Video

Video

- Videre (lat.) - to see

- Electronic medium for the recording, copying, playback, broadcasting, and display of moving visual (and audio) media

- Digital video – digital representation of video
  - Sequence of digital images
  - Compression algorithms
  - (+ digital sound)

Temporal resolution

- Human perception system (eye+brain) can perceive about 10 - 12 images per second as separate images.

- Persistence of vision
  - Image „remains" in cortex for 1/25s
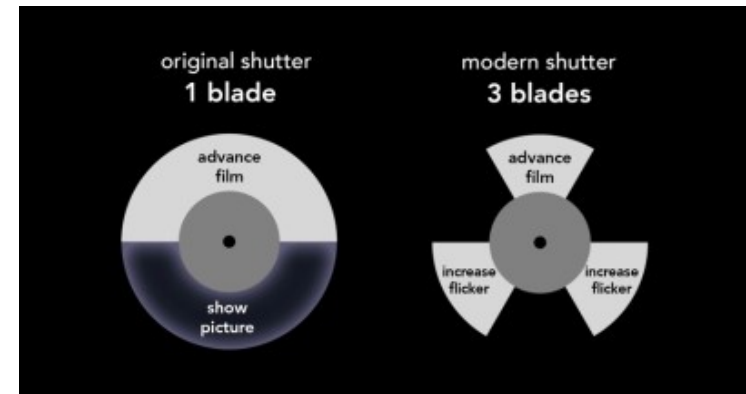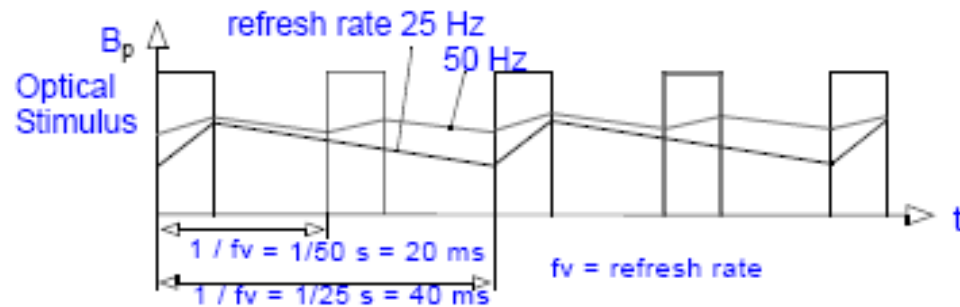 - Neuron saturation

Film projector

- For video illusion we need 16 images per second (FPS)
- ~1920: silent films use 20-26fps, 1930: 24fps

A lone battle against evil forces.

Why is the projection flickering?

Flickering

- Shutter closed during film movement
- High illumination change - flickering
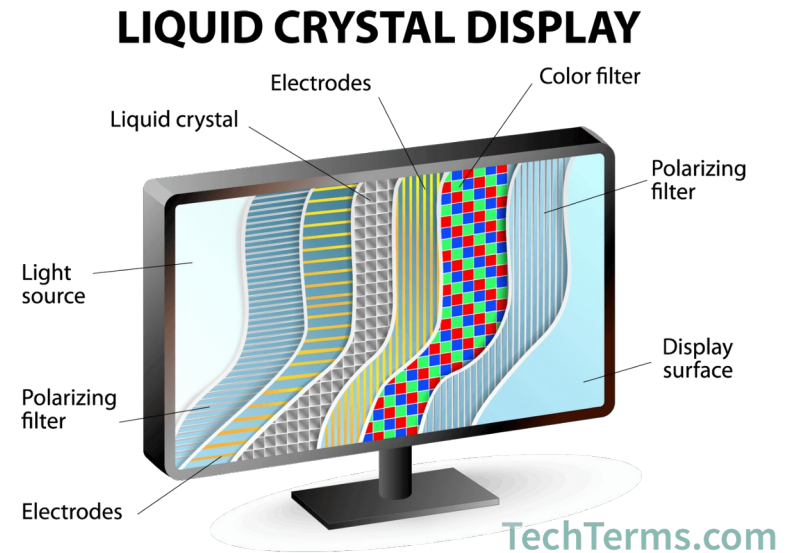- Darker display - higher shutter frame rate

