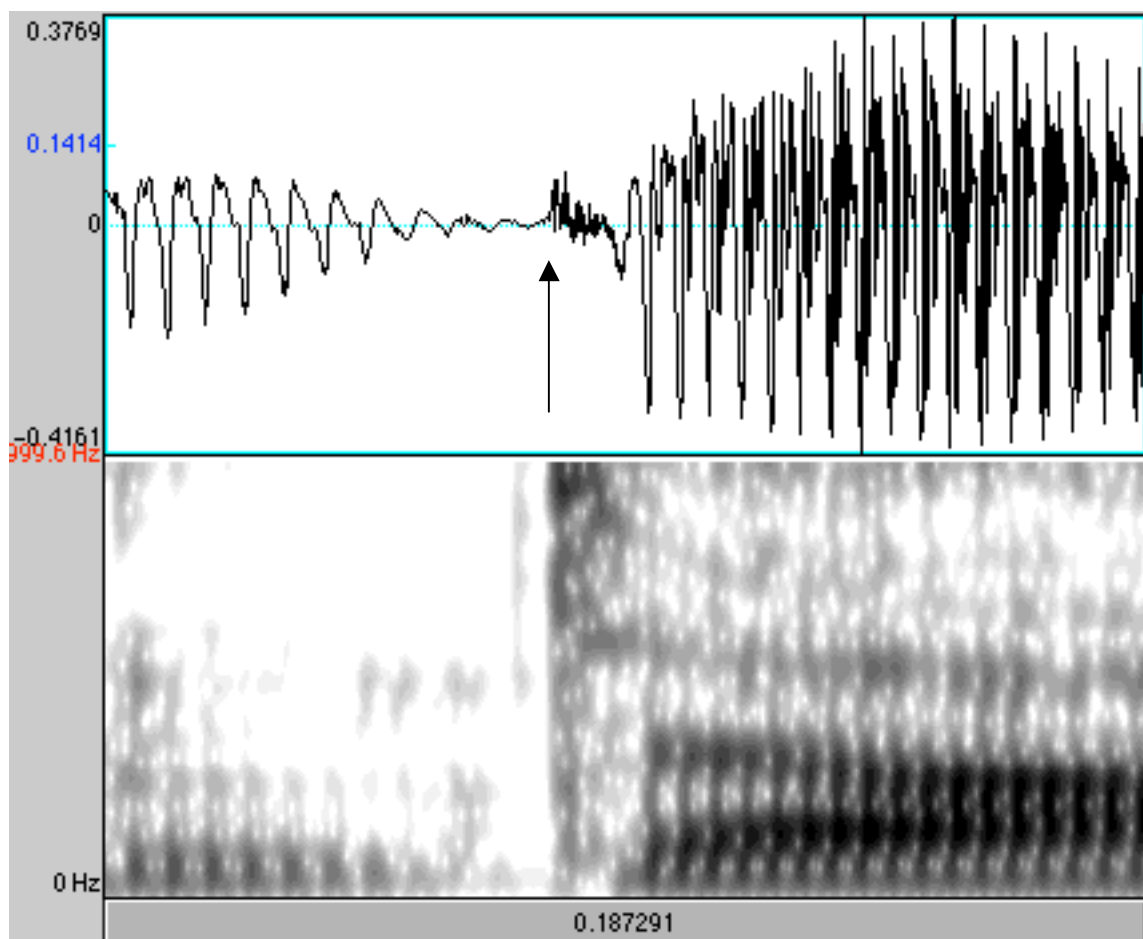
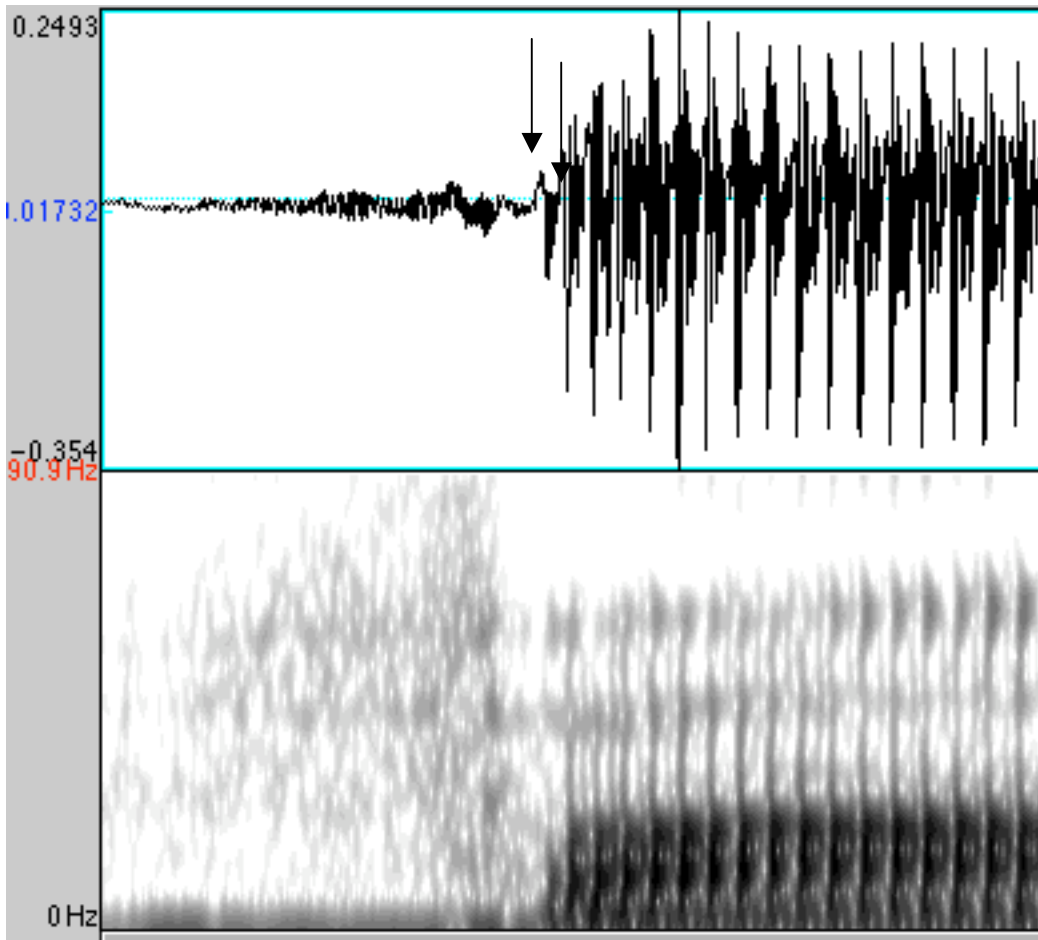Waveform and spectrogram of the initial stop release.
The arrow marks the release burst in the wave form.

