Phonetics 3.1: Introducing Acoustic Phonetics

April 17, 2020

Acoustic phonetics

Question to be answered:

How do we characterize speech sounds in terms of their physical (acoustic) reality?

Intuitive answer

Answer:

Speech is wiggly air.

More technical answer

Answer:

When you articulate a speech sound, at a fundamental level, you're manipulating air pressure; so, characterize sounds by these pressure fluctuations.

This manipulation reverberates through the atmosphere, and when it reaches your ear, your eardrum moves in response to the pressure changes.

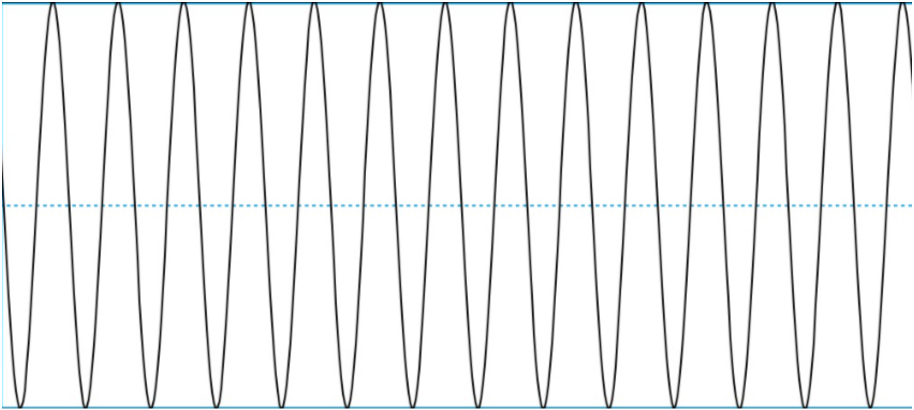
We have a very sophisticated mechanism for interpreting this movement as *sound*.

(This is the *auditory phonetics* part we won't say much about.)

Waves

We can represent this pressure disturbance with a *waveform*.

Here's an example of a simple waveform:



Waves

When we plot a waveform, the x-axis represents time and the y-axis represents the amplitude of pressure fluctuation.

A simple waveform like the one before corresponds to a **pure tone**.

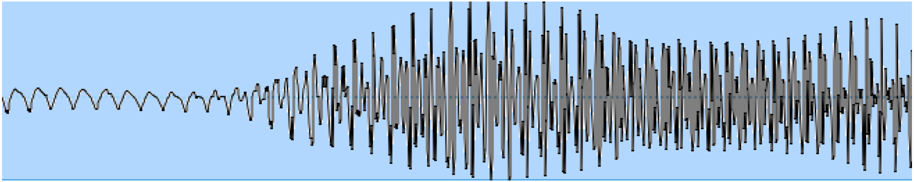
Waves

But speech is much more than pure tones. We can tell:

(i) whether something is a vowel or consonant
(ii) the identity of the vowel or consonant
(iii) what the speaker's voice sounds like
(iv) what type of mood the speaker is in...
(v) etc.

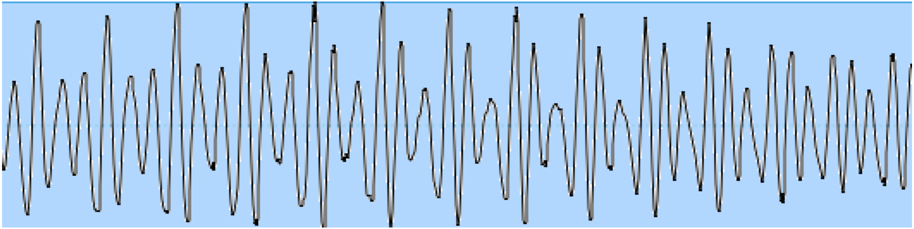
Waves

The sound waves associated with speech are **complex**. They might look more like this:



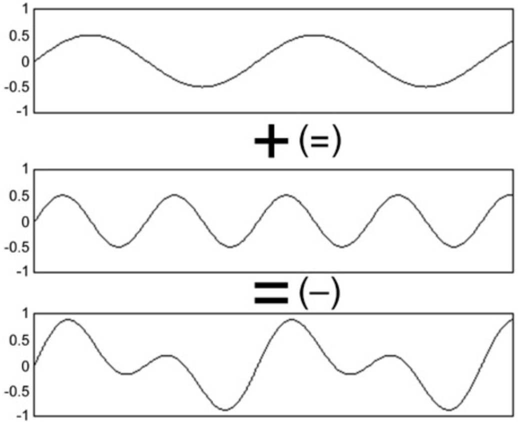
Waves

Or, zoomed in even further, this:



Waves

Complex waves can be analyzed as being the sum of two or more simple waves at different strengths and rates of oscillation:



Waves

In general, it's possible to break up a complex speech signal into component waves, using technology (typically by doing a Fourier transform)

...or by using your ears (which, amazingly, do something very similar to a Fourier transform)

Waves

What parts of the wave are interesting to us?

Time: x-axis MILLISECONDS (MS)

Frequency: rate of oscillation HERTZ (HZ)

Amplitude: deviation from 'equilibrium' value on y-scale PASCAL (PA)

Waves

Question: Where do these waves come from in speech?

Spoiler answer: vocal fold vibration

Follow-up question: What determines the relative amplitudes of the components which make up the complex wave?

Semi-spoiler answer: configurations in the vocal tract

Cliff hanger...

End of this video's lecture material.