

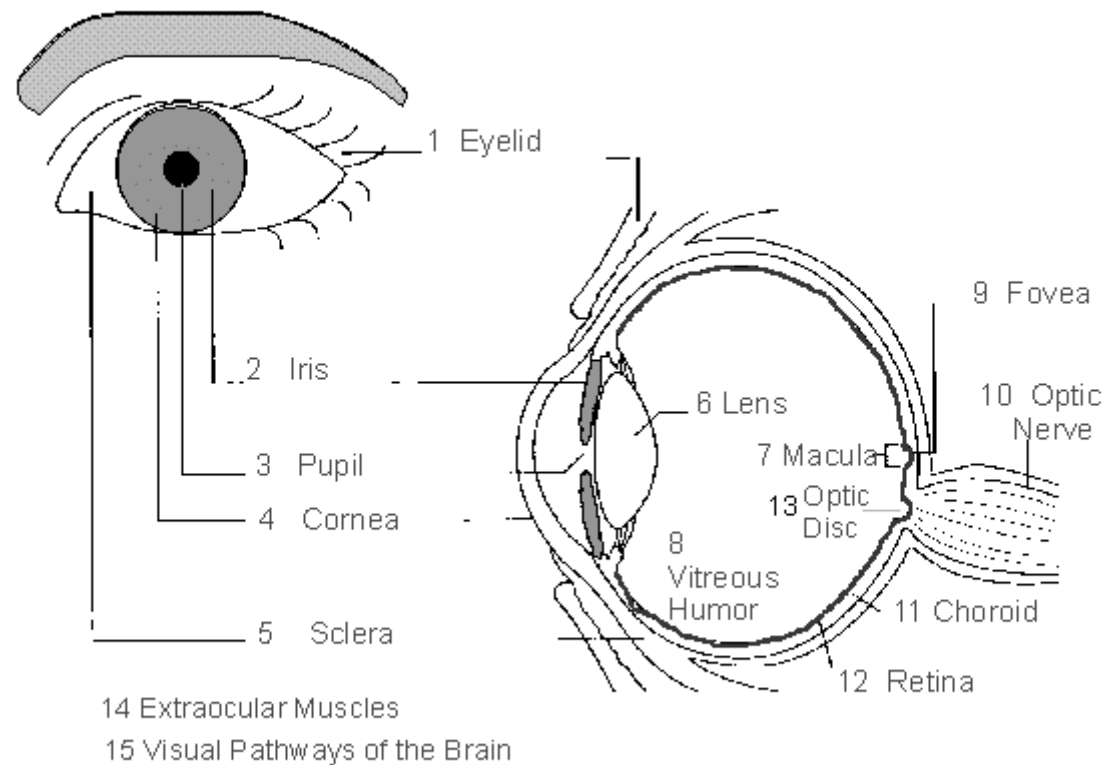
LECTURE 1 - Part 1

BASICS of ANALOG and DIGITAL VIDEO

- Analog Video
- Digital Video
- Digital Video Standards

ANALOG VIDEO

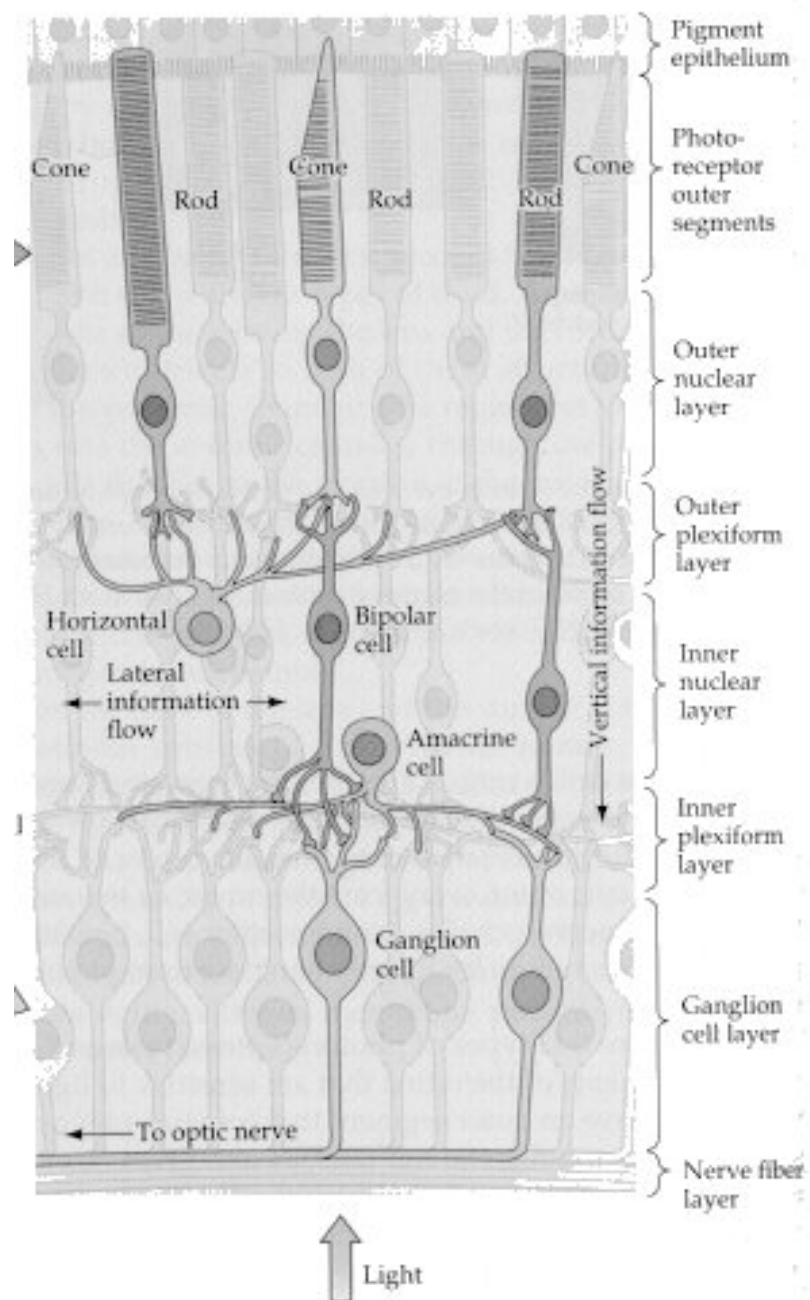
The physiology of vision

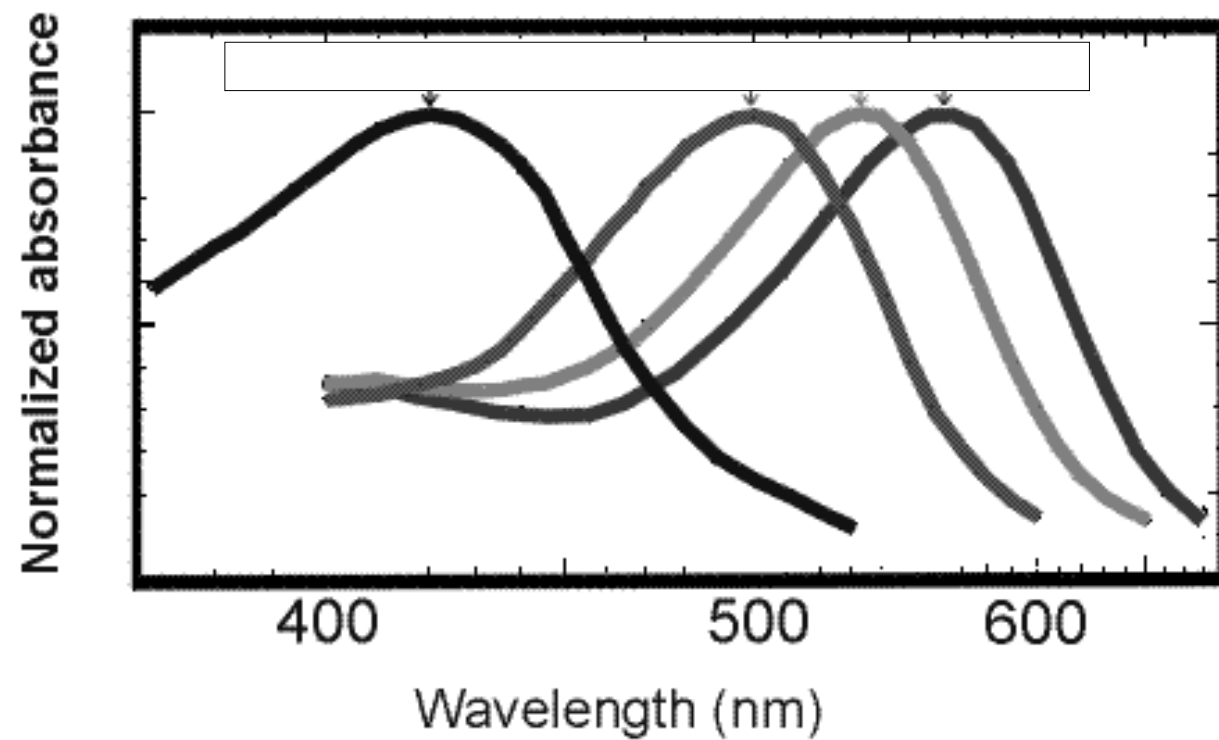


- The working principal of eye is very similar to that of a pinhole camera
 - The iris, acts the same way as a diaphragm by controlling the size of the pupil and adjusts the quantity of light that enters into the eye.
 - Behind the iris we find the crystalline lens which exactly acts like a camera's lens.
 - Information on the retina is a collection of points (about one million) that could be compared with the collection of points laying on a CCD array camera.

Rods and Cones

- They are the major light receptors. Over 125 millions of rods and cones for each eye
 - Rods: Very sensitive to light and motion. Most sensitive in the blue/green region. Highly convergent. Low spatial resolution.
 - Cones: Relatively insensitive to light intensity. Carry the color information (3 pigments). One-to-one convergence. High resolution.

