Lesson Proper for Week 3

Power of Sound

When something vibrates in the air is moving back and forth it creates wave of pressure. These waves spread like ripples from pebble tossed into a still pool and when it reaches the eardrums, the change of pressure or vibration is experienced as sound. Acoustics is the branch of physics that studies sound. Sound pressure levels are measured in decibels (db); a decibel measurement is actually the ratio between a chosen reference point on a logarithmic scale and the level that is actually experienced.

SOUND

Sound is a vibration that propagates as a typically audible mechanical wave of pressure and displacement, through a medium such as air or water. Audio or sound is the best way to attract attention. Audio provides effective way to convey an idea, elicit emotion or dramatized point. Audio is one of the most appealing elements of any exciting and successful multimedia presentation. Audio establishes the aural dimension, setting the mood, establishing the ambiance of your presentation.

Example:

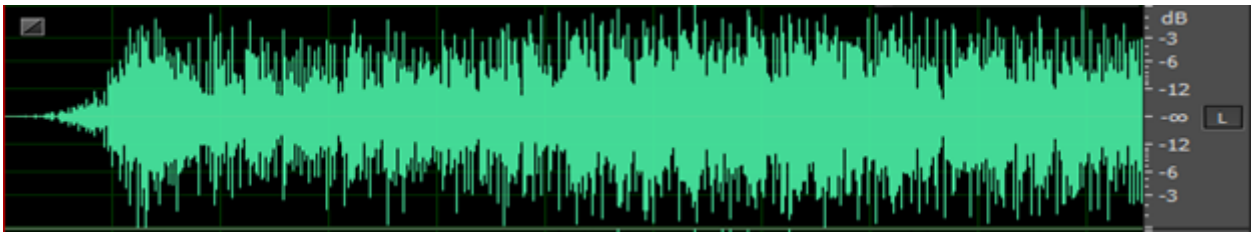


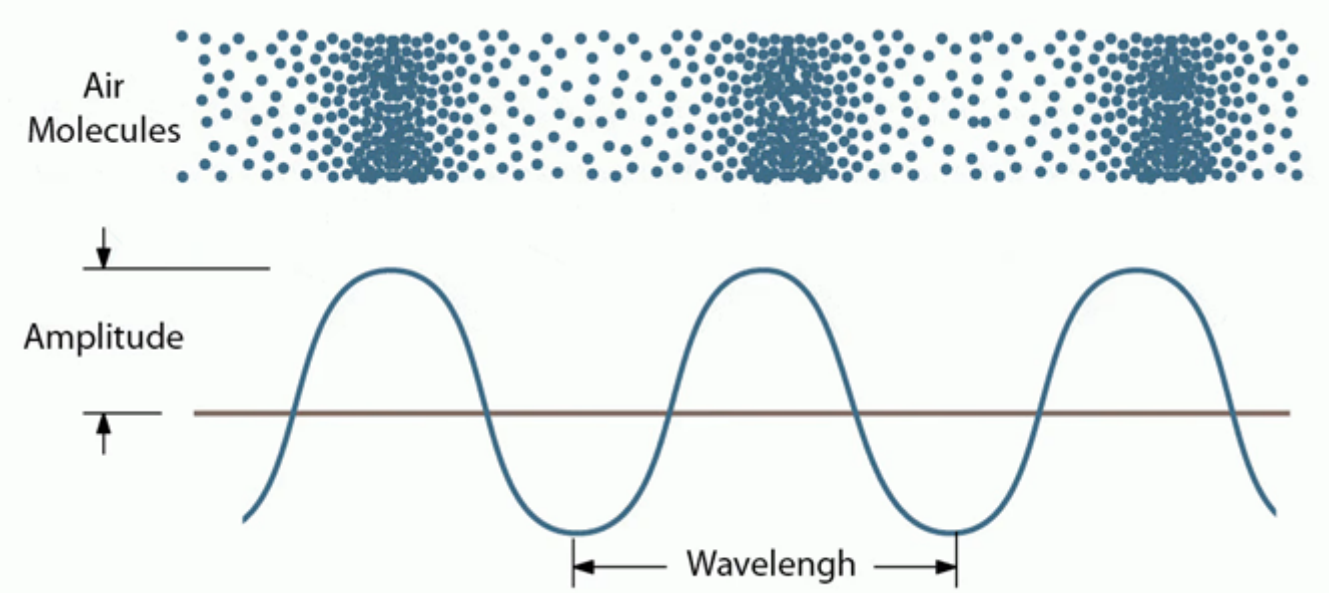
Figure 4: *Visual presentation of a digital sound wave*