Cathode displays

- Electron beam traversing matrix of fluorescent particles

- When a particle (pixel) is hit, it briefly glows

- To maintain realism, the beam has to refresh the screen fast enough (refresh frequency)

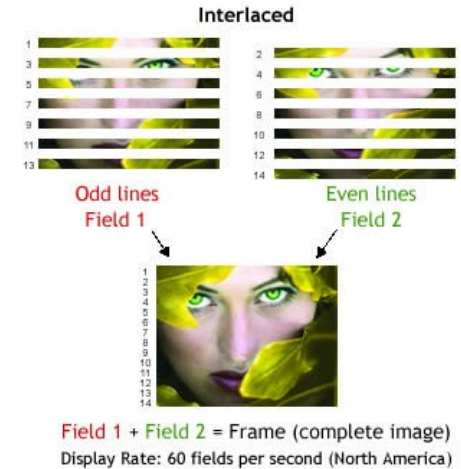- CRT monitors (<50Hz flickering) (~100Hz no flickering)
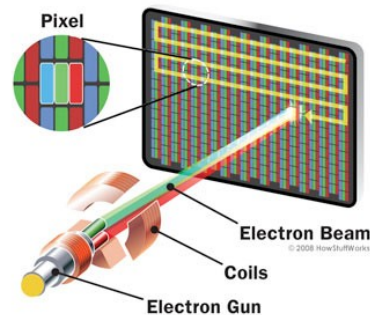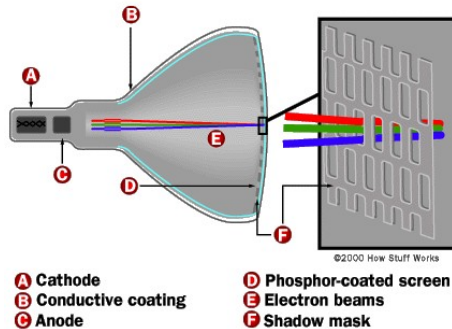
Flat panel displays

- Liquid crystal (LCD)

- Light-emitting diode (LED)

- Organic LED (OLED)

- (Plasma)

LIQUID CRYSTAL DISPLAY

Electrodes · Color filter · Liquid crystal · Polarizing filter · Light source · Display surface · Polarizing filter · Electrodes

TechTerms.com

Encoding rows

- Interlaced
  - Split image into two - odd and even lines
  - Reduce flickering on analog displays
  - Less space
  - Quick changes cause »combing« effect
- Progressive
  - Store each image separately
  - More space

Interlaced

Odd lines
Field 1

Even lines
Field 2

Field 1 + Field 2 = Frame (complete image)
Display Rate: 60 fields per second (North America)

Interlaced video example

(a)   (b)   (c)   (d)

(a) Image from video, (b) field 1, (c) field 2, (d) difference between 1 and 2

Encoding color

- Component video
  - Separate signals for color channels
  - Better image reproduction, no cross-talk
  - RGB, Digital video
- Composite video
  - Suitable for lower bandwidth
  - Luminosity and color mixed in common signal
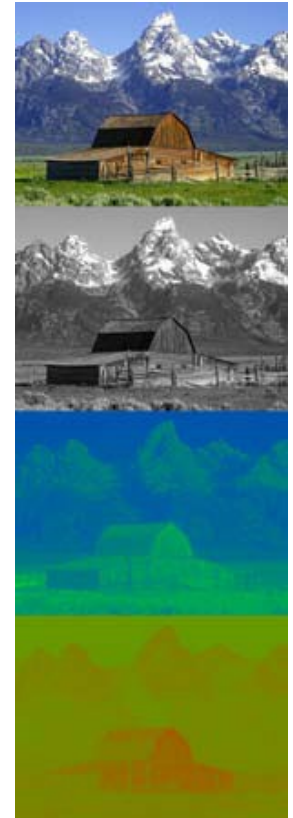 - Channel cross-talk
  - Analog TV: NTSC, PAL, SECAM

