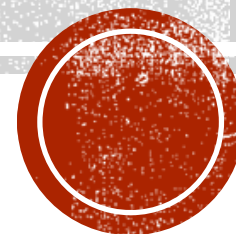
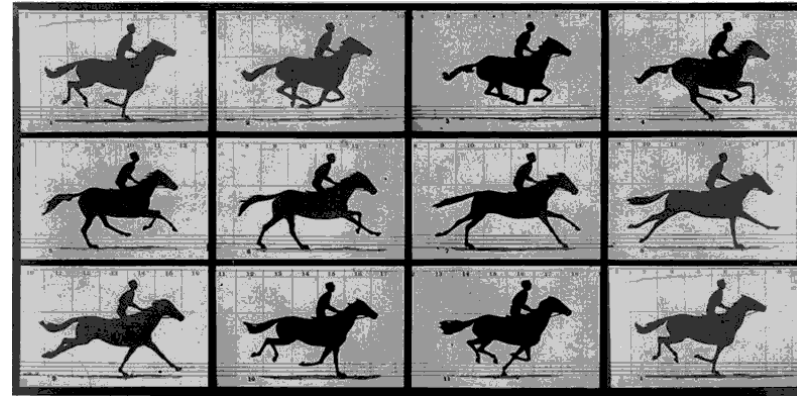


CHAPTER 4: VIDEO AND ANIMATION



INTRODUCTION



- Motion video and computer-based animation have become basic media for multimedia system.
- The visual effect of the motion is due to the biological phenomenon known as the persistence of vision
- An Object seen by the human eye remains mapped in the eye for approx. 25ms
- “When two light sources are close by and are illuminated in quick succession, we perceive the single light source is moving between two points”
- It is known that we perceive a continuous motion to occur at a frame rate higher than 15 frames/ second.

