LECTURE 11: Sound Waves & Audition

I. Sound Waves

> **Definition:**
> Sound waves are created by vibrations in moving air.

- **Mechanism:** When an object vibrates, it causes the surrounding air molecules to rapidly **condense** (compress) and **rarefy** (pull apart). These fluctuations in air pressure create a sound wave, which consists of alternating areas of compressed and rarefied air.
- Sound waves travel away from the vibrating object at approximately **700 mph**.

II. Audition (Hearing)

- The human ear's function is to transduce these fluctuations in air pressure into neural signals.
- **Frequency Range:** Sound waves audible to humans are generated by vibrations between **20 and 20,000 cycles per second (Hertz)**.

> **Note:**
> This corresponds to a wavelength range that the human ear can transduce, from approximately 17 millimeters to 17 meters.

- **Wavelength Relationship:**
  - Faster vibrations (higher frequency) result in **smaller wavelengths**.
  - Slower vibrations (lower frequency) result in **larger wavelengths**.

III. Three Physical Dimensions of Sound

1. Loudness (Amplitude or Intensity)

> **Definition:**
> The relative difference in the density of air molecules between compressed and rarefied air.

- **Characteristic:** Represents how far the sound travels or its energy.
- **Visual Representation:**
  - **LOUD:** High amplitude waves (large peaks and troughs).
  - **SOFT:** Low amplitude waves (small peaks and troughs).

2. Pitch (Tone or Frequency)

> **Definition:**
> The frequency of molecular vibrations, which is the distance between successive peaks of compressed air.

- **Measurement:** Measured in **Hertz (Hz)**, representing cycles per second.
- **Wavelength Relationship:** Every frequency has a corresponding wavelength.
- **Visual Representation:**
  - **HIGH PITCH:** High frequency waves (many cycles per second).
  - **LOW PITCH:** Low frequency waves (fewer cycles per second).
- **Neural Correlate:** Different pitches activate different "bends" or locations within the cochlea.

3. Timbre (Complexity of Sound Wave)

- **Purpose:** Allows us to determine the source of a sound by listening to its complexity.
- **Distinguishing Property:** Relates to how the sound wave's waveform is uniquely "distorted" or shaped (ranging from simple to complex waveforms).

Example:

Differentiating between various musical instruments even when they are playing the same note.