Color coding

- De-correlated luminosity and color
- YUV, YIQ, YCrCb
  - Y is illumination
  - UV/IQ/CrCb are chroma components
- Conversion from RGB to YUV :
  - $Y=0.229R+0.587G+0.114B$
  - $U=0.492(B-Y)$
 - $V=0.877(R-Y)$
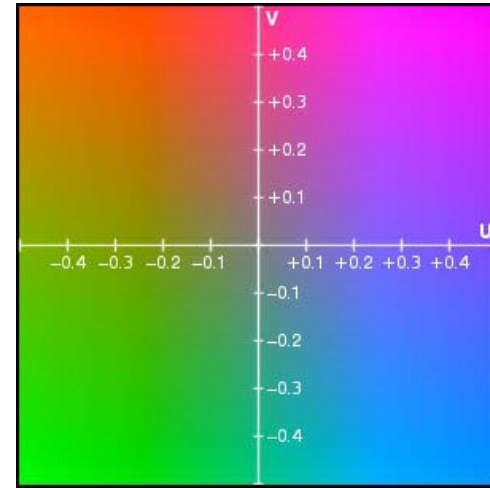
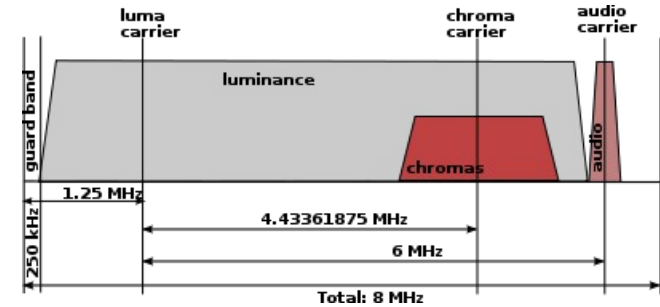UV plane Y=0.5

Color sub-sampling

- Humans are more sensitive to changes in illumination than in color
- Color can be sub-sampled - reduce size
- How many chroma values are actually retained
    - J: horizontal sampling frequency (region width, e.g. 4)
    - a: number of chroma samples (Cr, Cb) in the first line of J pixels
    - b: number of additional chroma samples in the second line of J pixels
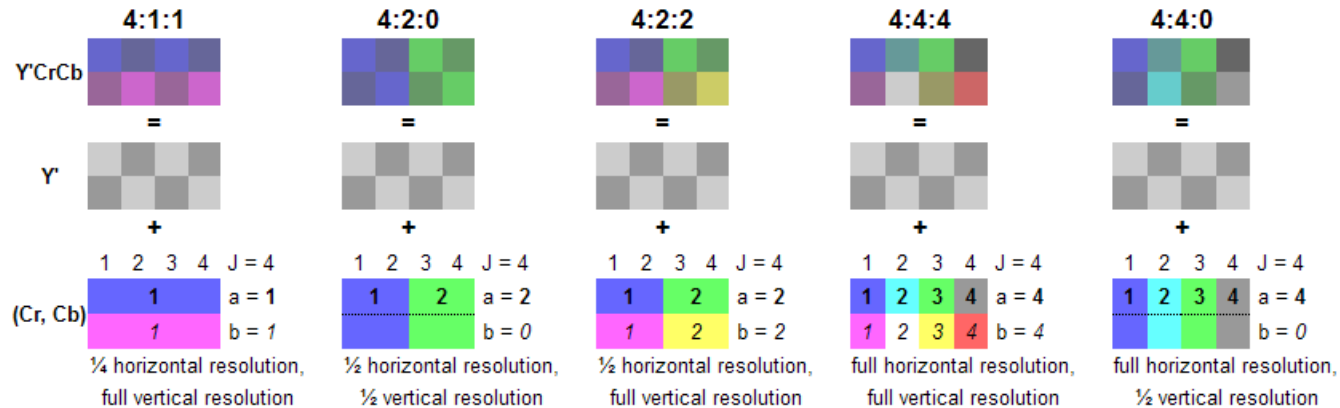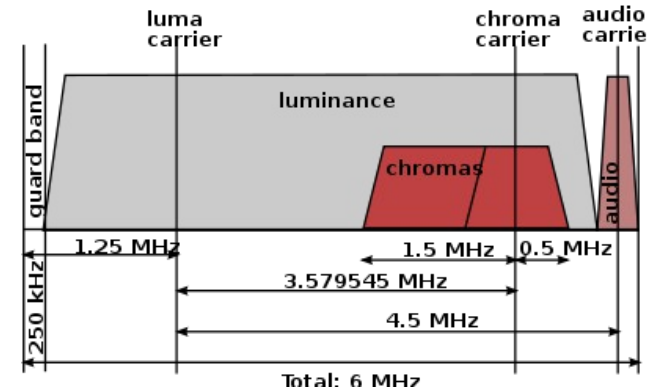
Analog television

