

Nature of Video

- Combination of time Variant Image and Sound
 - Most realistic media
- Dynamic
- Huge data size(Very large files)
 - Biggest data among all digital media
 - Compression is a must
- Video must be digitized from an analog signal



Analog Video (VHS)

VHS (Video Home System):

a consumer-level analog recording videocassette standard developed by Victor Company of Japan (JVC).

- Traditional Films:
 - Sequential image frames are recorded on film using a light sensitive technology similar to still photography
 - Film must be chemically developed
 - Editing requires physically cutting and splicing the film

Analog Video

- Video tape made it easier
 - VHS video format is analog
 - Image frames are recorded magnetically on the videotape
 - Special editing equipment is required to control 2 VCRs (Video Cassette Recorders) to copy video segments and record the edited segments together onto an edited video tape master
 - Copies are made from the master for distribution
 - Some image quality is lost with each copy

Digital Video (DV)

Digital video is the easiest

- Image frames are digitally recorded onto a mini DV tape
- Digital video can transfer directly from the camera to a computer that has a 'firewire' (IEEE 1394) connection
- Editing can be done with user friendly software on the computer
- Movie files can be played on a computer, recorded back to a mini DV tape, a CD, a DVD or even transferred to VHS videotape
- No loss of image quality with digital copying and transferring

Analog Video connections

- Composite:
 - Lowest quality
 - Single wire to transmit video signals
 - Luminous and color signals are merged
- S-Video:
 - Next higher quality
 - Use separate wires incased in a single cable
- Component:
 - Best quality
 - Each YCC signal is given its own cable

YCC (YCbCr): a family of color spaces used in video and digital photography systems. Y' is the luminance component and Cb and Cr are the blue-difference and red-difference chroma components

Broadcast standards

- ▶ NTSC
 - National Television System Committee
- ▶ P A L
 - Phase Alternating Line
- ▶ SECAM
 - Sequential Couleur Avec Memoire
or Sequential Color with Memory

Analog video standards

- ▶ **NTSC (National Television System Committee)**
 - Very popular TV standard
 - Uses 4:3 aspect ratio, 525 scan lines per frame, 30 fps
 - Uses interlaced scanning
 - Mostly uses in North America and Japan
- ▶ **PAL**
 - Uses 4:3 aspect ratio, 625 scan lines per frame, 25 fps
 - Use composite video
 - Mostly uses in Europe , China , India
- ▶ **SECAM**
 - Uses 4:3 aspect ratio, interlaced fields, 625 scan lines
 - SECAM are similar in many aspects and different slightly in their colour coding scheme

Getting Video into your computer

- ▶ Analog

- Needs video capture device that can digitize the analog video

- ▶ Digital

- Capture card or IEEE 1394 connection

Editing Video

- ▶ Digitized video is not linear like analog video
- ▶ Can access any part of video randomly
- ▶ Can cut and paste
- ▶ Can use special effects and transitions



Digital Video File Size Considerations

1 second of high-quality color video on $\frac{1}{4}$ of the computer screen = 1 MB file size

Determining file size

- **Frame rate:** lower the better (15 fps minimum)
- **Image size:** use smaller playback window
- **Color depth:** 8-bit vs. 16-bit vs. 24-bit color

Video Compression

Very high compression ratio is needed

- ▶ Loss-less compression: Not in practical use
- ▶ Lossy compression:
 - All methods for still image compression
plus
 - Color space compression
 - Inter-frame compression
 - Object-based compression

Video Compression

Color space compression

Widely used in video recorder / TV

Human eyes are less sensitive to color than luminance
(especially in motion images)

