THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department of
Electronic & Computer
Engineering
電 子 及 計 算 機 工 程 學 系

ELEC 1020

Media Production: Technology and Design

Lecture 5

Prof. James She (*james.she@ust.hk*)

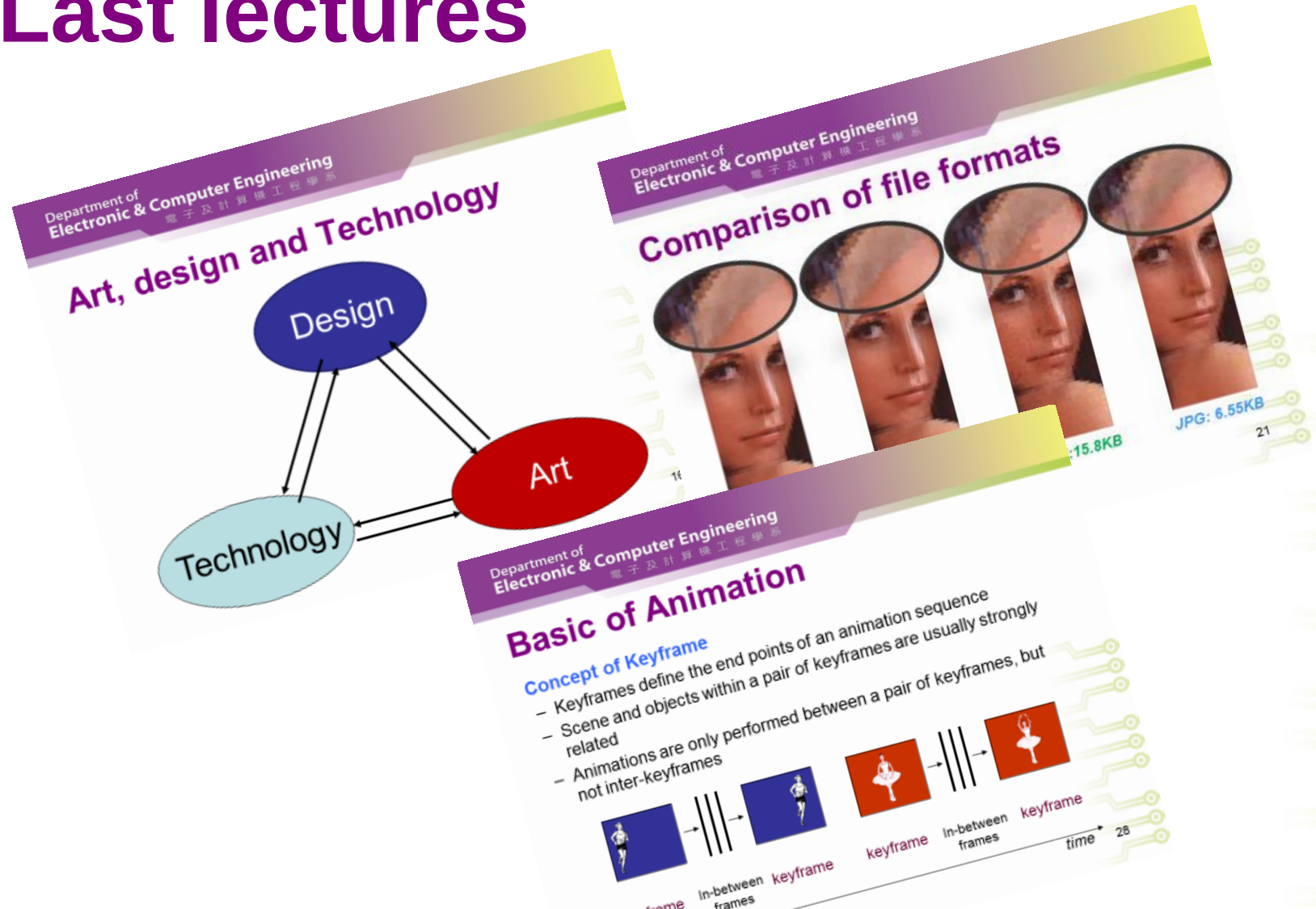
1-page Mid-Term Exam

15:10 – 16:10

*lecture after exam

5 minutes break

Last lectures



Outcomes from this lecture

1. Mid-term Exam (DONE!)

2. Sound and Sound Effects

Selected Creative Tasks