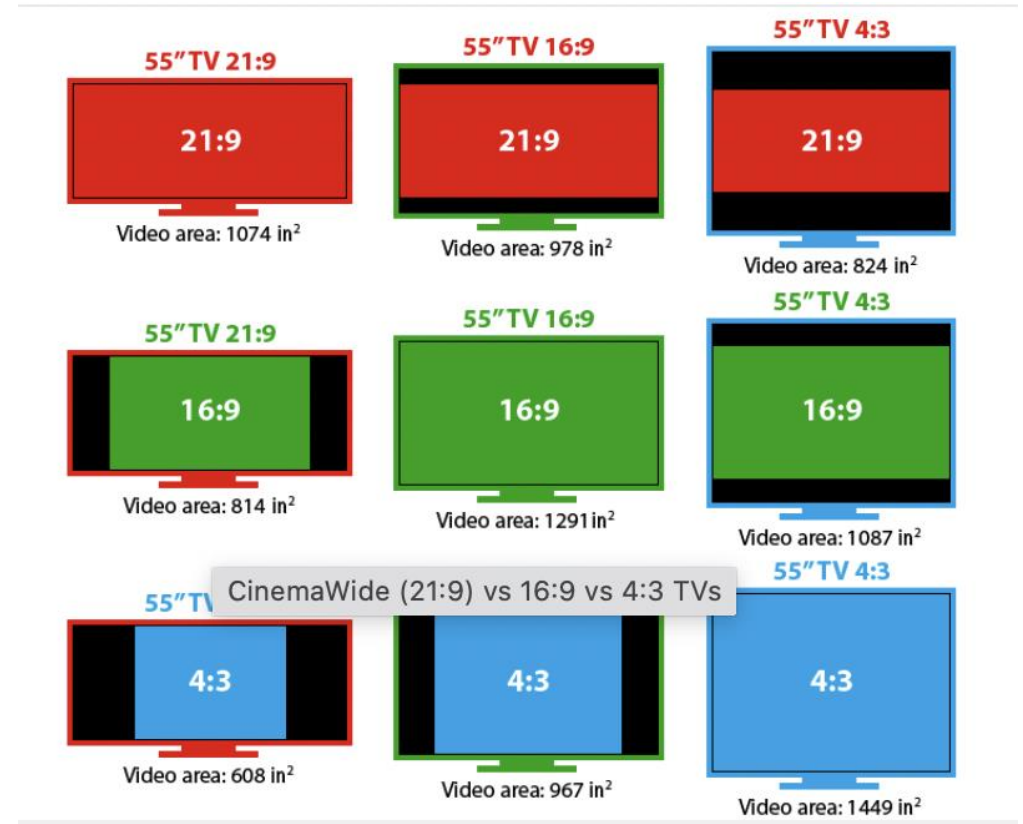




MEASURES FOR VIDEO REPRESENTATION

■ 1. Aspect Ratio

- The aspect ratio is the ratio between the width and the height of a display.
- It defines its overall shape, and it is usually presented as W:H (where W is the width, and H is the height).
- All TVs sold today have an aspect ratio of 16:9, which means that if the width is divided into 16 equal parts, the height of the TV or picture should be 9 parts.
- All the older TV's and computer monitors you grew up with had the squarish 4:3 shape— 33% wider than it was high.
- These are often referred to as square monitors



DISPLAY A 4:3 VIDEO SIGNAL ON A 16:9 MONITOR

- 1. Tolerate vertical black bars on the left and right sides of the screen (called “pillarboxing”),
- 2. Have horizontally stretched and distorted images, making people and objects appear shorter and wider:
- 3. Or zoom-in the video signal, which chops off the top and bottom portion of the images:



MEASURES FOR VIDEO REPRESENTATION

- **2. Horizontal detail and Picture Width**

- The picture width chosen for conventional TV service is $4/3$, $16/9$. Using the aspect ratio, we can determine the horizontal field of view from the horizontal angle.

- **3. Total detail content of the image**

- The product of the number of elements vertically and horizontally equals the total number of picture elements in the image.

- **4. Perception of Depth**

- It is the perception of third spatial dimension that depends upon the angular separation of the image received by the two eyes.

- **5. Luminance and Chrominance**

- The RGB gives a sense of color, but during the transmission of the signals from camera to the display, luminance & chrominance signals are used.



MEASURES FOR VIDEO REPRESENTATION

▪ 6. Temporal Aspect of Illumination

- Motion is the presentation of a rapid succession of slightly different still pictures. Between frames the light is cut off briefly.
- To represent visual reality ,two conditions must be met.
- **First**, rate of repetition must be high enough to guarantee a smooth transition.
- **Second**, rate must be high enough so that the persistence of vision extends over the interval between the flashes

▪ 7. Continuity of Motion

- Minimum 15 frames/second
- USA(NTSC): 29.97Hz
- Europe(PAL): 25 Hz

▪ 8. Flicker

- Periodic fluctuation of brightness
- Marginal value to avoid flicker is at least 50 refresh cycles/s
- Flicker is a visible change in brightness between cycles displayed on video displays. It applies to the refresh interval on cathode-ray tube (CRT) televisions and computer monitors, as well as plasma computer displays and televisions.