Fricative [f]
Release of [f] is marked by:
- rapid rise in amplitude
- disappearance of frication noise
- onset of clear formants.
In my speech, voice onset appears to coincide with [f] release (abrupt increase in intensity), so this could be used as a marker of vowel onset.
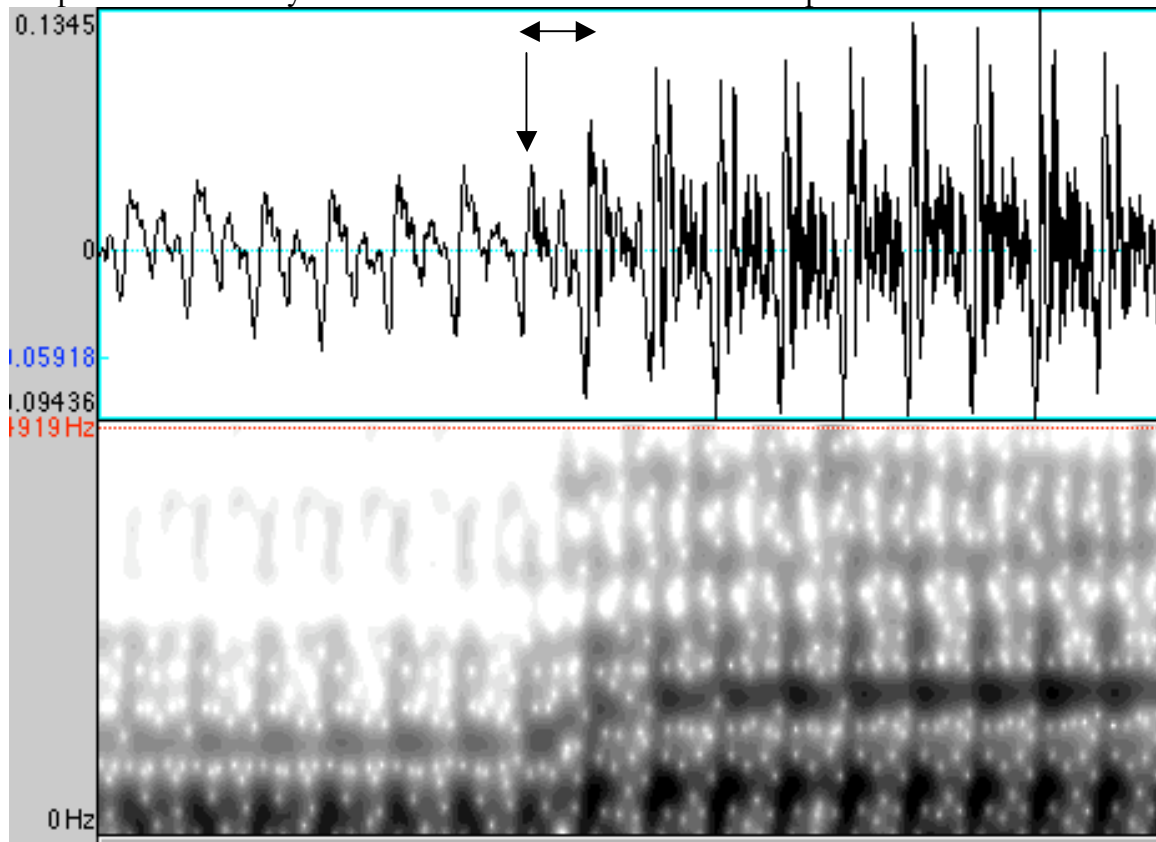
Nasals