http://ihome.ust.hk/~twuac/elec1020/creative_20089923_loop/

http://ihome.ust.hk/~kkkwokad/Bus/

http://ihome.ust.hk/~ihanda/HANDA2/

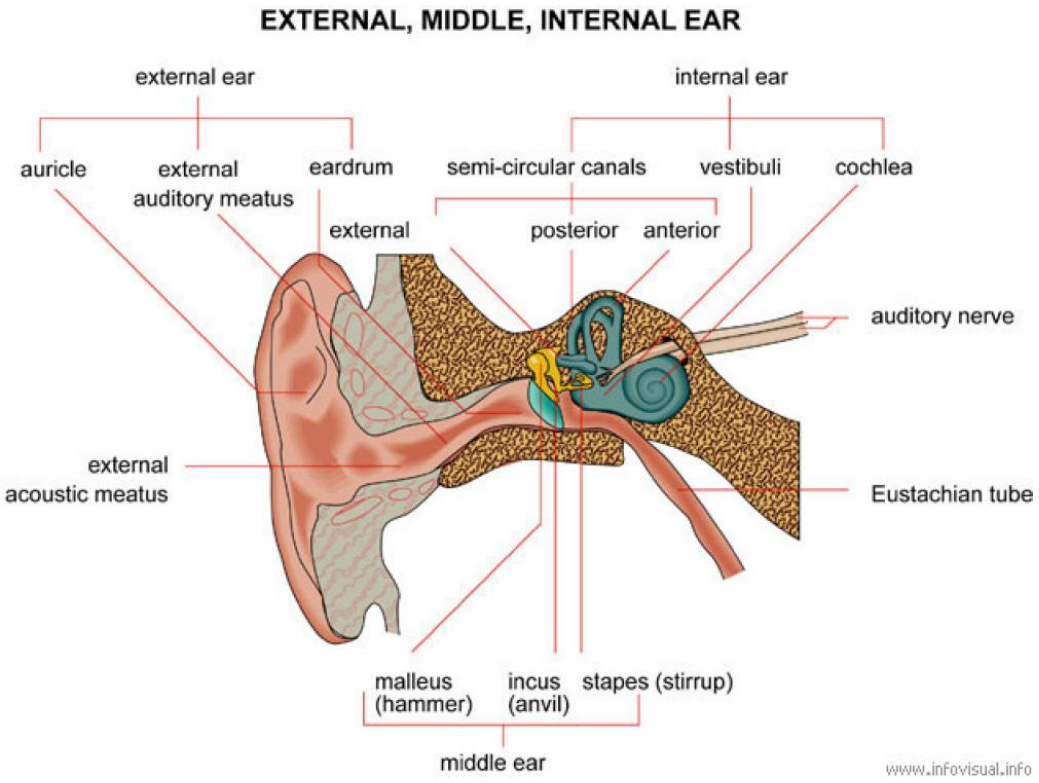
Sound and Sound Effect
– why bother?

Let's compare a nice media production with and without sound

http://www.youtube.com/watch?v=2pIWzUB79cQ

Sound (waves)

How ear works?

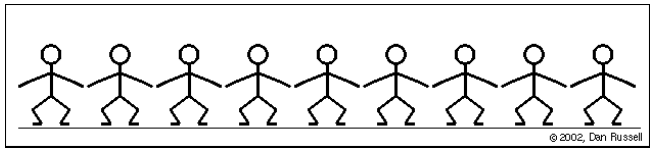


z..Z…Z

Let us utilizes the multimedia…
https://www.youtube.com/watch?v=qgdqp-oPb1Q

Sound as a “wave” form

What is a wave?