DEPTH PERCEPTION EXAMPLE



LUMINANCE AND CHROMINANCE. EXAMPLE



COLOR ENCODING

YCbCr

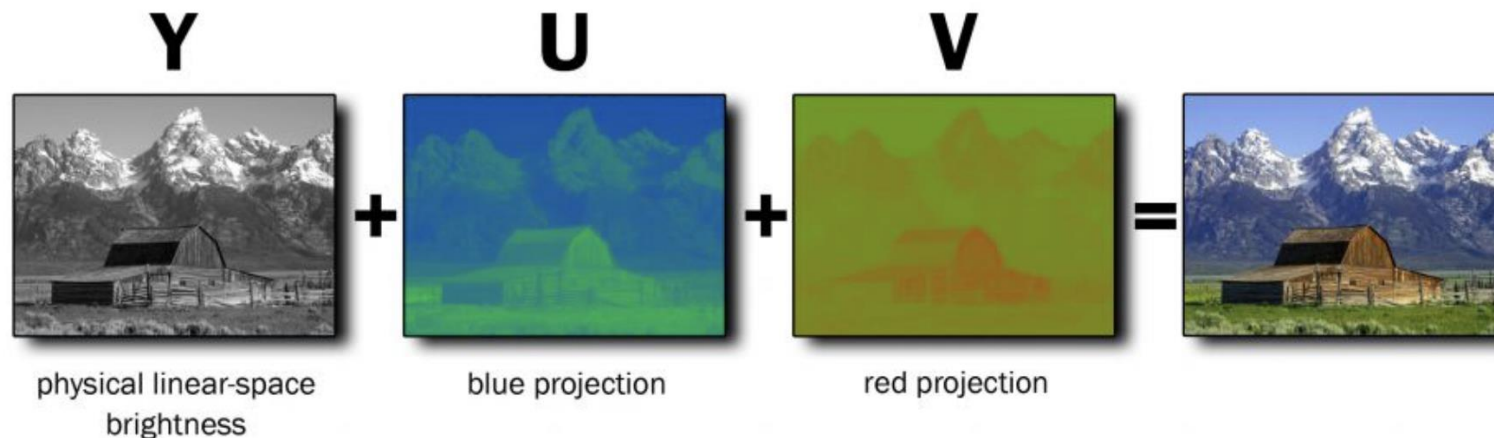


RGB



COLOR ENCODING (RGB+YUV)

- The YUV color space is primarily used on an analog television.
- YUV color space was particularly useful when color was first introduced to television as it could decode and display both color and black and white.
- Like all color spaces, YUV is just an abbreviated term for 'luma', 'red projection' and 'blue projection'.
- Essentially, a YUV system is a mathematical encoding system like any other, but incorporates both brightness and color.
- YUV is most useful for producing grayscale images, because all the user has to do is get rid of the U and V elements of the equation.



COLOR ENCODING (RGB+YUV)

- The color encoding system used for analog television worldwide (NTSC, PAL and SECAM). The YUV color space (color model) differs from RGB, which is what the camera captures and what humans view.
- When color signals were developed in the 1950s, it was decided to allow black and white TVs to continue to receive and decode monochrome signals, while color sets would decode both monochrome and color signals.
- The Y in YUV stands for "luma," which is brightness.
- U and V provide color information and are "color difference" signals of blue minus luma (B-Y)BLUE LUMA and red minus luma (R-Y)RED LUMA.
- These corresponds approx. to the hue & saturation of the color.



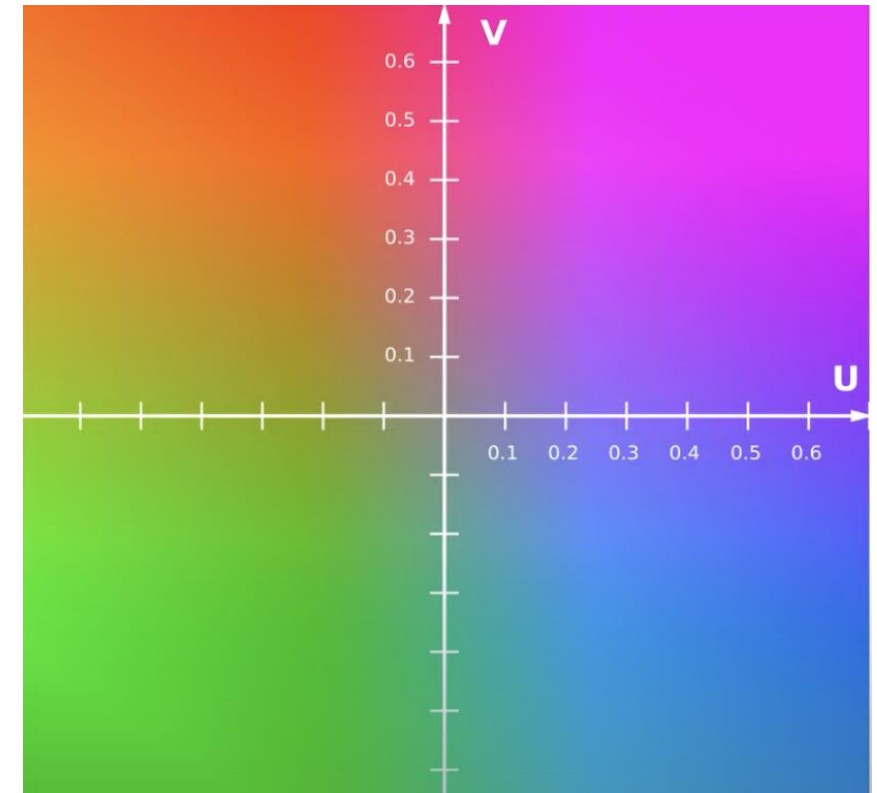
RGB TO YUV AND VICE VERSA..CONVERSION FORMULA