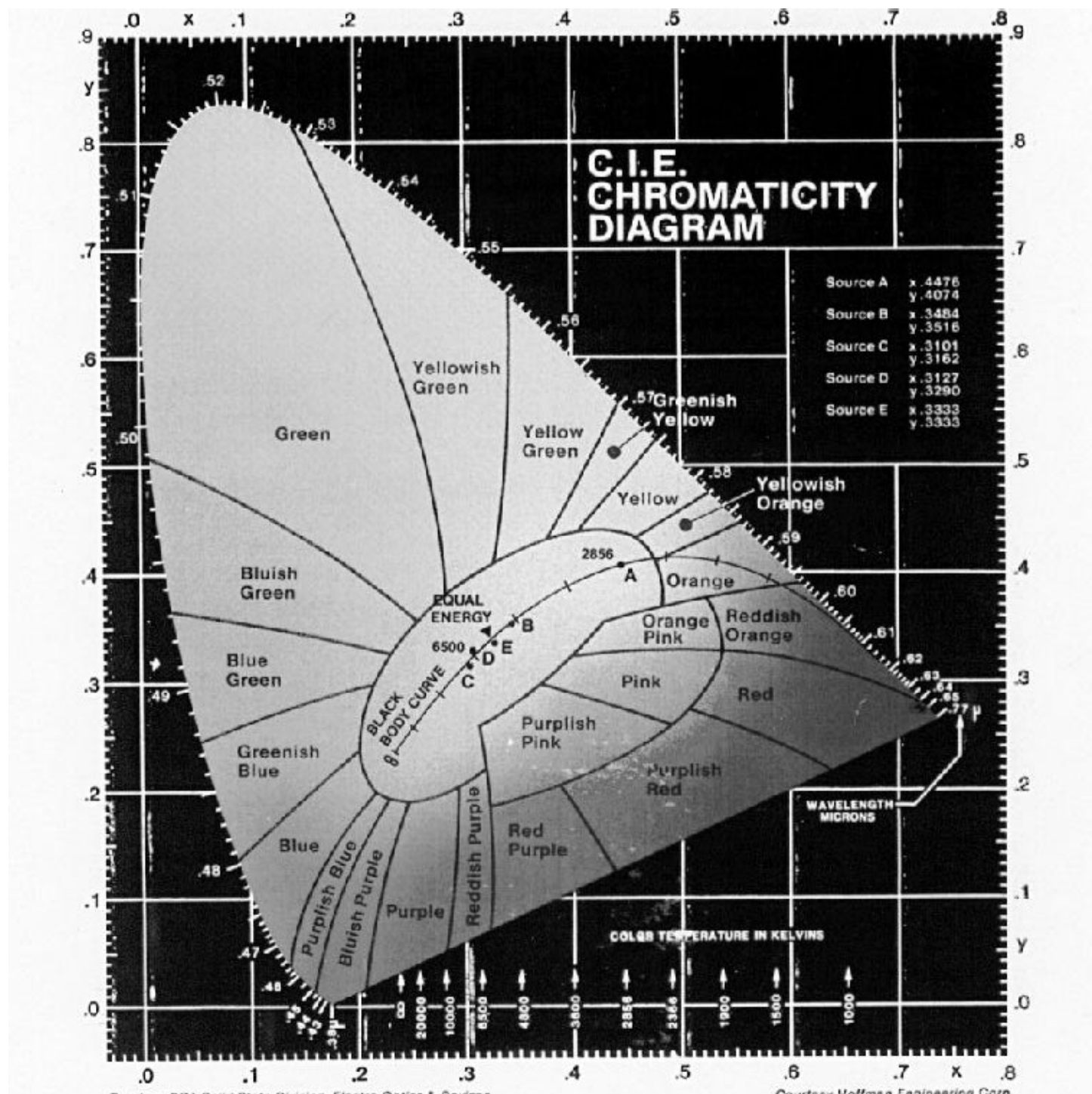




After Bowmaker & Dartnall, 1980

CIE Chromaticity diagram

- An attempt to quantify the trireceptor nature of human vision.
- Color perceptions are measured by giving subjects various combinations of 3 standard CIE primary colors and measuring their perception. These perceptions are plotted against an x-y diagram.



Hue, Saturation, Value

- Not easy to describe a color in R,G,B.
- H,S,V is more convenient since it models how human being visualizes color.
 - Hue: Specific individual pure color (described by dominant wavelength).
 - Value: How light or dark a color is related to gray scale (overall strength of light)
 - Saturation: The amount of pure hue in the color (ratio of dominant wavelength to others).