Release of a nasal stop is marked by:
- rapid rise in amplitude
- shift in formants
- reflected in the waveform as a change in the shape of the period
- rapid rise in the intensity of higher formants

In the example below, these criteria do not precisely line up: the onset of the formant transitions (and change in the shape of the period) precedes a clear increase in amplitude. It is clear that the release occurs during the period indicated. I mark the beginning of the period as the release because the shape of the period is sufficiently different from the preceding periods to suggest that the release occurs early in the period. But it is usually not possible to identify the moment of release to within half a period.
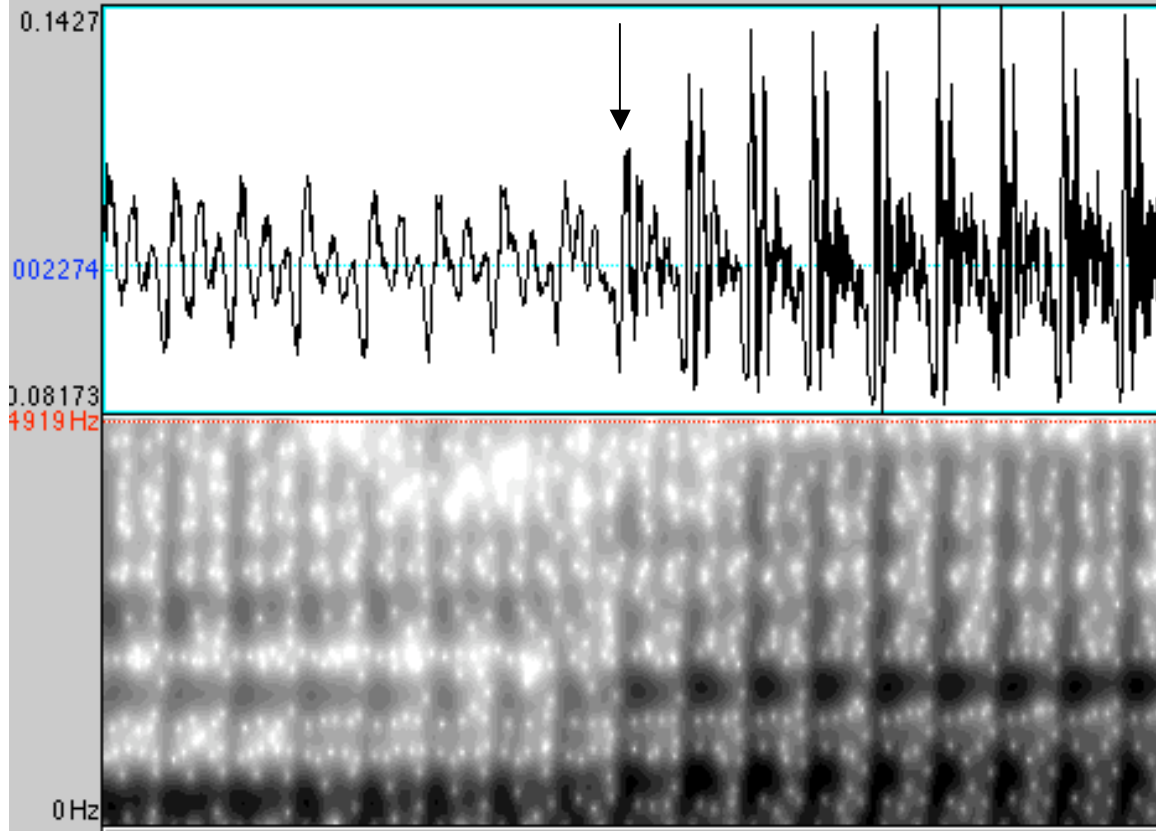
Lateral [l]
Release of [l] is marked by similar cues as the release of a nasal:
- rapid rise in amplitude
- shift in formants
- reflected in the waveform as a change in the shape of the period
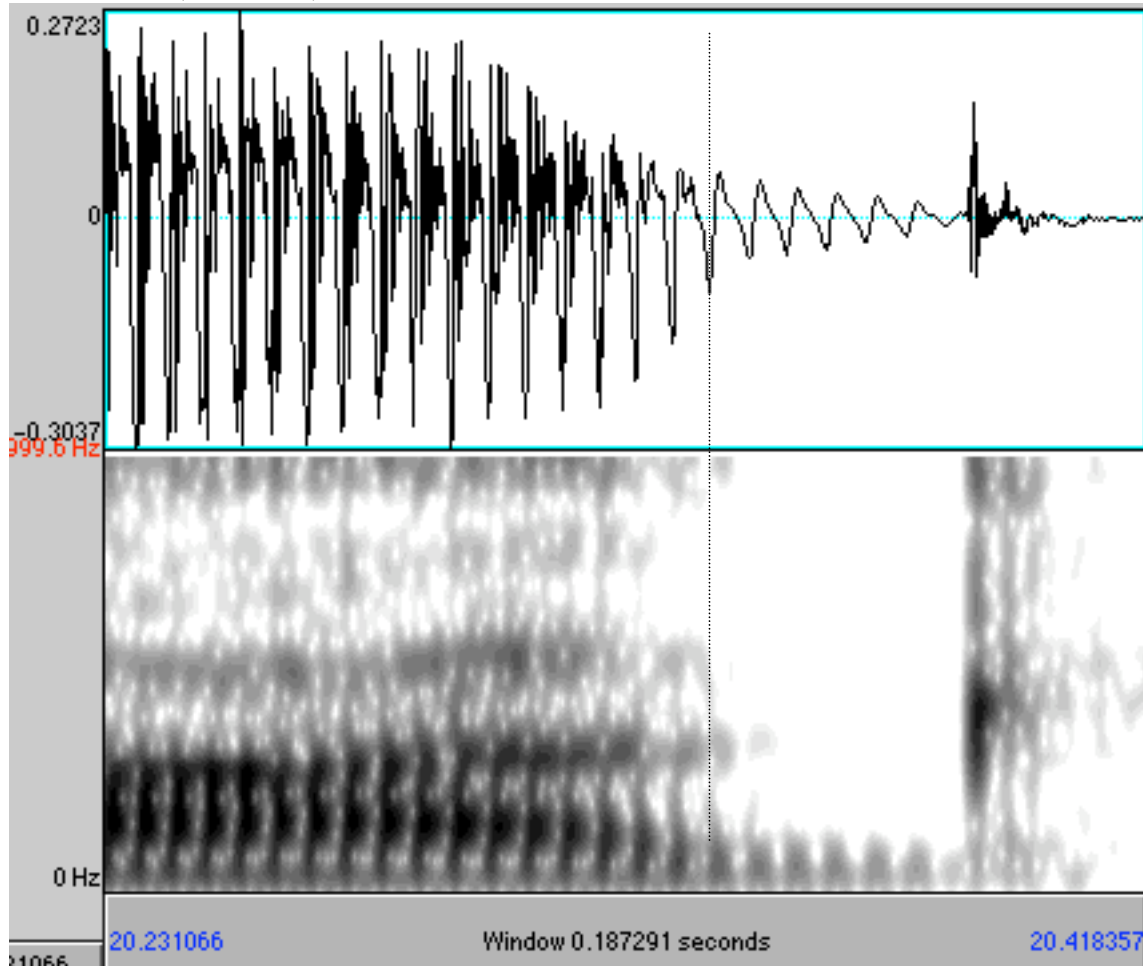
The sample below is my light [l]. American English speakers may have more velarized onset laterals which may show a less abrupt rise in amplitude.