From RGB to YUV

- $Y = 0.299R + 0.587G + 0.114B$
- $U = -0.147R - 0.289G + 0.436B$
- $V = 0.615R - 0.515G - 0.100B$

From YUV to RGB

- $R = Y + 1.140V$
- $G = Y - 0.395U - 0.581V$
- $B = Y + 2.032U$



EXPLANATION

- Our computers/Television sets physically use RGB channel signals.
- When we are processing, broadcasting or storing it to a disk., then RGB is not always the useful format to store colours. Hence we use YUV .
- Also called as YCbCr image, this has three values per pixel. Y is the luminance, it is the overall brightness of the pixel.
- This is effectively a greyscale value. If we ignore the U and V , then we have a greyscale image.
- Then U and V are the chrominance values which is the color information of the pixel . Blueness or redness. Ranges from -ve to +ve number
- No green, Why? Since it is achieved when the redness and blueness value is very small as seen in the graph.
- Why separation of RGB and YUV: For old black and white TV, if broadcasters would send RGB signal to B&W tv, they would be able to see the TV. This process will ignore the color components and only channel the luminance signal.
- Another aspect is Chroma subsampling: For Compression: Human perception is more sensitive to the changes in brightness than in the changes in color.



T.V SYSTEMS. BROADCAST VIDEO STANDARDS

- **1 National Television System Committee (NTSC)**
- NISC is a television broadcasting system used in a number of countries including Korea, Japan, Canada, North America, parts of South America, Mexico and the Caribbean islands.
- It is named after the National Television Systems Committee, the industry wide standardization body that created it.
- Set up in 1940 by the Federal Communication Commission in the United States to establish a nationwide standard for black and white TV transmission.
- It specified a standard using 525 horizontal lines, 30 frames per sec, 2 interlaced fields per frame.
- **Lines: 525**
Frame rate: 29.97 Hz
Picture resolutions: 720 x 480; 704 x 480; 352 x 480; 352 x 240



T.V SYSTEMS. BROADCAST VIDEO STANDARDS

▪ 2. Phase Alternating Line (PAL)

- PAL, short for Phase Alternating Line, is the analogue video format used in television transmission in most of Europe.
- PAL was developed in Germany by Walter Bruch, and first introduced in 1967.
- The name “Phase Alternating Line” describes the way that part of the colour information on the video signal is reversed in phase with each line, which automatically corrects phase errors in the transmission of the signal.
- Some engineers jokingly expand NTSC to “Never The Same Colour” while referring to PAL as “Perfect At Last” or “Peace At Last”!
- The PAL colour system is usually used with a video format that has 625 lines per frame and a refresh rate of 25 frames per second.
- **Lines: 625**
Frame rate: 25 Hz
Picture resolution: 720 x 576; 704 x 576; 352 x 576; 352 x 288



LIST OF COUNTRIES AND THEIR NTSC OR PAL TELEVISION FORMAT

NTSC

National Television System Committee

Antigua	El Salvador	Philippines
Bahamas	Ecuador	Puerto Rico
Barbados	Guam	Saipan
Barbuda	Guatemala	Samoa
Belize	Haiti	South Korea
Bermuda	Honduras	Saint Kitts
Bolivia	Jamaica	Saint Lucia
Burma	Japan	Saint Vincent
Cambodia	Mexico	Surinam
Canada	Midway Islands	Taiwan
Cayman Islands	Netherland Antilles	Tobago
Chile	Nicaragua	Trinidad
Colombia	North Mariana Island	United States
Costa Rica	Panama	Venezuela
Cuba	Peru	Virgin Islands