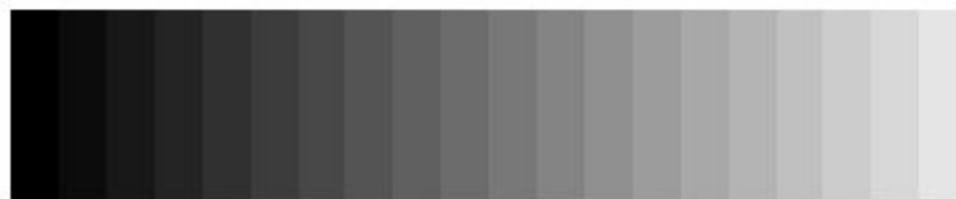
Hue Changes

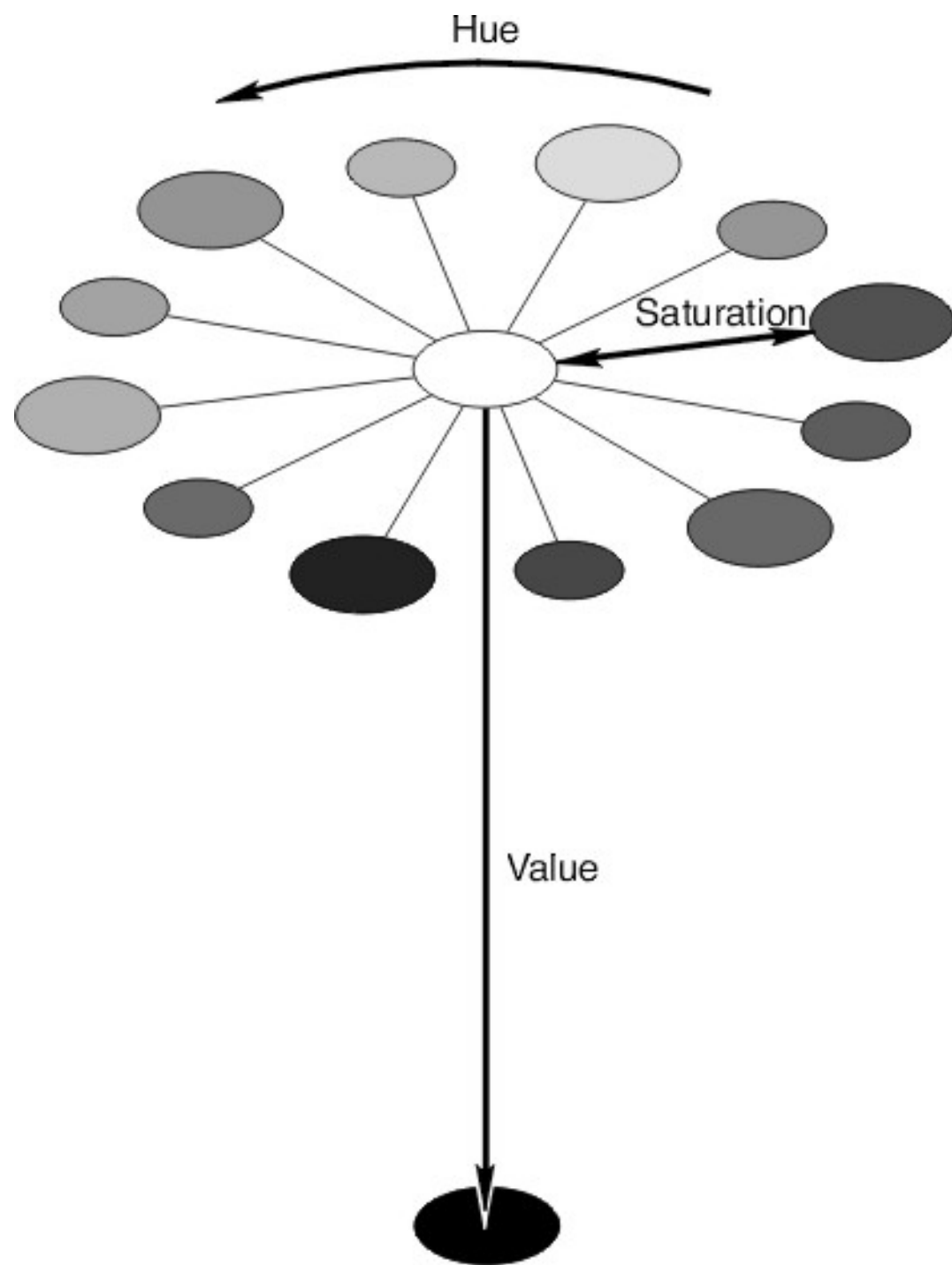


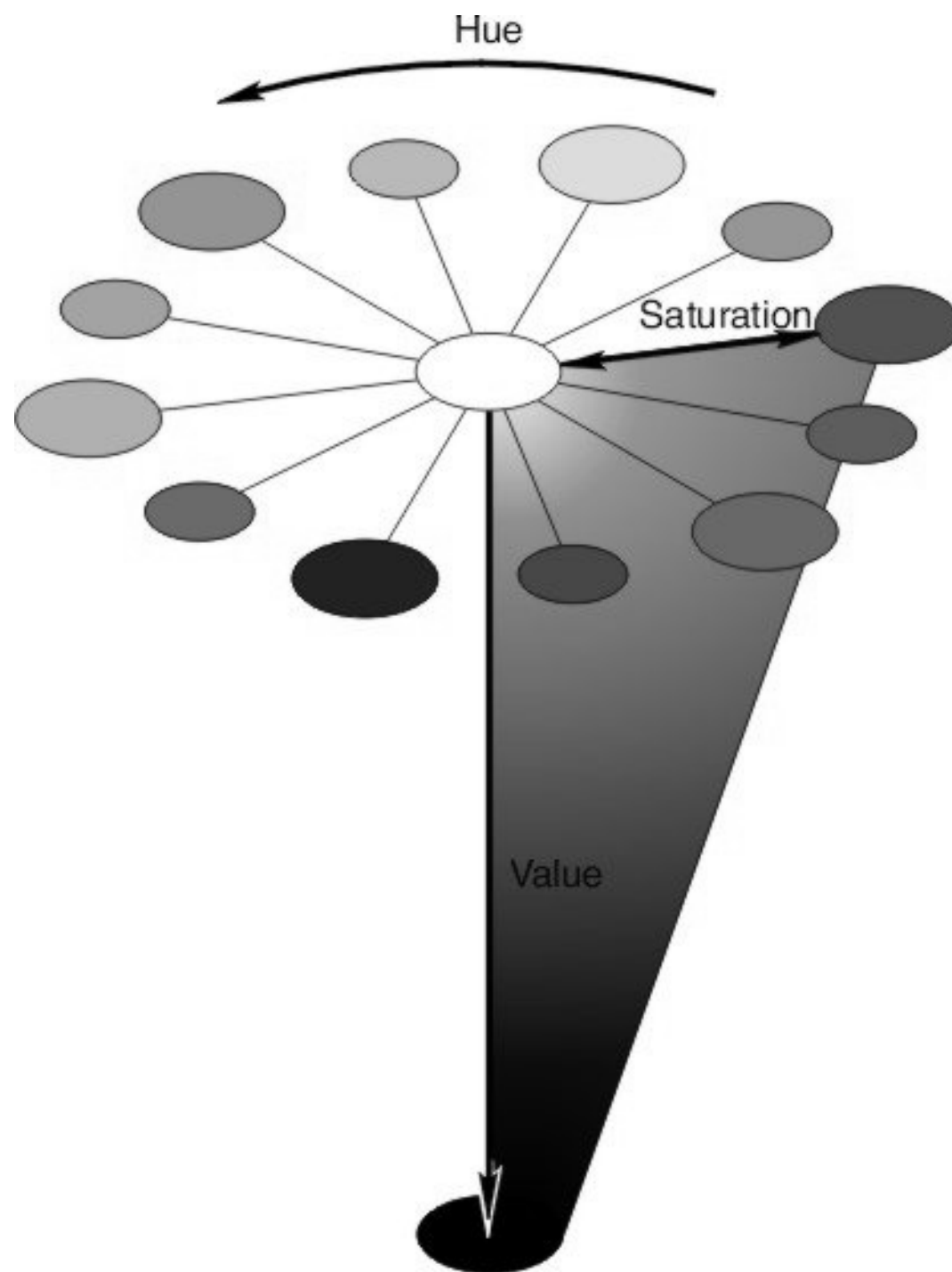
Saturation Changes



Brightness Changes



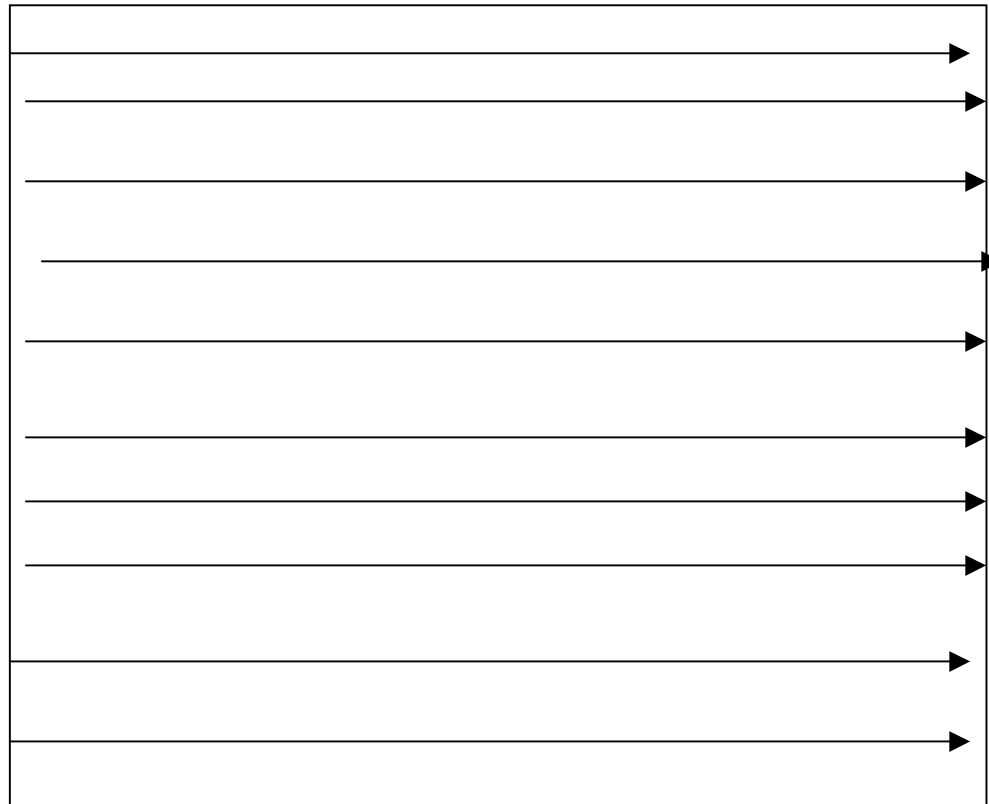




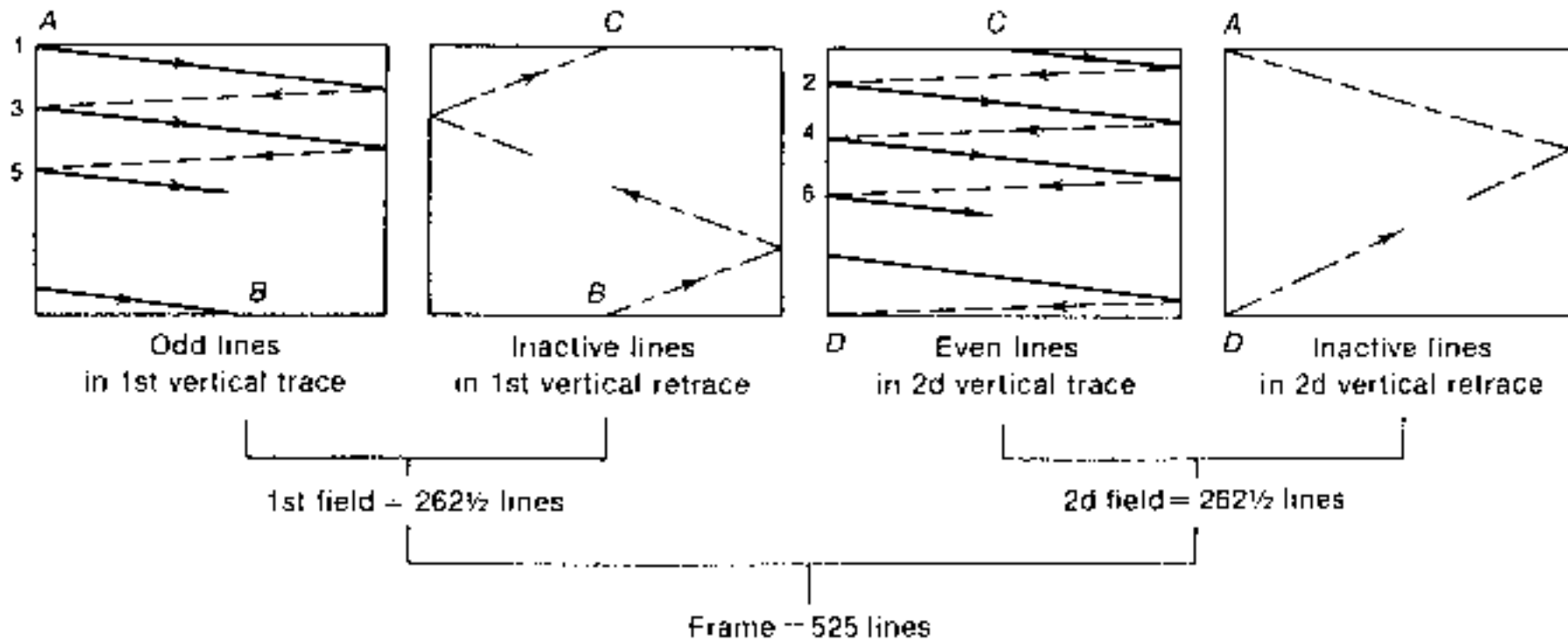