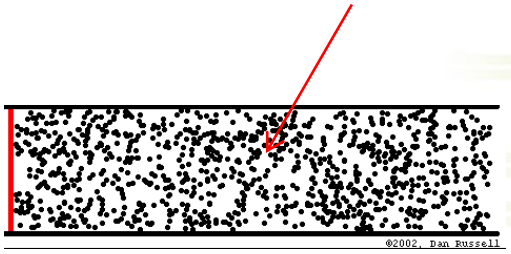


- a wave as "a disturbance/variation that transfers energy progressively from point to point in a medium and that may take the form of an elastic deformation or of a variation of pressure, electric or magnetic intensity, electric potential, or temperature.“ by Webster's dictionary

1. *A series of longitudinal/compression waves that move through air/other materials.*

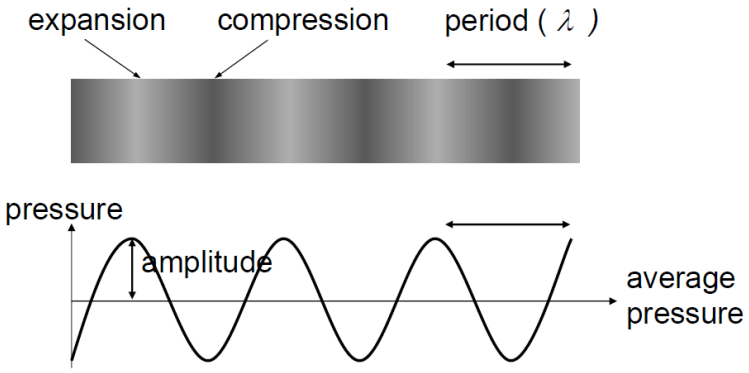
2. *Does not travel in a vacuum.*

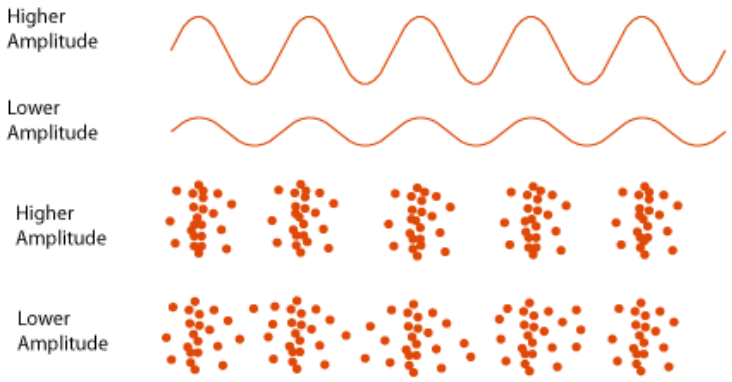
air particles

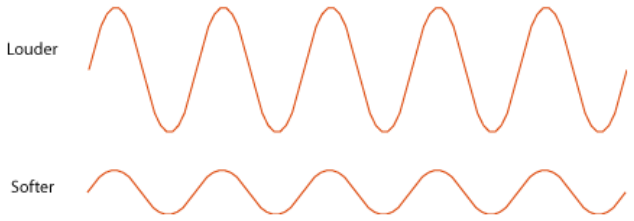


Basic physics of waveform

What is a wave?







- *Amplitude ➔ Loudness*

Human Perception: Loudness (Amplitude)

How to measure loudness?

Sound Pressure Level (SPL) meter:

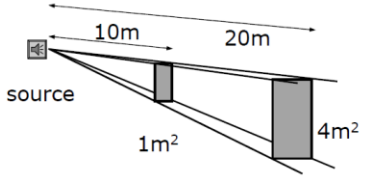
- Pascal (Pa) or Newton/m^2
- Loudness limits of ears: 2x10-5Pa – 120Pa

Our ears respond to sound pressure in logarithm scale:

- *Decibel (dB): a better measure to describe how loud a sound is.*

- $dB = 20 \log (P/P_0)$

  where P_0=20μ Pa, is the threshold of hearing



Sound	dB-SPL
Jet engine at 3m	140
Threshold of pain	130
Rock concert	120
Accelerating motorcycle at 5m	110
Pneumatic hammer at 2m	100
Noisy factory	90
Vacuum cleaner	80
Busy traffic	70
Quiet restaurant	50
Residential area at night	40
Empty movie house	30
Rustling of leaves	20
Human breathing (at 3m)	10
Threshold of hearing (good ears)	0

Approximate dB-SPL level of common sounds. (Information from S. S. Stevens, F. Warshofsky, and the Editors of Time-Life Books, Sound and Hearing, Life Science Library, Time-Life Books, Alexandria, VA, 1965, p. 173.)