What makes sound? Wavelength and amplitude

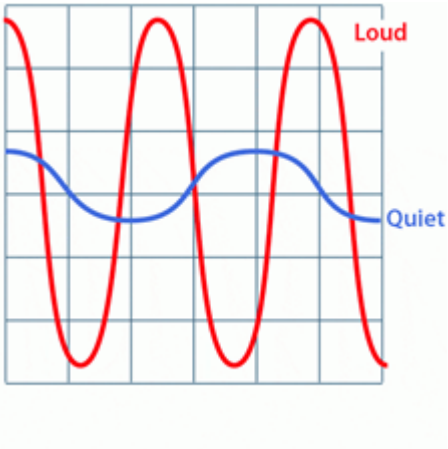
When a wave is created, the distance between one compression and the next compression is called the wavelength. The faster the sound waves pass a given point, the shorter the wavelength and the higher the frequency. Sounds of all frequencies travel at the same rate in the same medium. (Sound in dry air at 0 C travels at the rate of 1200 kilometers per hour, or 331.6 MPS; in a solid medium the sound waves travel faster.)

The vibrations can also "squeeze" the air molecules together very hard or very gently. This squeezing is called "amplitude" and is represented on the top half of the diagram below. The bottom half of the diagram is a representation of the pressure of the air during a sound wave. The horizontal line represents normal air pressure.

The more we push an object to make it vibrate, the larger the vibrations and the louder the sound, or the greater the amplitude. Sound waves with the same frequency can have different amplitudes.



Since sound is a form of energy, it can be changed from one form to another. Other forms of energy can be transformed into sound. Sound energy can be changed into electrical energy. Sound waves that are changed into electricity can be seen on an oscilloscope.
Sound travels quickly in air at nearly 340 meters per second but can travel through steel at about 5,200 meters per second. 770 MPH, is the speed of sound, or Mach 1.



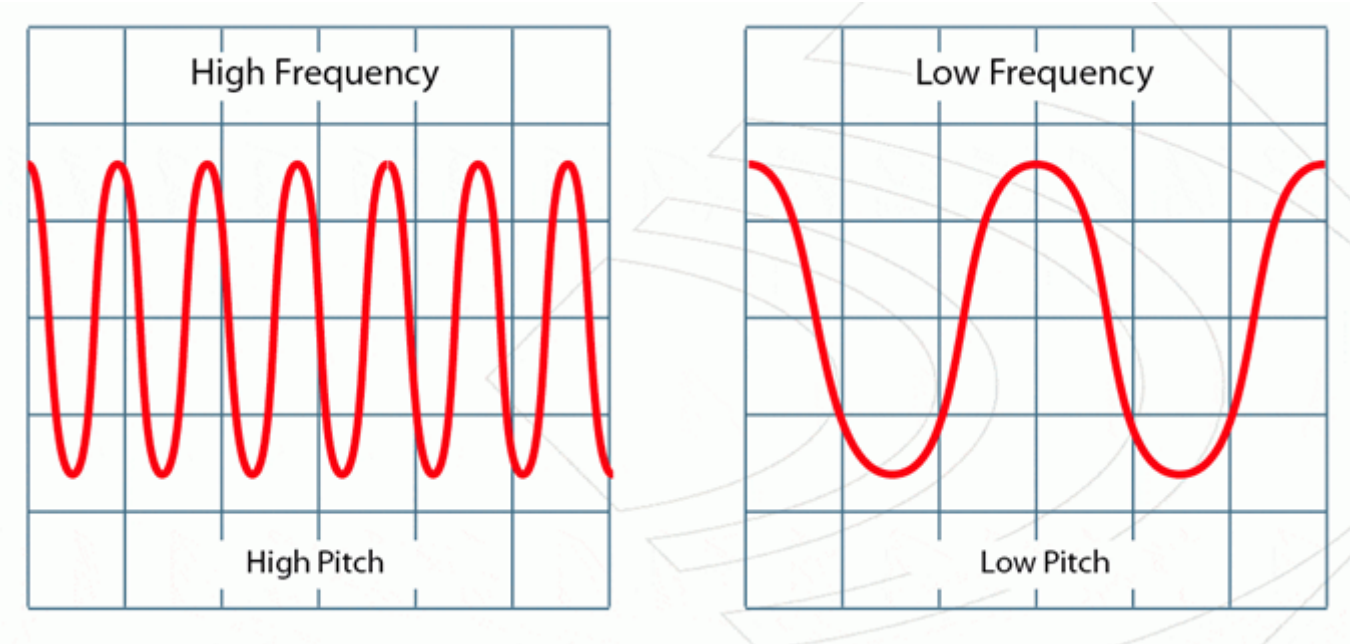
When you go to a rock concert, you may have to cover your ears because the sound is so loud. This loudness is called intensity. Intensity is measured in units called decibels or dB. The threshold of sound is 0dB. A rock concert has an intensity of 120 decibels. Sounds of 120 decibels or greater can cause people pain and ear damage.