- PAL
  - Phase Alternating Line
  - 625 lines per image
  - 25fps, aspect ratio 4:3, interlaced
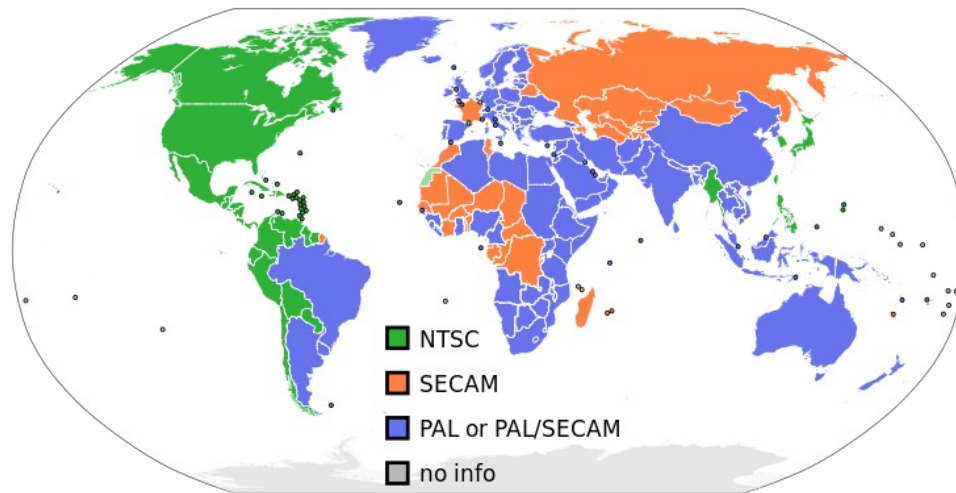 - YUV color space
- NTSC
  - Used in North America
  - YIQ color space
  - 525 lines (29.97fps), interlaced
  - Problems with NTSC: color tone shift due to geography and weather
  - To reduce channel cross-talk the chroma phase is alternating

Analog television formats

| TV standard	FPS	# lines	Frequency band (MHz)	Channel allocation (MHz)		
				Y	I or U	Q or V
NTSC	29.97	525	6.0	4.2	1.6	0.6
PAL	25	625	8.0	5.5	1.8	1.8
SECAM	25	625	8.0	6.0	2.0	2.0

Digital video

- Storing on digital devices

- Direct manipulation (denoising, cutting, etc.)

- Inclusion in multimedia applications

- Direct access to different parts of videos

- Copying does not degrade quality

- Easier decoding, better noise tolerance
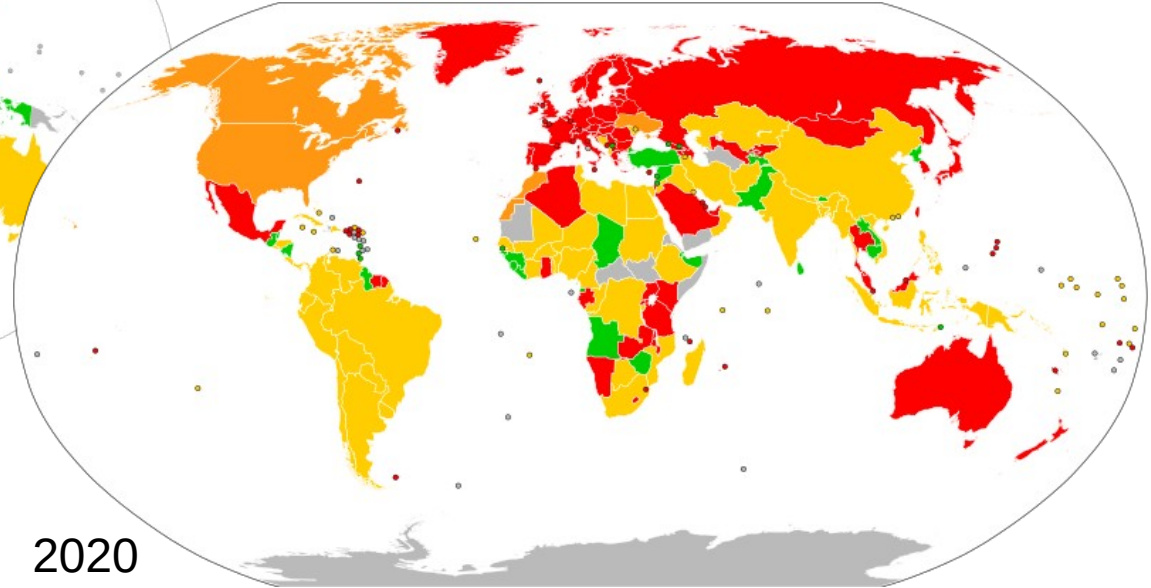
Digital terrestrial television (DTT)