<u>Coda consonants</u>

Stops
- The stop closure should be easy to identify as long as the coda stops are realized with full closures (see below).

Waveform and spectrogram of the region around the closure of a final voiced stop.
Dotted line marks a reasonable estimate for the moment of stop closure.
Cues:
- Drop in overall amplitude of the waveform.
- Drop in intensity of formants, particularly F2 and above.
- Waveform period becomes more sinusoidal (due to loss of higher formants).
- F1 falls to a low frequency.

- It's generally not possible to see spectral/waveform changes within a period, so you have to make a fairly arbitrary decision about where to measure in relation to the periods where you see the changes that indicate stop closure. I've chosen the zero-crossing.

Note: Don't give to much weight to disappearance of formants. How long formants remain visible going into a stop closure depends on the way your spectrogram maps intensity to the gray scale (see below). It's a rapid drop in intensity that we're looking for.

Spectrogram of the same stop closure as above with a lower intensity threshold for a frequency to be plotted:
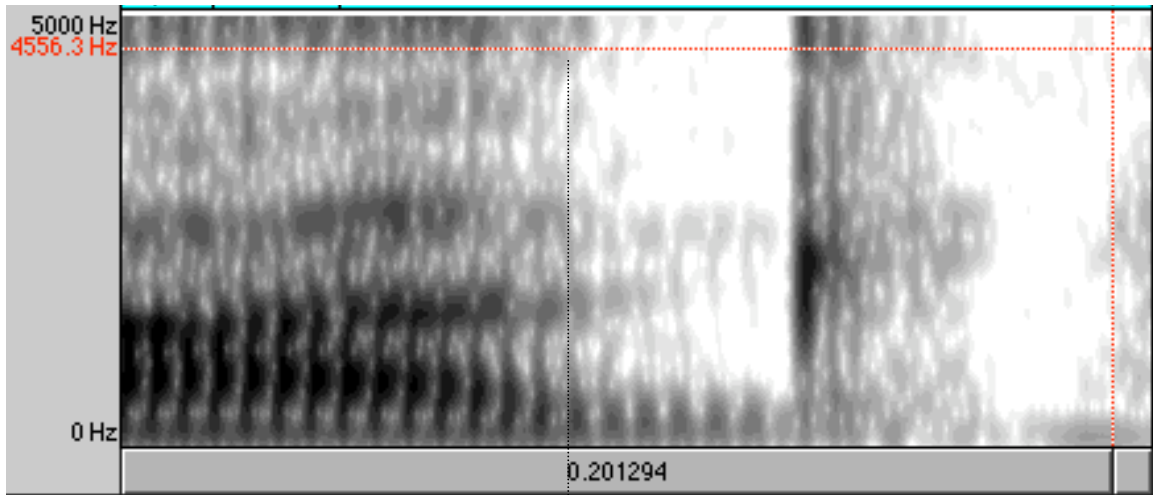
Nasals

