Sound

Mechanical vibration

↓

Air molecules

Radiating wave (A wave)

Sound: pressure varies at a point in space

↓

Push against surface (displacement & mix)

Voltage \( v(t) \)

↓

Digital: represented sound in a computer as series of numbers

→ discrete time, discrete value

\[ f[n] = Q[p(nT)] \]

Can convert back to sound:

Speaker passes current through magnetic field

→ moves "cone"

→ forms air

→ produces sound...

Why sound? Because we hear

Why music? Because it useful (evolutionary advantage)

- info at a distance
- consistent / reliable
- correlates with physical force
- correlated with

Footsteps

· common in higher animals
· "what" info? depends on what we care about
Course Overview

**Fundamentals**

- Signal Processing
- Audio
- Psychoacoustics (hearing)
- Pattern Recognition
- Auditory Scene Analysis
- Speech Recognition
- Lab Theory

**Applications**

- Audio Compression
- Speech Synthesis
- Audio Content-Based Retrieval

**Topics**

1. Audio Proc - tools and techniques
   - Advanced DSP - some applications
   - Specific techniques

2. Practical experience - computer examples
   - Reading papers
   - Project or HW

3. Synchronicity
   - Lectures (class)
   - Demonstrations
   - Discussions < demos<br>  - project 1st

4. Mandatory
   - Problems, papers, Matlab, Java, C++
   - Build a web site

5. Exam - 2 midterms, 1 final

6. Project - any specific aspect (same ideas...)
   - Lab visio
   - Practical - Matlab, C++
   - Several projects

**Lines**

- Cert
- March
- April
- May
- June
- July
- Aug
- Sept
- Oct
- Nov
- Dec
Course overview - summarize some of the key points
- see where we're going
- start playing
- slight talk
- index

1. Speech signal
   - waveform
   - spectrum
   - energy of waveform
   - variation in time
   - phonemes - stops, vowels, fricatives, glides
   - linguistic variation

Q ?
- SS
- resonance
- voicing
- pulsation

2. WPAC
   - speech: \( \text{sound} + \text{model} \)
   - Q noise
   - subband - channel mixing
   - N models - can use jointly

- examples at various levels
- synthesis

3. ASR - basic blocks
   - compact models
   - basic eq:
     \[ W_{\text{speech}} = \max (p(x|W)) \]
     (search)

4. Audio CBR
   - mixture
   - search < by example
   - music file

- Music file hide
- increment