Standards: DVB-T, ATSC, ISDB-T, DTMB

DVB-T
ATSC
ISDB-T
DTMB
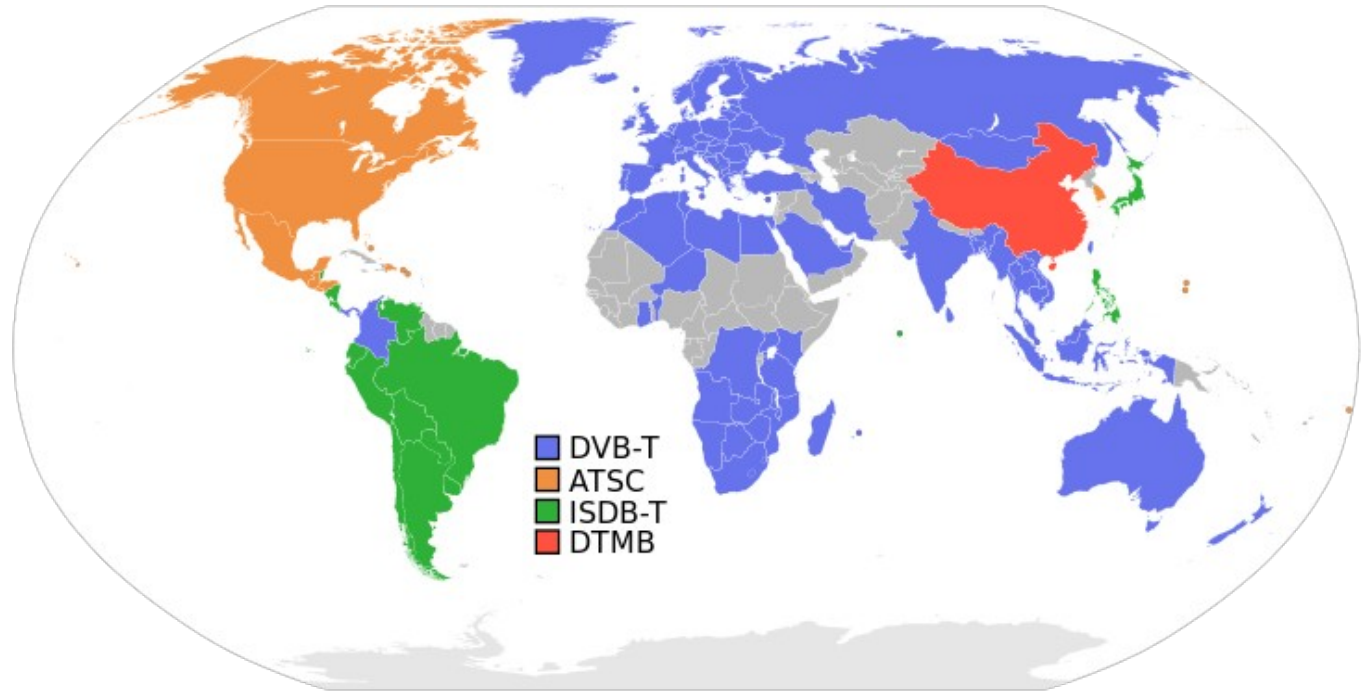
Transition to digital television
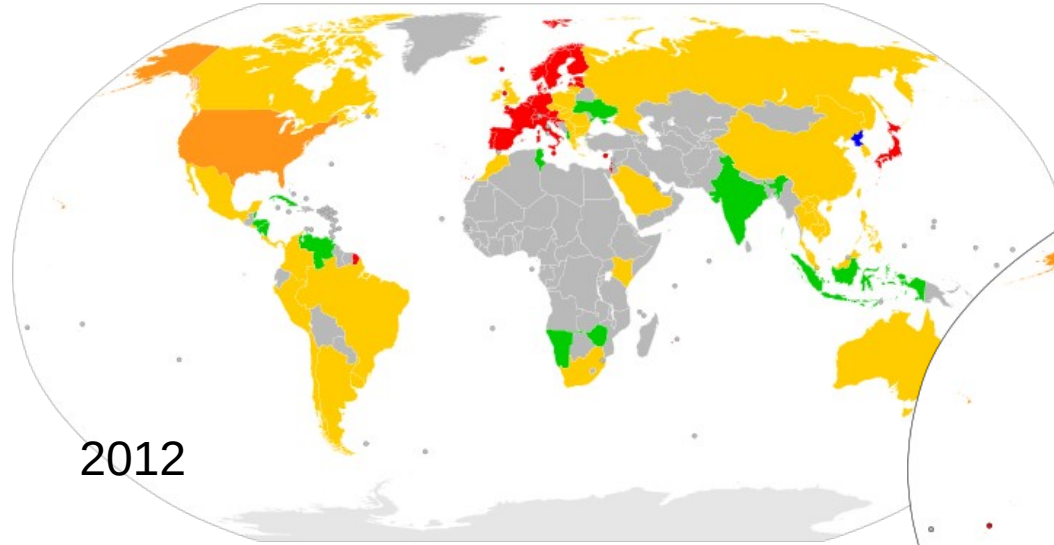
2012