Persistence of vision

- Human eye retains image for a fraction of a second after it views it.
- Motion pictures : 24frames/sec
- PAL : 25 frames/sec
- NTSC : 30 frames/sec

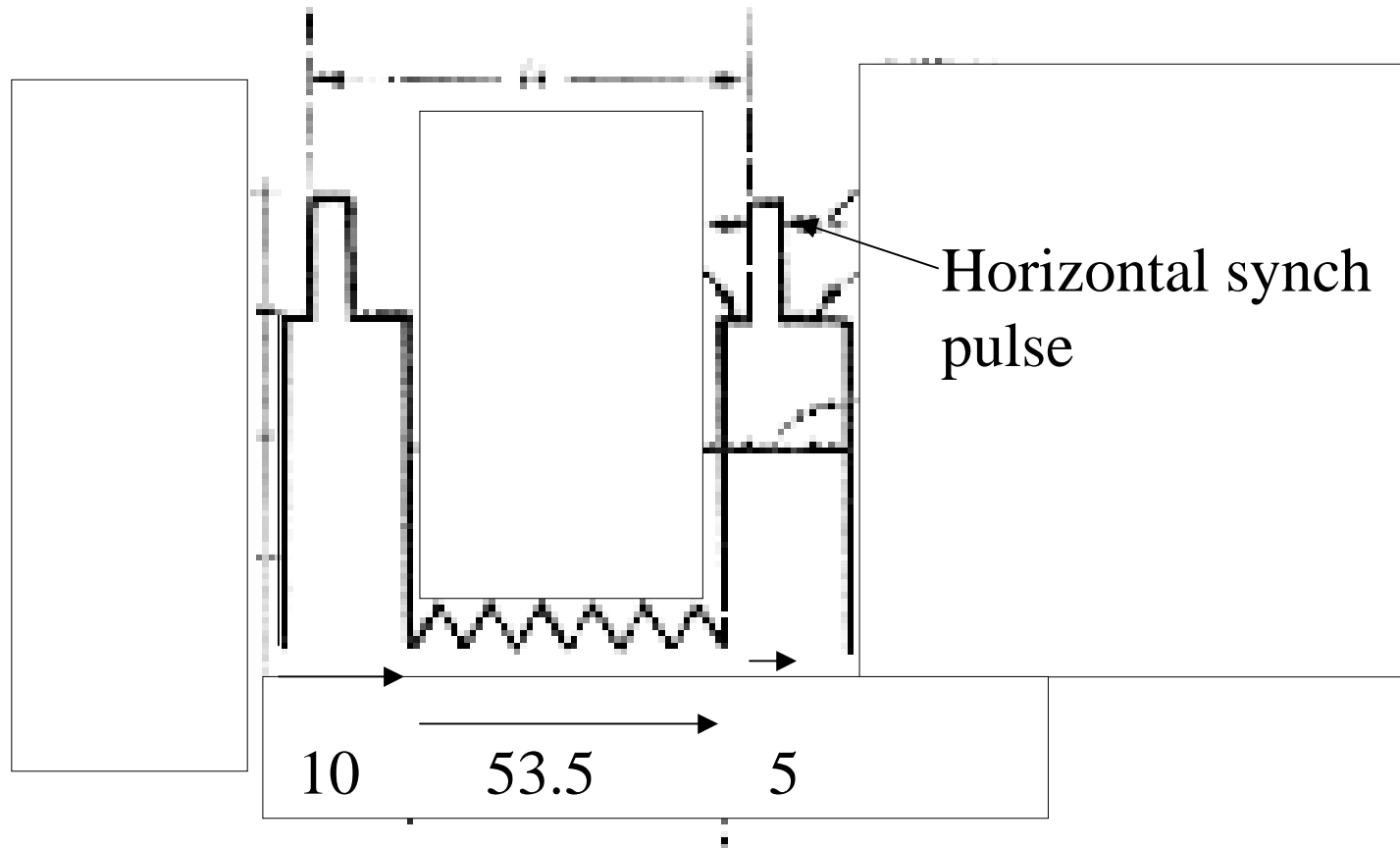
- To increase frame rate: Rotating shutters
- Scan the frame twice



Basic Black and White TV



Basic Black and White TV



ANALOG VIDEO

1-D analog video signal $f(t)$ contains both timing and intensity information

It is obtained by sampling a 3-D signal $s(x_1, x_2, t)$ in x_2 and t dimensions.

