ONLINE TUTORIALS

• Go to http://uacbt.arizona.edu

• Log on using your username & password.
  (same as your email)

• Choose a category from menu. (ie: audio)

• Choose what application.

• Choose which tutorial movie. (quicktime needed to view movies)
ACOUSTICS
REFLECTION & ABSORPTION

- Rooms can both reflect & absorb sound waves.

- Because rooms reflect sound, often sound carries further in a room than out-doors.

- Certain materials in the room, rugs, carpets etc. tend to absorb higher frequencies.

- A room with little high frequency absorption is often termed “live” & one with significant absorption is termed “dead”.
DEFINITION OF AN ECHO

A distinct repetition of a sound.

One Second Echo
• When a sound reflects from surfaces within a room in the first few milliseconds distinct echoes can be heard these are termed “Early reflections”.

![Diagram of Early Reflections](image)
REVERBERATION

- Many closely spaced (in time) reflections as to not be distinctly heard.

- Reverberation, or reverb for short, occurs directly after the early reflections.
REVERBERATION

- The time it takes for the reverb to decay to one millionth of its original intensity or 60 DB SPL lower.
- Larger, more reflective rooms (live rooms) have longer reverb times.
STANDING WAVES

- Rooms with parallel walls can create a situation where the walls reflect sound waves back and interfere constructively and destructively with a sound source in the room to produce what are called Standing Waves. This occurs when the wave is a frequency at which the room resonates.

- When standing waves occur there will be areas in which the waves combine in phase to produce a build-up of loudness & areas where they will combine out of polarity to cancel each other to reduce loudness.
ROOM MODES

- Every room has a number of frequencies with which it resonates.
- These frequencies are called modes. Modal frequencies occur in relation to each of the room’s dimensions.
- The larger the room dimension the lower the frequency of resonance.
- These modes tend to originate at low frequencies where room dimension is equal to the modal wavelength thus reinforcing low frequencies in rooms.
Room resonances or modes

When a room is excited at one of its resonant frequencies, the sound pressure level (SPL) will increase by a maximum of 6 dB SPL at that frequency as the speakers get closer to each room boundary. (floor, wall, corner etc.)

- floor => 6 dB
- ceiling => 6 dB
- wall => 6 dB
- corner => 18 dB

This means in general bass frequencies will be reinforced as the speaker(s) get closer to the rooms boundaries.

You can calculate room resonances with this equation:

\[
\text{frequency} = N \times \frac{565}{\text{dimension}}
\]

\[
n = \text{mode (1,2,3...)}
\]
ACOUSTICS KEY POINTS

• Know what reflection & absorption are in room materials

• Know the term echo

• Know what early reflection & reverberation are

• Know what standing waves are and how they can effect bass in different room locations

• Know what room modes are and how it can effect the frequency response of a speaker system in a room
ENJOY YOUR ACOUSTICS!

• Listen for echoes (listen to the clock chimes reflect off bldgs.)
• Notice the acoustics of the various rooms you enter.
• Find & enjoy spaces that have nice long reverb tails.
• Listen for early reflections in rooms and outside.
• Listen for resonances in rooms and how they change at different locations.
Driver: The transducing element in a loudspeaker system.

Driver Design Types:

1. Moving Coil (most common)
2. Ribbon (fast & smooth sound)
3. Electrostatic (condenser) (fast but reduced low frequency efficiency)
The most common type of loudspeaker is the MOVING COIL speaker, where a coil of wire is suspended in the magnetic field of a circular magnet. When a current is passed through the coil a varying magnetic field is generated by the coil. The two magnetic fields interact causing movement of the coil. The movement of the coil causes a cone, which is attached to the coil, to move back and forth. This compresses and decompresses the air thereby generating sound waves.
MOVING COIL HORNS (INDIRECT RADIATORS)

- Most efficient use of energy.
- More directional than cone drivers

A moving coil compression driver is attached to the “throat” horn. The horn acts as an acoustic impedance matcher.

At the throat we have a small area and high pressure with small amplitudes, efficiently loading the diaphragm. As the wave fronts travel towards the horn mouth, the pressure drops, while the amplitude and the area increases.

By matching the acoustic impedance greater efficiency is realized.
The ribbon loudspeaker consists of a small aluminum ribbon that is placed between two pole plates which are attached to a magnet. A current is fed through the ribbon and thus the ribbon functions like the coil in a dynamic loudspeaker.

The ribbon has the function of a cone (though it does not look like it) because it moves and thus brings the air into motion. It's efficiency (maximum sound level) depends mainly on the strength of the magnet.
Electrostatic Driver
LOUDSPEAKER

- Sealed or Acoustic Suspension.
- Vented, Ported or Bass reflex.
ADVANTAGES & DISADVANTAGES

❖ Sealed or Acoustic Suspension.
  ❖ Advantages: Tight, controlled, "punchy" bass
  ❖ Disadvantages: Less efficient, bass frequencies don’t extend as low.

❖ Vented, Ported or Bass reflex
  ❖ Advantages: Lower frequency extension.
  ❖ Disadvantages: "Boomy" less controlled bass.
MULTIPLE SPEAKER SYSTEMS

Three way system

- Woofer or low frequency driver
- Midrange driver
- Tweeter (high frequency driver)

Two way system

- Woofer or low frequency driver
- Midrange/tweeter driver
CO-AXIAL LOUDSPEAKER

A horn or mid frequency driver is mounted directly in the center of low frequency driver.

By having both high & low frequency drivers basically at the same point in space, the time arrival of the fundamental and the harmonics is correct. Have a point source often provides the ability to localize instruments in space. (Good imaging)
CROSS-OVER NETWORKS

In a multiple driver system it is desirable to send only the frequencies that each driver can reproduce to each driver. This is the function of a cross-over.

Design-Types

Passive (no power needed for cross-over)
Active (power needed for cross-over)
A passive cross-over network is one which requires no external power to operate. Usually inside the speaker cabinet, the signal passes through “passive” components, (ie: capacitors, resistors & inductors) to filter out the frequencies each driver can not reproduce well.
In an active cross-over a powered network is placed before the power amplifiers. The amplifiers are then connected directly to the each driver. This provides a more efficient use of power due to the active cross-over having no net loss of signal.
This diagram shows the frequency response curves for the signal sent each driver, low, mid & high. The point at which the signal transitions between drivers is the called the cross-over point.
CONTROL ROOM MONITORING

- Large Soffit mounted systems (recessed into a wall)
- Near field (speakers on or near console)
  - **Advantages:** Less room interaction due to speakers being away from room boundaries and generally lower volume levels
  - Comp (compare) speakers - for listening to how product will sound on a modest system.
- **Tip:** Always listen to a CD or tape that you are familiar with to evaluate the control room acoustics & speakers.
CONTROL ROOM MONITORING

Large Soffit mounted system

Near field speakers
LOUDSPEAKERS KEY POINTS

• Know design types- hint very similar to microphone types

• Know what a driver is and what kind of enclosures there are and their respective advantages & disadvantages

• Know what a horn or indirect radiator is and it’s advantage/disadvantages

• Know what crossover network is an it’s purpose

• Know the two types of crossovers and their differences

• Know what co-axial speaker is & it’s advantages/disadvantages

• Know the different categories of control monitors (speaker placements)
After Class

• Move your speakers closer then further from a wall or corner and listen how that affects bass & imaging.

• Notice if your speakers have ports.

• Are your speakers active or passive?

• How does listening distance affect what your hear?

• Stand near a wall and listen to the bass, does it get louder?