PAL

Phase Alternating Line

Afghanistan	Dubai	Liberia	Somalia
Albania	England	Macedonia	South Africa
Algeria	Ethiopia	Madeira	SW Africa
Angola	Faeroe Islands	Malaysia	Slovenia
Argentina	Finland	Malta	Spain
Australia	Ghana	Montenegro	Sri Lanka
Austria	Gibraltar	Mozambique	Sudan
Azores	Guinea	Nepal	Swaziland
Bahrain	Holland	New Guinea	Sweden
Bangladesh	Hong Kong	New Zealand	Switzerland
Belgium	Iceland	Nigeria	Tanzania
Bosnia	India	Norway	Thailand
Botswana	Indonesia	Oman	Turkey
Brazil	Ireland	Pakistan	Uganda
Brunei	Israel	Paraguay	United Arab Emirates
Cameroon	Italy	Portugal	United Kingdom
Canary Islands	Jordan	Qatar	Uruguay
Croatia	Kenya	Romania	West Germany
Cyprus	Kuwait	Serbia	Zambia
Denmark	Laos	Singapore	Zimbabwe



T.V SYSTEMS. BROADCAST VIDEO STANDARDS

- **3. Systeme Electronique Pour Couleur Avec Memoire (SECAM)**
- SECAM is an analogue television system, using frequency modulation to encode chrominance information.
- SECAM was introduced in France in 1967, where it is still used.
- SECAM was developed arguably to protect French television equipment manufactures and to make it more difficult to view non-French programming.
- SECAM removes colour artefacts but halves colour resolution.
- SECAM uses the same bandwidth and resolution (720x576) as PAL



PROGRESSIVE AND INTERLACED SCAN

INTERLACED



1080p vs. 1080i



PROGRESSIVE VS INTERLACED SCAN

Progressive

- It is a process where every frame of the video signal is scanned in a progressive way. Each frame is scanned as a complete picture.

Parameter	Progressive Scan
Picture quality	Better picture quality
Image resolution	Higher image resolution overall
Time to scan	Requires longer time to scan
Synchronization	Better for audio and image synchronization
Bandwidth	Higher bandwidth
Use cases	Better for 24FPS videos and live videos
	Better for live videos

Interlaced

- Works by scanning every second frame of a video signal. Every second frame is then combined to create a full video frame.

Interlaced Scan
Lower picture quality
Relatively lower image resolution
Requires shorter time for scanning
Lesser audio and image synchronization
Lower bandwidth
Not suitable for 24FPS videos
Better for recorded videos



FILE SIZE CALCULATION FOR VIDEO

- A Video with resolution of 704x576 size, with 30 frames per second, running for a 90 minute length, and has 24 bit per pixel color coding. The video is in an uncompressed raw format. What is the total file size in Megabytes?
- There are 8 bits in a byte, so 24 bits per pixel implies 3 bytes per pixel.
- $704 \times 576 \text{ pixels} \times 3 \text{ bytes per pixel} \times 30 \text{ frames per second} \div (1024 \times 1024 \text{ bytes per megabyte}) \cong \mathbf{34.8 \text{ MB/s}} = 278.4 \text{ Mb/s}$.
- 'MB' is megabytes, 'Mb' is megabits. Don't conflate them, because you'll be off by a factor of 8.
- Total data = $34.8 \text{ MB/s} \times 60 \text{ seconds per minute} \times 90 \text{ minutes} \div (1024 \text{ megabytes per gigabyte}) \cong \mathbf{183.5 \text{ GB}}$.



ANIMATION AND ITS TYPES

- To animate something is, literally, to bring it to life.
- An animation covers all changes that have a visual effect
- Visual effect can be of two major kinds:
 - Motion dynamic & Update dynamic
- A computer animation is an animation performed by a computer using graphical tools to provide visual effects
- ☐ Traditional Animation
- ☐ Stop Motion
- ☐ Computer Animation



TRADITIONAL ANIMATION



- Traditional animation (also called cel animation or hand-drawn animation) was the process used for most animated films of the 20th century.
- The individual frames of a traditionally animated film are photographs of drawings, which are first drawn on paper.
- To create the illusion of movement, each drawing differs slightly from the one before it.
- Examples of traditionally animated feature films include Pinocchio (United States, 1940), Animal Farm (United Kingdom, 1954), and Akira (Japan, 1988). Traditional animated films which were produced with the aid of computer technology include The Lion King (US, 1994).