Human Perception: (Pitch) - Frequency

Frequency is perceived as pitch

- Audible frequency range: 20Hz-20KHz
- Max. sensitivity: 1-5kHz
- Relatively insensitive at low and high frequencies

Interesting sound and hearing test

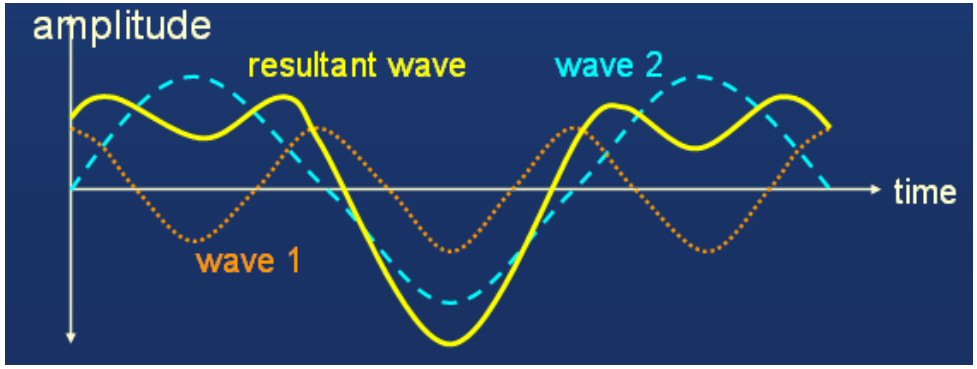
(Warning: you may find some sound annoying)

1Hz – 20kHz test: http://www.youtube.com/watch?v=xmKEhOS1QAo

Human Perception: (Pitch) - Frequency

Frequency is perceived as pitch

• Simple sine waves with different frequencies can be combined to form complicated waveforms by superposition



• *Perception of a pitch is related mainly to the fundamental frequency of the sound being played*

Digital Audio Processing

Audio Processing

Types of processing

Amplitude control:
Volume control, Panning, Dynamic range control, Noise gating, Down-mixing, etc.

Time delay:
Echo, Reverberation, Chorus and Flanging, Phasing

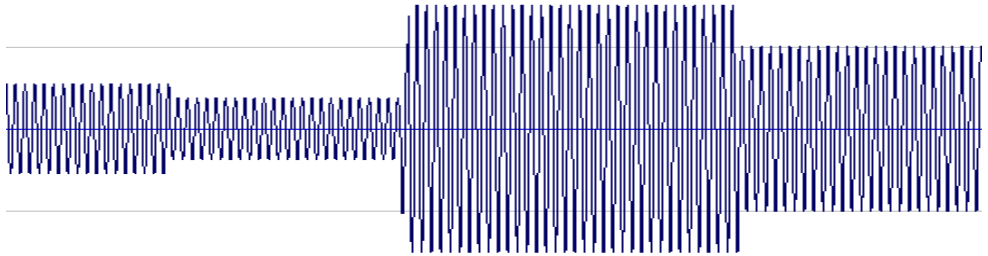
Time domain control:
Time stretch, re-sampling