ANALOG VIDEO STANDARDS

Component analog video

RGB

YCrCb (YIQ or YUV)

Composite Video

NTSC, PAL, SECAM

S-Video

NTSC, PAL, SECAM

CAV

- Each primary is considered as separate

$$Y = 0.3R + 0.59G + 0.11B$$

$$Cr = R - Y$$

$$Cb = B - Y$$

Adv.: Best color reproduction

Disadv: More BW

CV

- NTSC (National Television Standards Committee)

525 lines/frame, 60 fields/sec, 4:3 aspect ratio

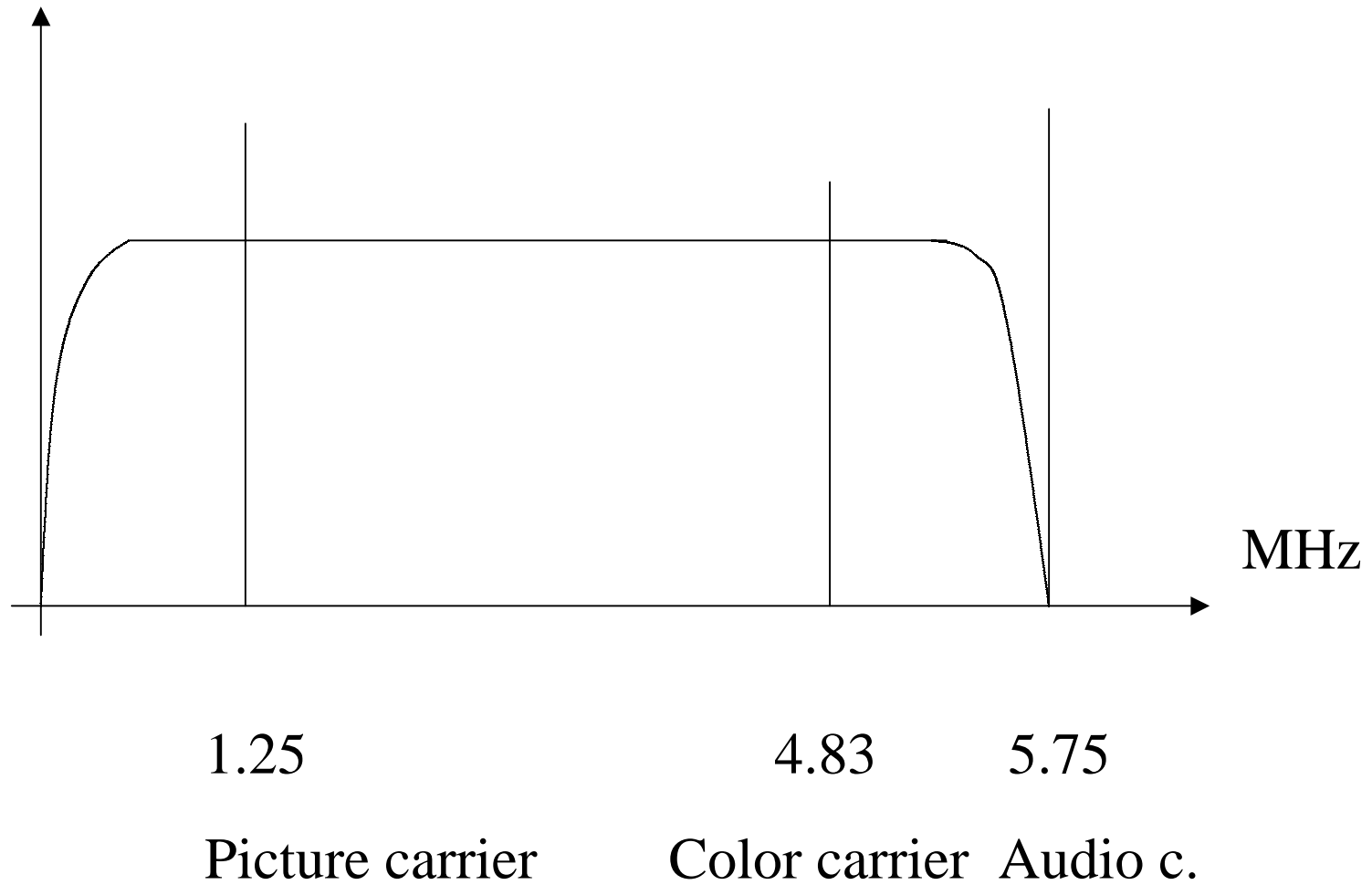
Horizontal sweep frequency: 15.75 KHz

Horizontal retrace : 10Msec

452 elements/line

BW : 4.2MHz - Total: 6 MHz

Basic NTSC TV



- PAL - SECAM

Phase Alternating Lines

Sequential Color and Memory

BW : 8 MHz

625 lines/frame

50 fields/sec

NTSC/525 Advantages

- Higher Frame Rate
- Less inherent picture noise

NTSC/525 Disadvantages

- Lower Number of Scan Lines
- Smaller Luminance Signal Bandwidth.
- Susceptability to Hue Fluctuation
- Lower Gamma Ratio
- Undesirable Automatic Features

