

ECE 537 Homework 7

Due: October 23, Urbana time

1. Estimate the front cavity resonant frequencies of /t/ and /k/. In beatboxing (<https://en.wikipedia.org/wiki/Beatboxing>), a /k/ is often used to represent a snare, while a /t/ is often used to represent a high-hat. A snare is a circle of mylar about 30cm across and held unmoving at the rims, while a high-hat is a circle of brass approximately 30cm across and free to move at both ends. What can you conclude about the speed of sound in brass versus mylar?
2. In (Fujimura, 1962), the combined pharynx+nasal cavity can be approximately modeled as a tube that has fixed input at the glottis (so that $U(x, \Omega) = U_G(\Omega)$ at $x = 0$), is open at the lips (so that $P(x, \Omega) = 0$ at $x = \ell$), and is uniform in cross-sectional area. The velum is an arbitrary point, x , somewhere between the larynx and the lips. Use a uniform tube model to calculate $B(\Omega) = \Im \{U(x, \Omega)/P(x, \Omega)\}$ at an arbitrary point, x , in a uniform tube acoustic model. Does your result resemble $B_i(\Omega)$ in Fig. 2 of (Fujimura, 1962)?
3. Suppose that $\mathbf{z}$ is a multivariate normal random variable (https://en.wikipedia.org/wiki/Multivariate_normal_distribution) with zero mean and unit variance, and $\mathbf{x} = \mathbf{W}\mathbf{z} + \mathbf{t}$ for some non-symmetric matrix $\mathbf{W}$. Prove that the probability distributions $p_X(\mathbf{x})$ and $p_Z(\mathbf{z})$ are related by the flow equation.