Frequency response:
Equalization

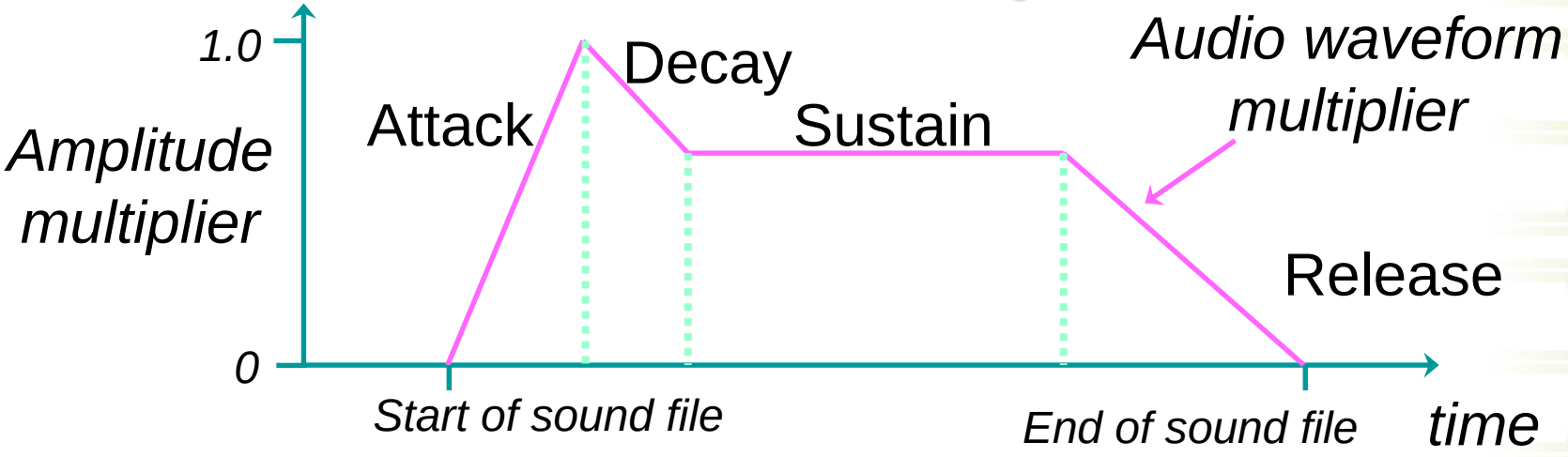
Non-uniform Volume Control

Transitions

Abrupt change in a continuous audio should be avoided



Transitions are introduced in volume change



Time stretch/shrink

Change the duration of audio sample

Important to many applications

- *Change the tempo of a musical sample*
- *Synchronizing sound to video in film production*
- *Delaying a person's speech if he/she talk too fast*

Not a easy task

- *Simply stretching/shrinking the time axis may not work as it will modify the pitch/quality as well*