PAL/625 Advantages

- Greater Number of Scan Lines
- Wider Luminance Signal Bandwidth
- Stable Hues
- Higher Gamma Ratio

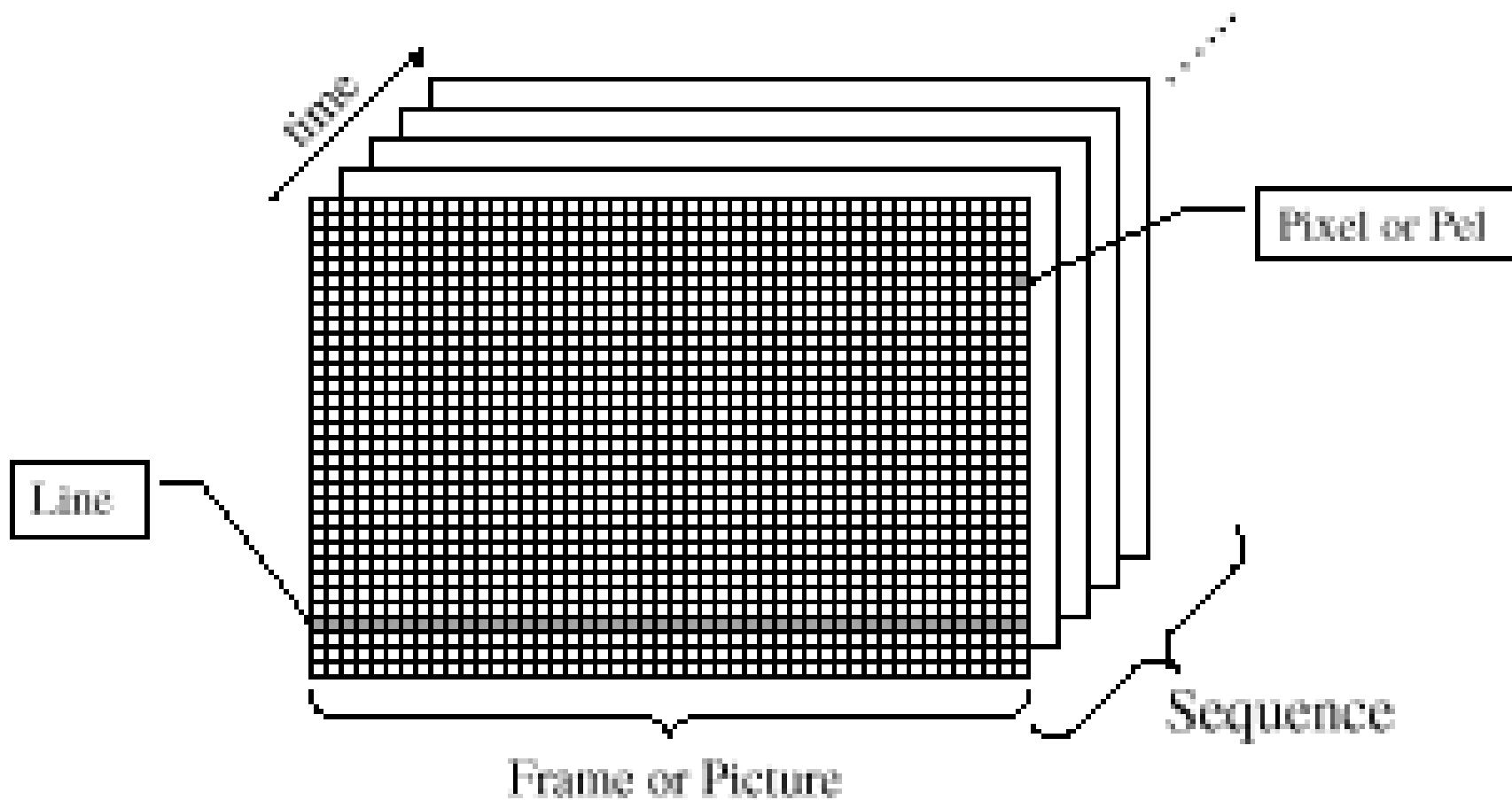
PAL/625 Disadvantages

- More Flicker
- Lower Signal to Noise Ratio
- Loss of Colour Editing Accuracy
- Variable Colour Saturation

DIGITAL VIDEO

- Digital data communication (computer networks, e-mail)
- Digital audio (CD players, digital telephony)
- Digital video

Images and video



Applications

- All Digital HDTV (20Mbits/sec)
- Multi-media (1.5 Mbits/s)
- Videoconferencing (384 kbits/s)
- Videophone (8-16Kbits/s)
- Medical imaging
- Education, military, traffic systems,...

Bottleneck

- HDTV - 1440x1050 lum
720x525 chrom
30 frames/s x 8 bits/pel/channel

545 Mbps

Bitrate requirements

- Conventional phone - 0.3 - 56kbits/s
- ISDN - 64-144 kbits/s
- T1 - 1.5 Mbits/s
- Ethernet - 10 Mbits/s

Compression is needed

- H.261
- MPEG1
- MPEG2
- MPEG4
- AVI
- Quicktime

Advantages

- Open architecture video systems
- Interactivity
- Variable-rate transmission on demand
- Easy sw conversion from one standard to another
- Integration
- Editing capabilities
- Robustness to channel noise and ease of encryption

Some digital video standards

- DV - acquisition format
- DVD - Uses MPEG2 (distribution)
- D1-D2 - recorder

Digital video processing

- Motion estimation
- Standards conversion
- Filtering
- Data compression