IV. HOW DO WE RECORD SOUND - microphones

- Electro-Mechanical Transducers
- Convert acoustic energy into electrical energy
- Different pickup elements
- Different pickup patterns
Microphones

- Carbon
  - Rugged
  - Cheap - $1 to $5
  - Limited Frequency Response 100Hz to 5KHz
  - Most Common type in the world
  - Inside telephones
Microphones

- Crystal or Ceramic
  - Fragile
  - Inexpensive $5 to $15
  - 80Hz to 8KHz
Microphones

- Dynamic Ribbon
  - First Pro Quality Mic
  - Somewhat delicate
  - Expensive - $150+
  - 50Hz to 15KHz
  - Slow Transient Response
  - Very Smooth/silky sound
Microphones

- Dynamic Moving Coil
  - Very Rugged
  - Reasonably Priced - $60 to $350
  - 50 Hz to 15 KHz
  - Most popular Pro Mic
Microphones

- **Studio Condenser**
  - Fragile
  - Costly - $150 to $7,000
  - 20Hz to 20KHz
  - Requires constant Polarizing Voltage--Phantom Power or external
  - Excellent Transient Response
Microphones

❖ Electret Condenser
  ● Rugged
  ● Small
  ● Reasonably Priced - $100 to $500
  ● 30Hz to 18KHz
  ● Requires 1.5 volt battery
  ● Lavalier
  ● Cell phone
Pickup Patterns

◆ Omni-Directional
  • Accepts sound from all around mic
  • Ideal for interview situations
Pickup Patterns

- **Cardioid**
  - Accepts sound primarily from the front
  - Ideal for live sound applications
**Pickup Patterns**

- Hyper-Cardioid & Super Cardioid
  - Accepts sound only from the front
  - Ideal for isolating sound—directional
  - “Shotgun” or “Boom” are common names
Pickup Patterns

- Bi-Directional
  - Accepts sound from front & back
  - Used in music studio recording
  - Also called “Figure of Eight”
Digital--pulse code modulation

- analog converted to dig, then back for playback
- quality excellent
  - increased dynamic range -96 db
  - reduced noise and distortion,
  - most analog problems eliminated (esp gen loss)
- Five steps
5 steps
1. Microphone--transducer

- Changes sound vibration into electrical signal
- this is an analog step
2. Anti-aliasing

- unwanted high frequency signals
  - above the normal hearing range but can be "aliased" into the audible range in sampling.
- pass the original analog (from the mike) signal through a low pass filter.
3. Sampling

- Sample voltages at fixed intervals along the waveform of the analog signal.
- How often you measure the voltage
- The more often the better the signal
  - Sampling frequency
    - Twice its frequency.
    - For 20,000 hz, 40,000 rate
  - Digital audio today uses 32, 44.1, and 48 kHz
    - 32 is for broadcast (max bandwidth is 15k)
    - Pros use 44.1 and 48
Sampling

lower sample rates take fewer snapshots of the waveform.....

resulting in a rough recreation of the waveform.

faster sample rates take more snapshots....

resulting in a smoother and more detailed recreation of the waveform.
4. Quantizing

- samples are converted into discrete values called quantizing levels
  - greater number of levels, greater the accuracy of the representation of the signal.
Quantizing--bit depth

Original Waveform

Waveform Sampled at 16 bits

Waveform Sampled at 8 bits
5. Coding/storage

• Analog voltages converted to binary digits
  • --series of pulses
    • (0--no voltage, 1--voltage)
  • each digit is a bit
  • each bit allows two levels of quantification
    • 2 bits gives 4 levels
• 16 bit system (65,536)
  • sufficient to deal with quantizing noise
    • artifact of the process of quantizing.)
• some 20 bit systems used.
\( n \text{ bits} = 2 \text{ to the } n \text{ quantizing levels} \)

- 2 squared....4
- 2 cubed......8
- 2 to the 4th...16
- 2 to the 5th...32
- 2 to the 6th...64
- 2 to the 7th...128
- 2 to the 8th...256
- 2 to the 16th...65,536
- 2 to the 32nd...4.3 million
V. WHAT IS GOOD SOUND?

- sound that is technically and aesthetically excellent
technical

- frequency response
- signal to noise ratio
- dynamic range
- clean
  - no distortion,
  - no hum
  - no phase cancellation
aesthetic

- intelligibility--words are clear
- tonal balance--
  - no one range stands out
    - too much low--muddy
    - too much high--sibilance + noise
    - too much mid--harsh, shrill
  - timbres sound natural
  - ensembles blend
aesthetic

- spacial balance
  - clear where sounds are coming from

- Definition
  - --each element is defined

- Airiness
  - --open sounding

- Appropriate acoustics
  - radio announcer not in reverberant setting

- production values- combination grabs or moves you.
Slumdog Millionaire
open