Formation of the closure of a nasal stop is generally marked by:
- drop in amplitude
- abrupt drop in the amplitude of some formants above F1 (e.g. F2 and F4+ in the example below).
- formant transitions (or even relatively abrupt jumps in formants)
(The shift in overall vocal tract configuration at the vowel-nasal boundary can result in substantial shifts in formant structure).
- corresponds to change in the shape of the period in the waveform.
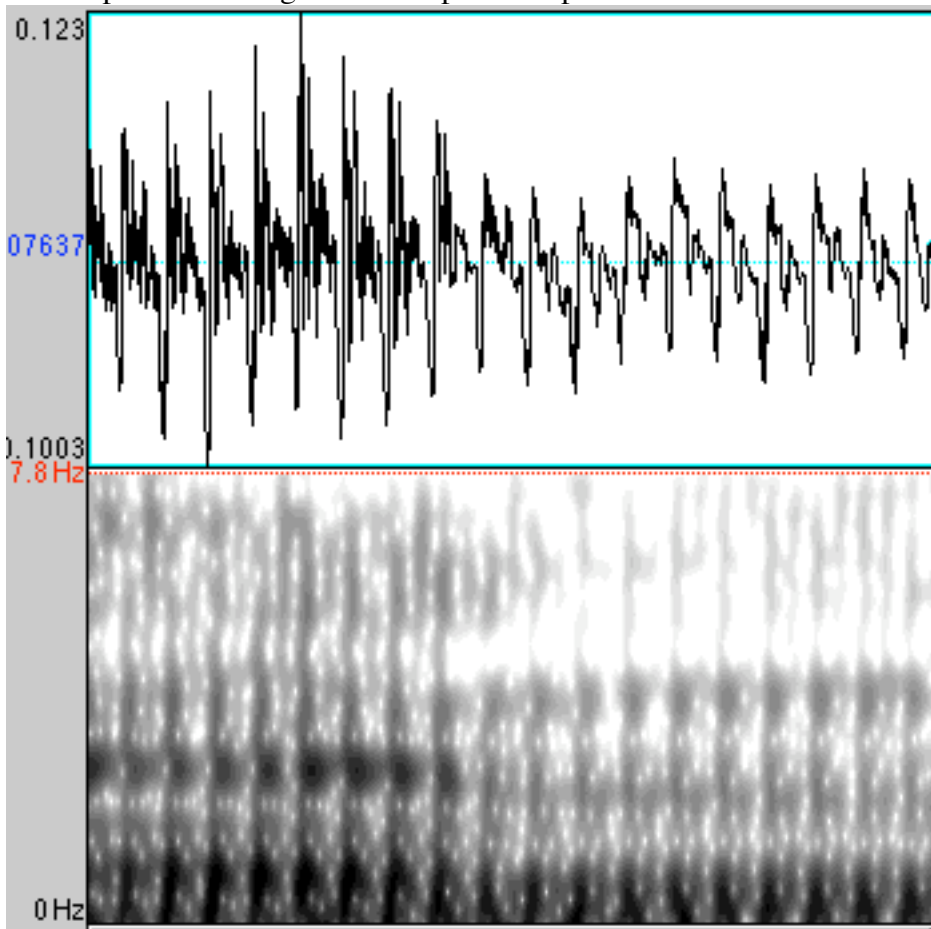
Lateral [l]

See if you can identify cues to the formation of a lateral constriction. Coda /l/ is velarized, and often vocalized – i.e. there is no contact between tongue tip and alveolar ridge. As a result the transition from vowel to /l/ is often gradual, and it is difficult to segment the two.