

ECE 537 Homework 5

Due: October 9, Urbana time

1. Sketch a gesture constellation, gestural score, and tract variable score for the word “plum.”
2. Suppose you have a pipe with a length of l and a cross-sectional area of A , open at both ends. If you blow across one end at the right angle, your breath hitting against the edge of the pipe will generate an air pressure source $P_S(\Omega)$. Assuming the pressure at the other end of the pipe is 0, express the forward-going and backward-going waves in the pipe as functions of $P_S(\Omega)$.
3. In class we said that, in the rounded vowels of English (/u, u, o/), the entire vocal tract behind the lips is a single large half-wave resonator. That’s not quite true: besides the labial constriction, these vowels also have a high back tongue body constriction. These vowels can therefore be better approximated with four cavities: cavity 1 is the pharynx, cavity 2 is the velar constriction, cavity 3 is the mouth, cavity 4 is the labial constriction. The lowest formant (F_1) is created by an acoustic compliance with volume $V_b = l_1 A_1 + l_2 A_2 + l_3 A_3$ interacting with an acoustic mass with area A_4 and length l_4 . The second formant (F_2) involves out-of-phase oscillation of the pharynx and mouth, driving air back and forth through the velar constriction, with $u_4(t) \approx 0$ flow escaping through the lips. Write formulas for F_1 and F_2 in terms of c , V_b , and the lengths, areas, or volumes of cavities 1, 2, 3, and/or 4.