original

stretching

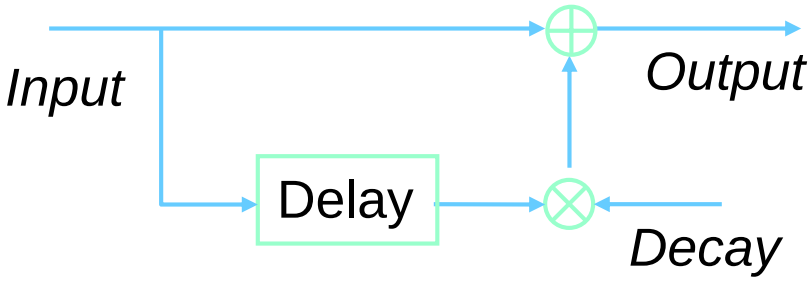
shrinking

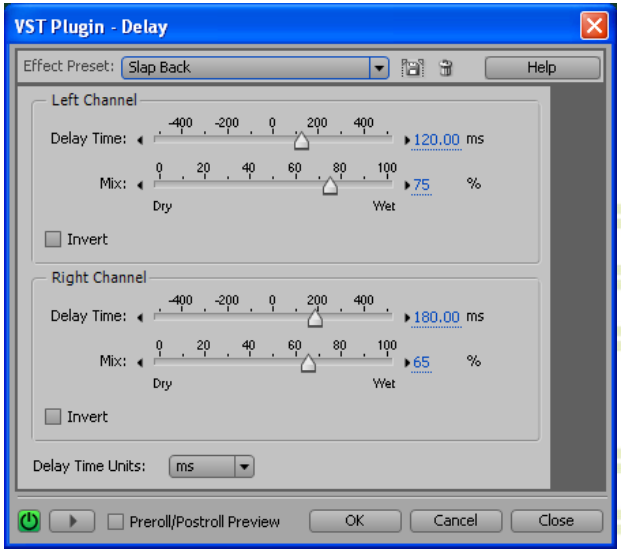
Delay/Echo

original

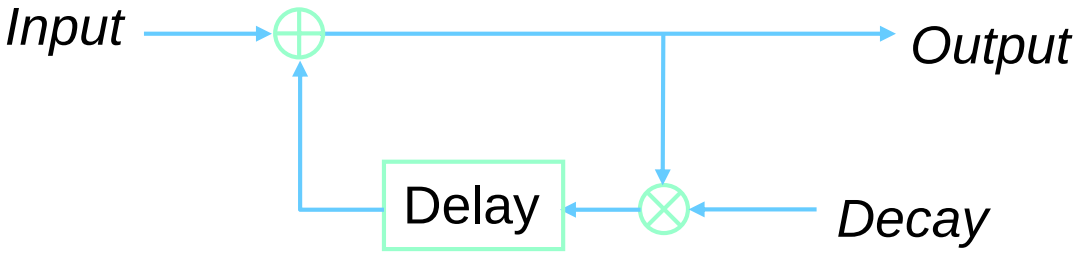
Produced by adding a time-delayed signal

- Simple echo





- Multiple echoes



Delay/Echo

Special effects from echos

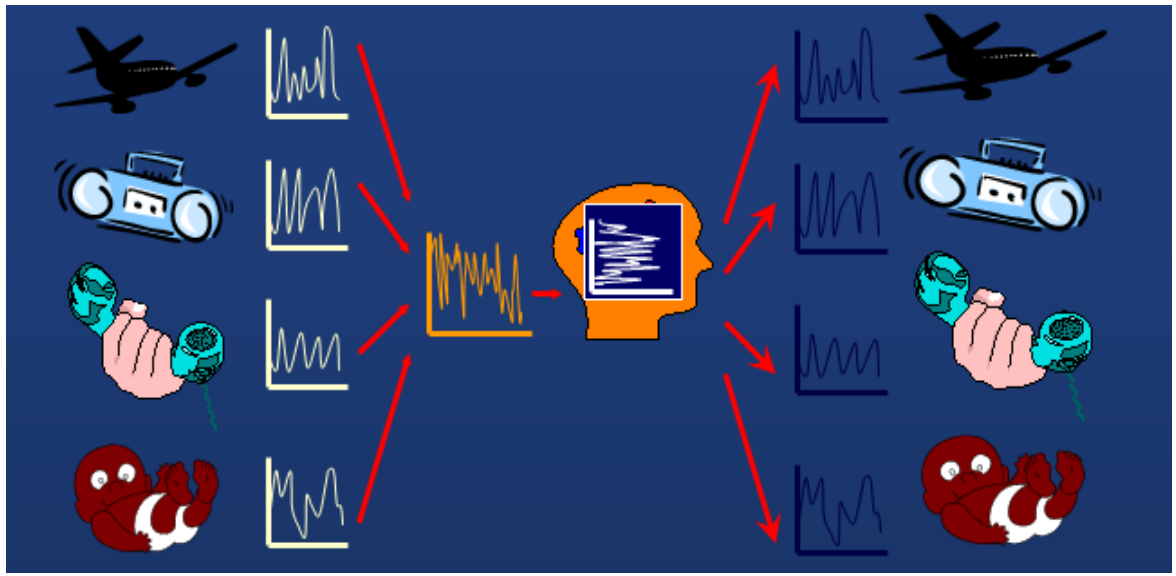
Simple echo

- *Very short delay (say 15ms) and long decay time results in metallic or robotic sound* 

Multiple echoes

- *Multiple delay with Pre-delay/echo give the effect of traveling back in time in science fiction* 

Human Perception and Sound Effects
The magic of human brain



Magical brain capability: map a collection of perceived sound waveforms (sound effects) to some known objects, memories, feelings, scenes, messages, etc.

• We can manipulate this on your audience to convey a marketing message more effectively

Audio Processing, Human Perception, Design Principles

What is Sound Effect?

http://www.youtube.com/watch?v=fbDFAaPfl28

- End of Lecture 5 -