Nasals & Laterals

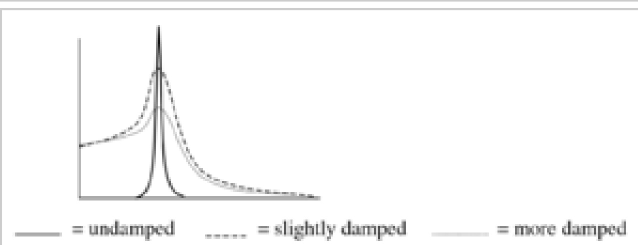
From UW Phonetics/Sociolinguistics Lab Wiki

Contents

Damping, Bandwidth and Nasals

- Damped waves are not sinusoidal (i.e. they are complex). The greater the damping the less sinusoidal or the more complex a wave is. Unlike simple waves, complex waves have energy spread across a range of component frequencies.

- The spread of energy broadens the bandwidth of the resonators and decreases the energy at the center frequency.



Schematic diagram of power spectra of waves with three degrees of damping.

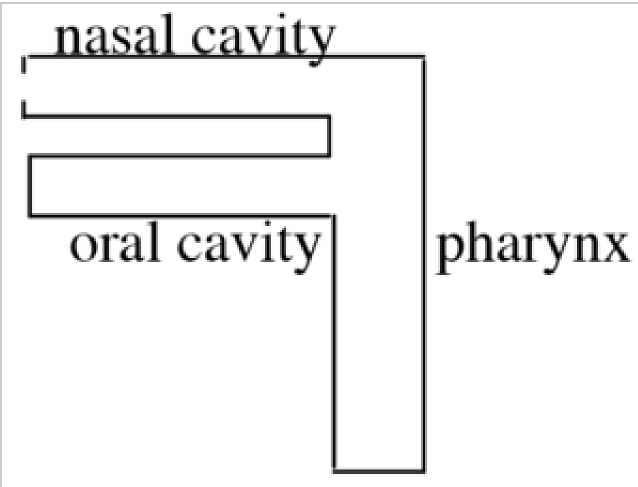
- Adding the nasal cavity lengthens the vocal tract significantly. The additional soft tissue and the standing air in the nasal cavity increases the absorption of energy which increases damping in the vocal tract.

- The increased damping in nasals results in formants (particularly F1) with wider bandwidths and less energy at the center frequency.

Formants, Side Cavities and Anti-Resonances in Nasal Stops

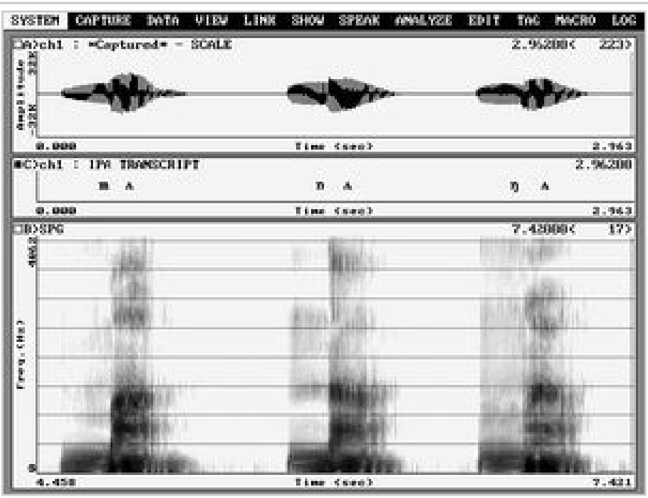
- With the velum open, the nasal cavity together with the vocal tract up to the velum act as a tube that is open at one end and is considered the main resonating tube. The overall length nasal + pharyngeal tube is greater than in a neutral oral vocal tract so the resonant frequencies are lower than are seen for a schwa with the same vocal tract. The nostrils act as a constriction at the tube's opening further lowering all formants.

- The oral cavity (forward from the velum) acts as a second tube called a side cavity. Because the articulators are fully occluded at a particular place (labial, alveolar, post-alveolar, palatal, velar) the side cavity is also a tube closed at one end (the place of occlusion) and open at one end (uvula). The resonances of the side (oral) cavity are added to the resonances of the main (pharyngeal + nasal) cavity.



Schematized vocal tract for [m]. The pharynx and the nasal cavity make up the main resonator with a narrowing at the nostrils. The oral cavity (lips to uvula) makes up the side cavity.

- Because the opening of the oral side tube is at the uvula, its resonant frequencies absorb sound energy from the overall spectrum. Therefore the resonances of the side cavities are referred to as anti-resonances or antiformants. The anti-resonances are important cues that listeners use in distinguishing one nasal place of articulation from another (though the formants are as usual stronger place cues).