Based on that fact, convert color to
Luminance(Y) and
Chrominance(U,V) values

$$Y = 0.299R + 0.587G + 0.144B$$

$$U = (B - Y)$$

$$V = (R - Y)$$

Video Compression

► Color space compression

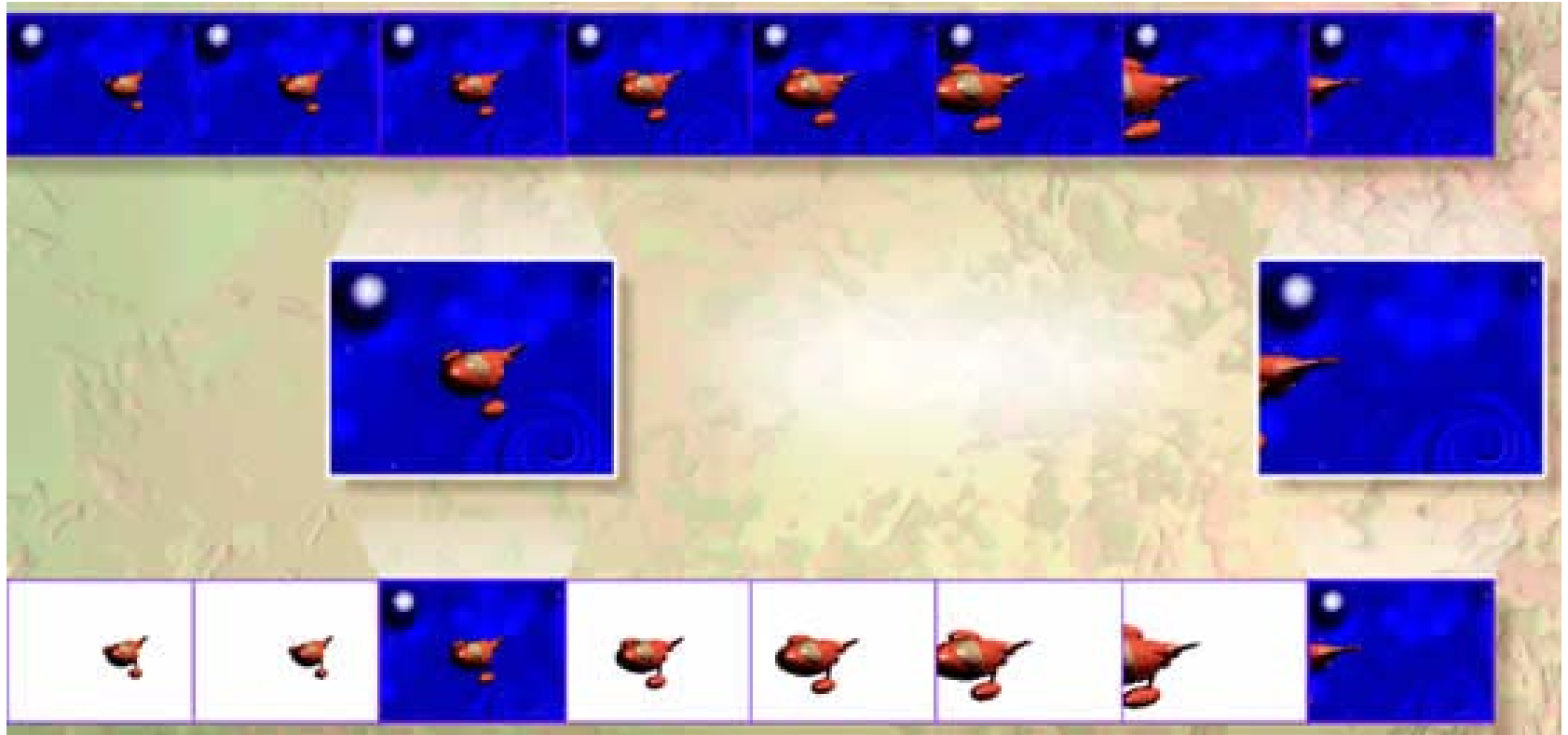
- YUV color space reduce the color information
 - $Y:U:V = 4:2:2$ (Used in TV)
(for every 4 samples of luminous information there are only 2 samples of color signals)
 - $Y:U:V = 4:1:1$ (JPEG)
 - $Y:U:V = 4:2:0$ (JPEG)

Video Compression

▶ Inter-frame compression

- compare each frame in the video with the previous one
- For similar frames copy content from the previous frame
- For frames with small modifications, take a copy from the previous frame and apply modifications(shift, rotate, lighten, or darken) (**Difference Coding**)
- Leads to problems if the video sequence needs to be edited
 - (if the original frame is simply cut out the following frames cannot be reconstructed properly)

Inter-frame compression



Video Compression

- ▶ Object-based compression
 - Decompose image into tree structure of objects
 - This is a kind of Vector Quantization (VQ)

Video Codec (COding-DECoding)

- Codec found in hardware such as Capture Cards and DV camcorders or in software
- Two types available:
 - Without inter-frame compression
 - With inter-frame compression

Codecs without inter-frame compression

- ▶ Capturing Codec
 - DV(Digital Video) in digital camera
- ▶ Editing Codec
 - Motion JPEG

Video Codec (COding-DECoding)

Codecs with HIGH inter-frame compression

▶ Media Distribution Codec (Wide bandwidth)

- Sorenson Video
 - VQ base, good quality
- MPEG1 / 2
 - DCT based, International Standard

▶ Web Codec (Narrow Bandwidth)

- RealVideo G2
 - Scalability, self adjustment
- MPEG4
 - Object based compression

Video File Formats

- ▶ .flv Flash Video File
- ▶ .mov Apple QuickTime Movie
- ▶ .mp4 MPEG-4 Video File
- ▶ .mpg MPEG Video File
- ▶ .rm Real Media File
- ▶ .wmv Windows Media Video File

Video File Formats

- ▶ Platform standard
 - AVI: Audio Video Interleave (Windows)
 - QuickTime: Macintosh/Windows
- ▶ International standard
 - MPEG1 / 2 / 4 –ISO

Streaming Formats

- ▶ WMV: Windows Media
- ▶ RM: Real Media