How does pitch work?

Every sound has a range from a high to a low pitch. The pitch of a sound depends on upon the frequency of the vibrations that cause it. The frequency of a sound is the number of complete waves or vibrations that go past a particular place each second.

- The more vibrations per second, the higher the frequency and sound pitch.
- The fewer vibrations per second, the lower the frequency and sound pitch.

For example, a sound with a frequency of 880 Hz is an octave higher than one with a frequency of 440 Hz. For humans, hearing is limited to frequencies between about 20 Hz and 20000 Hz, with the upper limit generally decreasing with age.



Multimedia Sound Systems

The multimedia application user can use sound right off the bat on both the Macintosh and on a multimedia PC running Windows because beeps and warning

sounds are available as soon as the operating system is installed. On the Macintosh you can choose one of the several sounds for the system alert. In Windows system sounds are WAV files and they reside in the windows\Media subdirectory.
There are still more choices of audio if Microsoft Office is installed. Windows makes use of WAV files as the default file format for audio and Macintosh systems use SND as default file format for audio.

WAVEFORM MEASUREMENTS
Several measurements in sound wave that describe waveforms are the following:

- **Amplitude** - Reflects the change in pressure from the peak of the waveform to the trough. High-amplitude waveforms are loud; low-amplitude waveforms are quiet.
- **Cycle** - Describes a single, repeated sequence of pressure changes, from zero pressure, to high pressure, to low pressure, and back to zero.
- **Frequency** - Measured in hertz (Hz), describes the number of cycles per second. (For example, a 1000-Hz waveform has 1000 cycles per second.) The higher the frequency, the higher the musical pitch.
- **Phase** - Measured in 360 degrees, indicates the position of a waveform in a cycle. Zero degrees is the start point, followed by 90º at high pressure, 180º at the halfway point, 270º at low pressure, and 360º at the end point.
- **Wavelength** - Measured in units such as inches or centimeters, is the distance between two points with the same degree of phase. As frequency increases, wavelength decreases.

Digital Audio
Digital audio is created when a sound wave is converted into numbers – a process referred to as digitizing. It is possible to digitize sound from a microphone, a synthesizer, existing tape recordings, live radio and television broadcasts, and popular CDs. You can digitize sounds from a natural source or prerecorded. Digitized sound is sampled sound. Ever nth fraction of a second, a sample of sound is taken and stored as digital information in bits and bytes. The quality of this digital recording depends upon how often the samples are taken.

Preparing Digital Audio Files
Preparing digital audio files is fairly straight forward. If you have analog source materials – music or sound effects that you have recorded on analog media such as cassette tapes.
Ø The first step is to digitize the analog material and recording it onto a computer readable digital media.

Ø It is necessary to focus on two crucial aspects of preparing digital audio files:
o Balancing the need for sound quality against your available RAM and Hard disk resources.
o Setting proper recording levels to get a good, clean recording.

Remember that the sampling rate determines the frequency at which samples will be drawn for the recording. Sampling at higher rates more accurately captures the high frequency content of your sound. Audio resolution determines the accuracy with which a sound can be digitized.

