Speech

- source/filter model of speech production
- speech analysis
- speech synthesis

Quiz 2: November 2, 2-4pm, 50-340 (Walker)
- Coverage up to and including all of week 7, including HW7.
- Closed book except for two page of notes (four sides total)
- No electronic devices. (No headphones, cellphones, calculators, ...)
- No HW8 – a practice quiz is posted.

Source/Filter Model of Speech Production

Speech is generated by the passage of air from the lungs, through the vocal cords, mouth, and nasal cavity.

Vibrations of the vocal cords are “filtered” by the mouth and nasal cavities to generate speech.

During voiced speech, the glottis generates puffs of air that are a few ms in duration. The frequency of puffs ranges from 100–300 Hz.

Speech Production

X-ray movie showing speech in production.

Source/Filter Model of Speech Production

Vowels sound different because mouth and lip positions are different.

Buzz from vocal cords → throat and nasal cavities → speech
Source/Filter Model of Speech Production
Harmonic content is natural way to describe vowel sounds.

Demonstration
Physical model of the vocal tract.
Buzzer represents sound from glottis. Machined cavities represent vocal tract.

Formants
Resonant frequencies of the vocal tract.

Speech Production
Same glottis signal + different formants → different vowels.

We detect changes in the filter function to recognize vowels.
Singing
We detect changes in the filter function to recognize vowels ... at least sometimes.
Demonstration.
“la” scale.
“lore” scale.
“loo” scale.
“ler” scale.
“lee” scale.
Low Frequency: “la” “lore” “loo” “ler” “lee”.
High Frequency: “la” “lore” “loo” “ler” “lee”.

Speech Production
Same glottis signal + different formants → different vowels.

Source/Filter Model
Model of speech production.

Acoustic sources:
• pulse train with period \( N_p \) for voiced utterances
• gaussian noise for unvoiced utterances

Gain: \( G \) controls loudness

Vocal tract: filter represented shapes of mouth, tongue, and lips

"Flights from Denver ..." was analyzed with the source/filter model and a new sound was produced using a modified model
Summary
Introduction to speech processing
• source/filter model of speech production
• speech analysis
• speech synthesis