2020

Transition completed, all analog signals terminated

Transition completed for full-power signals only; LPTV stations still being broadcast in analog

Transition in progress, broadcasting both analog and digital signals

Transition not yet started, broadcasting analog signals only

Does not intend to transition, broadcasting analog signals only

No information available

HDTV

- High resolution digital television
- Increase width of viewing angle
- First generation Sony (1970) - analog
- Standard for digital television
  - Advanced Television Systems Committee (ATSC)
  - Codec MPEG-2 for video compression
  - Resolution 1920×1080 (progressive)
  - Enables progressive and interleaved encoding (progressive default)
 - Aspect ration 16:9 (anamorphic)

3D video

- Stereoscopic photography
  - Two images at two positions (50 mm to 75 mm apart)
  - Impression of a third dimension
- Video technology
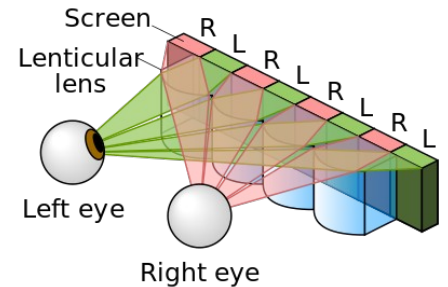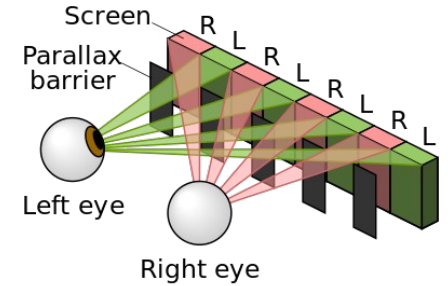 - Wearable technology
  - Autostereoscopy

Wearable 3D video technology

- Anaglyph glasses (passive)
- Polarized glasses (passive)
- Binocular HMD (active)
- Active shutter glasses (active)