Formula for determining the size of the digital audio
Monophonic = Sampling rate * duration of recording in seconds * (bit resolution / 8) * 1

Stereo = Sampling rate * duration of recording in seconds * (bit resolution / 8) * 2

Ø The sampling rate is how often the samples are taken.
Ø The sample size is the amount of information stored. This is called as bit resolution.
Ø The number of channels is 2 for stereo and 1 for monophonic.
Ø The time span of the recording is measured in seconds.

Editing Digital Recordings

sound editing operations that most multimedia procedures needed are described in the paragraphs that follow

1. **Multiple Tasks**: Able to edit and combine multiple tracks and then merge the tracks and export them in a final mix to a single audio file.
2. **Trimming**: Removing dead air or blank space from the front of a recording and an unnecessary extra time off the end is your first sound editing task.
3. **Splicing and Assembly**: Using the same tools mentioned for trimming, you will probably want to remove the extraneous noises that inevitably creep into recording.
4. **Volume Adjustments**: If you are trying to assemble ten different recordings into a single track there is a little chance that all the segments have the same volume.
5. **Format Conversion**: In some cases your digital audio editing software might read a format different from that read by your presentation or authoring program.
6. **Resampling or downsampling**: If you have recorded and edited your sounds at 16 bit sampling rates but are using lower rates you must resample or downsample the file.
7. **Equalization:** Some programs offer digital equalization capabilities that allow you to modify a recording frequency content so that it sounds brighter or darker.

8. **Digital Signal Processing**: Some programs allow you to process the signal with reverberation, multitap delay, and other special effects using DSP routines.
9. **Reversing Sounds**: Another simple manipulation is to reverse all or a portion of a digital audio recording. Sounds can produce a surreal, other wordly effect when played backward.
10. **Time Stretching**: Advanced programs let you alter the length of a sound file without changing its pitch. This feature can be very useful but watch out: most time stretching algorithms will severely degrade the audio quality.

Making MIDI Audio

MIDI (Musical Instrument Digital Interface) is a communication standard developed for electronic musical instruments and computers. MIDI files allow music and
sound synthesizers from different manufacturers to communicate with each other by sending messages along cables connected to the devices.
Creating your own original score can be one of the most creative and rewarding aspects of building a multimedia project, and MIDI (Musical Instrument Digital Interface) is the quickest, easiest and most flexible tool for this task.
The process of creating MIDI music is quite different from digitizing existing audio. To make MIDI scores, however you will need sequencer software and a sound synthesizer.
The MIDI keyboard is also useful to simply the creation of musical scores. An advantage of structured data such as MIDI is the ease with which the music director can
edit the data.
A MIDI file format is used in the following circumstances :

- Digital audio will not work due to memory constraints and more processing power requirements
- When there is high quality of MIDI source
- When there is no requirement for dialogue.

A digital audio file format is preferred in the following circumstances:

- When there is no control over the playback hardware
- When the computing resources and the bandwidth requirements are high.
- When dialogue is required.

Audio File Formats

A file format determines the application that is to be used for opening a file.
Following is the list of different file formats and the software that can be used for

opening a specific file.

1. *.AIF, *.SDII in Macintosh Systems
2. *.SND for Macintosh Systems
3. *.WAV for Windows Systems
4. MIDI files – used by north Macintosh and Windows
5. *.WMA –windows media player
6. *.MP3 – MP3 audio
7. *.RA – Real Player
8. *.VOC – VOC Sound
9. AIFF sound format for Macintosh sound files
10. *.OGG – Ogg Vorbis

Red Book Standard

The method for digitally encoding the high quality stereo of the consumer CD music market is an instrument standard, ISO 10149. This is also called as RED BOOK standard.

The developers of this standard claim that the digital audio sample size and sample rate of red book audio allow accurate reproduction of all sounds that humans can hear. The red book standard recommends audio recorded at a sample size of 16 bits and sampling rate of 44.1 KHz.

Software used for Audio

Software such as Toast and CD-Creator from Adaptec can translate the digital files of red book Audio format on consumer compact discs directly into a digital sound editing file, or decompress MP3 files into CD-Audio. There are several tools available for recording audio. Following is the list of different software that can be used for recording and editing audio ;

- Soundrecorder from Microsoft
- Apple's QuickTime Player pro
- Sonic Foundry's SoundForge for Windows
- Soundedit16

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