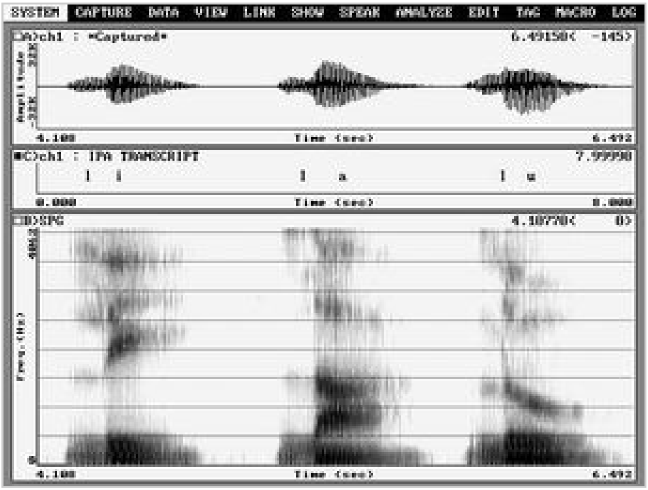


Spectrogram of bilabial, alveolar and velar nasal onsets.

Laterals

- Laterals generally have a central closure (with openings on either side) or a side closure (with an opening on only one side).

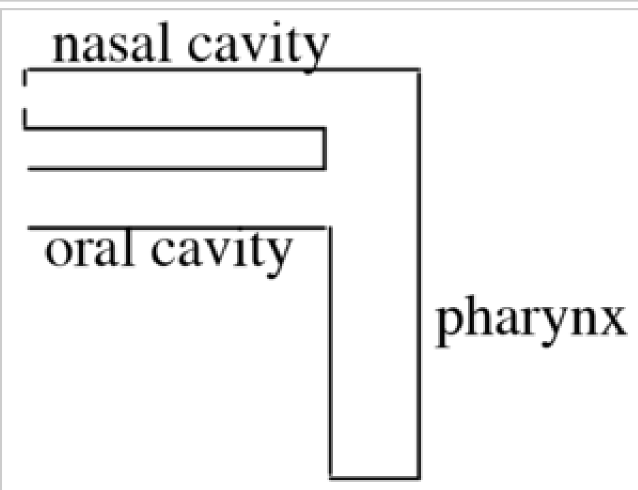
- The pocket of air above the tongue acts as a side resonator (like the oral cavity in nasal stops do). It is very short so the anti-resonances that it produces is relatively high frequency (between F2 and F3).



Spectrogram of /li, la, lu/. Note the zero at about 2000 Hz.

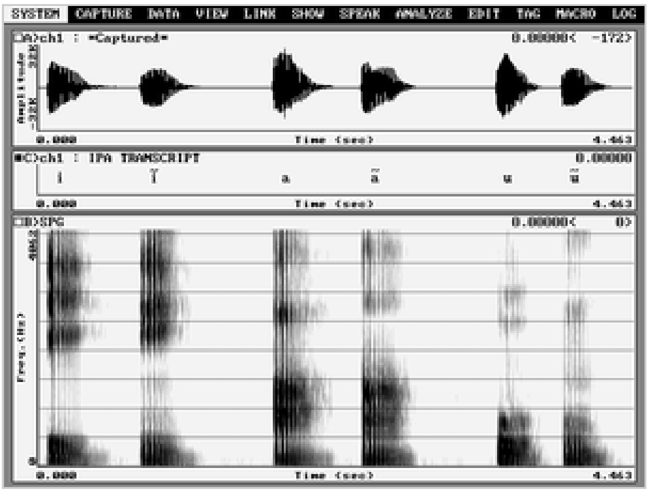
Nasalization

- In nasal (and nasalized) vowels there are two main resonators acting together in a resonant system. The pharynx + nasal cavity or nasal tract (with resonances around 400, 1200, 2000 Hz), and the pharynx + oral cavity or oral tract (with resonances around 500, 1500, and 2500 Hz).



Schematic of the vocal tract for a nasalized vowel. nasal cavity oral cavity pharynx.

- In addition to the two main resonators (oral and nasal tracts) the nasal cavity acts as a side resonator. Because the mouth is more open and there is more coupling between the oral tract and atmosphere. The opening at the velo-pharyngeal port (velum) is wider than the opening at the nostrils, therefore the nasal cavity acts as a side tube closed at the nostrils (around 12.5 cm long) with anti-resonances around 680 and 2040 Hz.



Spectrogram of /li, la, lu/. Spectrogram of the oral and nasal versions of /i, a, u/. Note the increase in formants and the zeros.