Polarizing 3D Glasses
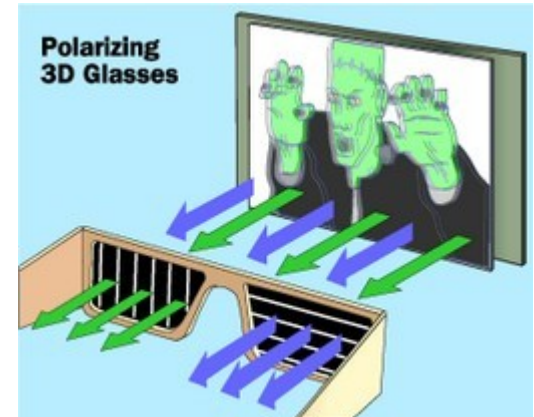
Autostereoscopy (Glassesless 3D)

- Eye/head tracking (active)

- Parallax barrier (passive)

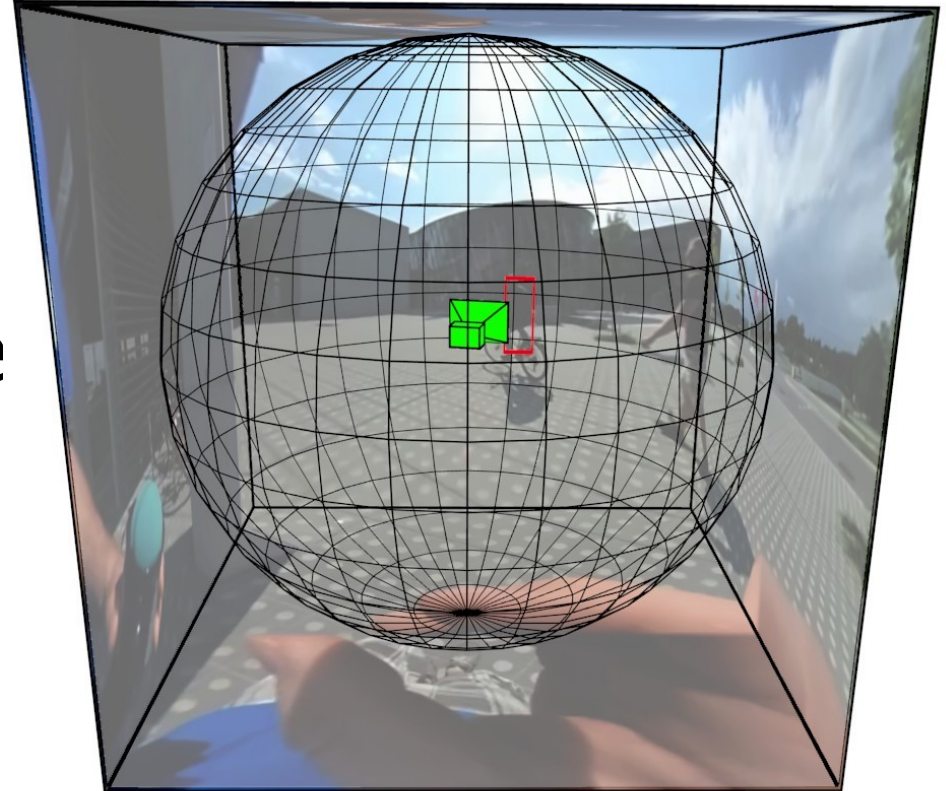- Lenticular lens (passive)

Author: Cmglee

Problems with 3D video

- Technology
  - Resolution
  - Frame rate
  - Cross-talk
- Usefulness
  - Limited value

- Cost
- Health
  - Motion sickness
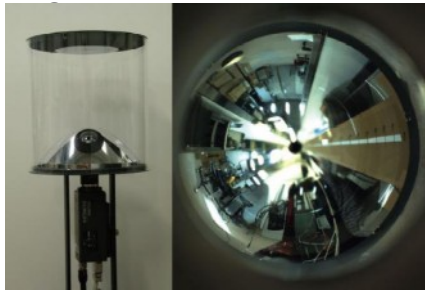 - Headaches
  - Nausea
  - Disorientation

Omnidirectional video

- Single camera origin

- Projection sphere

- Interactive experience
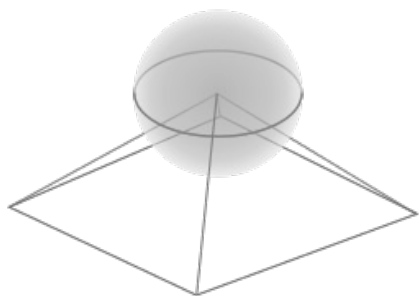
Omnidirectional video acquisition