STOP MOTION

- Stop-motion animation is used to describe animation created by physically manipulating real-world objects and photographing them one frame of film at a time to create the illusion of movement.
- Examples include The Tale of the Fox (France, 1937), The Nightmare Before Christmas (US, 1993), Corpse Bride (US, 2005), Coraline (US, 2009)



COMPUTER ANIMATION

- A computer-based animation is an animation performed by a computer using graphical tools to provide visual effects.
- Computer animation encompasses a variety of techniques, the unifying factor being that the animation is created digitally on a computer.
- This animation takes less time than previous traditional animation.



COMPUTER ANIMATION CAN BROADLY BE CATEGORIZED INTO TWO CATEGORIES:

- Motion Dynamics
 - ✓ Induction of life by changing the position of the object
 - ✓ Example: Animation of a bouncing ball
- Update Dynamics
 - ✓ Induction of life by changing the shape, size, color, transparency, textures, and structure of the object
 - ✓ Example: Animation of flower blooming from bud.



FUNDAMENTAL PROCESS IN ANIMATION

1. INPUT PROCESS

- The first step in producing computer animation is input process.
- Key frames have to be created and input them to the computer.
- Key frames are the frames in which the objects being animated are at extreme or characteristic positions.
- They can be drawn using traditional artistic tools, such as pen and brush, and then digitized.
- They can also be created using drawing or painting tools directly.
- In composition stage, the foreground and background figures are combined to generate the individual frames.



FUNDAMENTAL PROCESS IN ANIMATION

2. INBETWEEN PROCESS

- The animation of movement from one position to another needs a composition of frames with intermediate positions in between the key frames
- The process of in between-ing is performed in computer animation through interpolation
- The system is given the starting and ending positions
- It calculates the positions in between the frames.



2. INBETWEEN PROCESS..CONTD

- The easiest interpolation is linear interpolation
- It has many limitations: the object does not move smoothly, look unreal.
- Spline interpolation can make object move more smoothly . Inbetweening also involves interpolating the shapes of objects
- Some animation involves changing the color of objects
 - This is usually done using color look-up table (CLUT)
 - By cycling through the colors in the CLUT, the objects' colors will change
- Morphing is a popular effect in which one image transforms into another.



CONTROLLING ANIMATION

- Full explicit control —the animator provides a description of everything that occurs in the animation
- *Either by specifying simple changes, such as scaling, transformation or by providing key frames*
- Procedural control —using a program to calculate the position, angle, etc. of the objects
- *In physical systems, the position of one object may influence the motion of another*
- Constraint-based systems —movement of objects that are in contact with each other is constraint by physical laws
- An animation can be specified by these constraints
 - Tracking live action
 - People or animals act out the parts of the characters in the animation
 - The animator trace out the characters



DISPLAYING ANIMATION

- The rules governing the showing of video apply to animation as well .The frame rate should be at least 10, preferably 15 to 20, to give a reasonably smooth effect
- There are basically three common ways to display animation
- 1.Generate a digital video clip
- *Many Animation tools will export an animation in common digital video format, e.g., QuickTime*
- 2.Create a package including runtime system of the animation tool
- *For example, Director can create a projector including all casts. The projector can then be distributed and play the animation.*
- 3. Show the animation in the animation tool



ANIMATION TOOLS

- Macromedia Director and Flash

- *It is one of the most popular interactive animation tool for generating interactive multimedia applications.*

- Meta Creations Poser

- *It understands human motion and inverse kinematics, e.g., move an arm the shoulders will follow.*

- Discreet 3D Studio Max

Very popular for creating 3D animations

- Animation language—VRML (Virtual Reality Modeling Language)



END OF CHAPTER 4