- Catadioptric camera
- Multi-camera
  - Wide-lens (less cameras, low resolution)
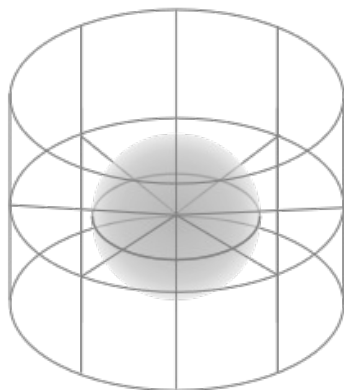 - Narrow-lens (more cameras, high resolution)

- Calibration (factory, post-processing)
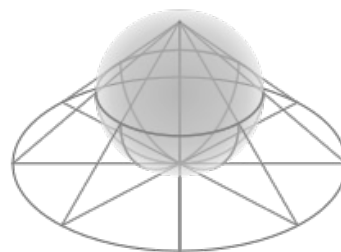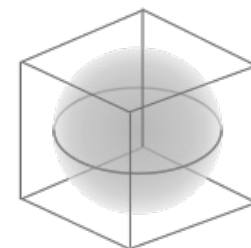
Re-projection approaches

Flat   Equirectangular   Stereograph   Cubemap
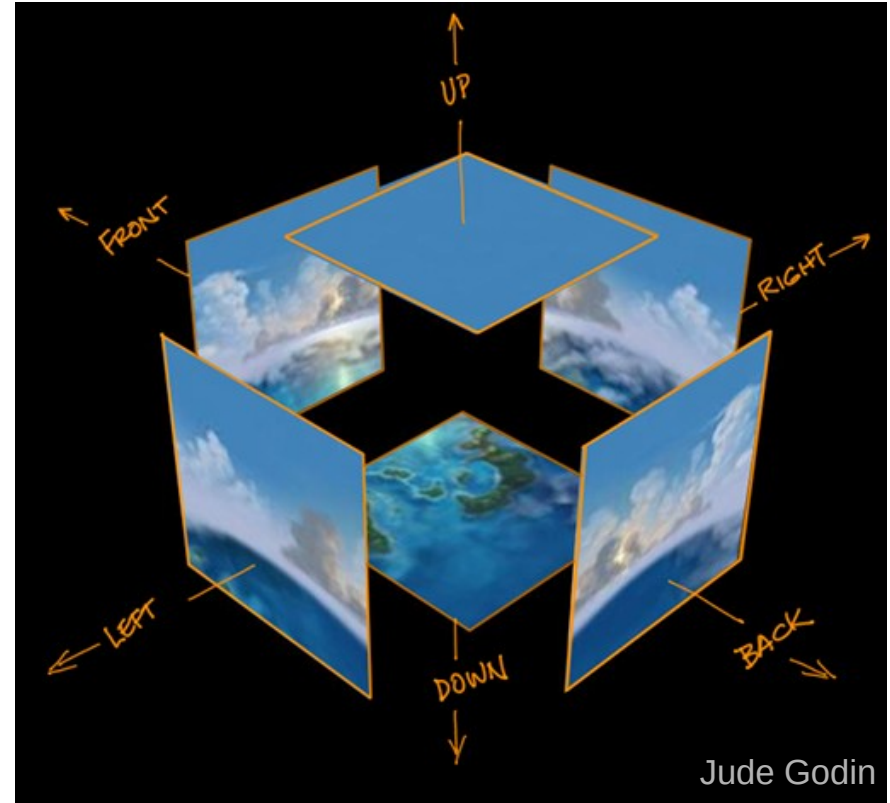
View generation

- Rendering
  - UV mapping
  - Cubemap

- Limitation
  - View angle
  - Resolution

Jude Godin

Conclusion

- Interest
  - USA, 2016 - 90% think 360° video improves experience

- Use cases
  - Panoramas (aesthetic)
  - Live entertainment - BBC
  - Sports and tourism
  - Consumer-created (travel)

BBC

BBC