3D viewing and VR applications

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Outline

› Visual depth perception

› Creating a 3D viewing experience

› VR Applications

Depth perception – monocular cues

› Static
  › Prior knowledge
  › Perspective
  › Texture gradient
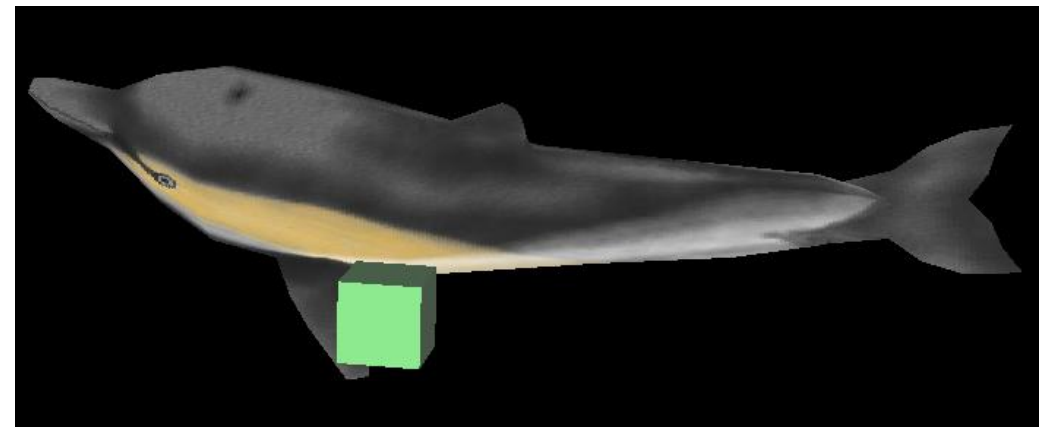 › Position relative to horizon
  › Accommodation
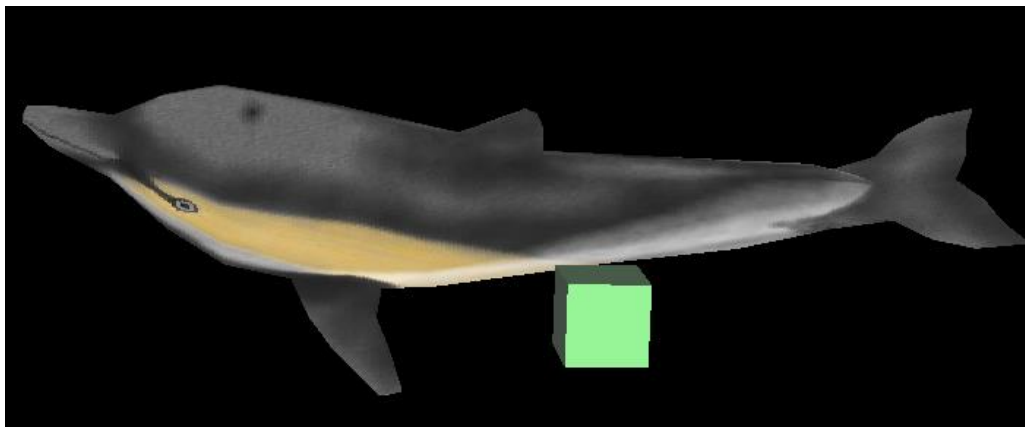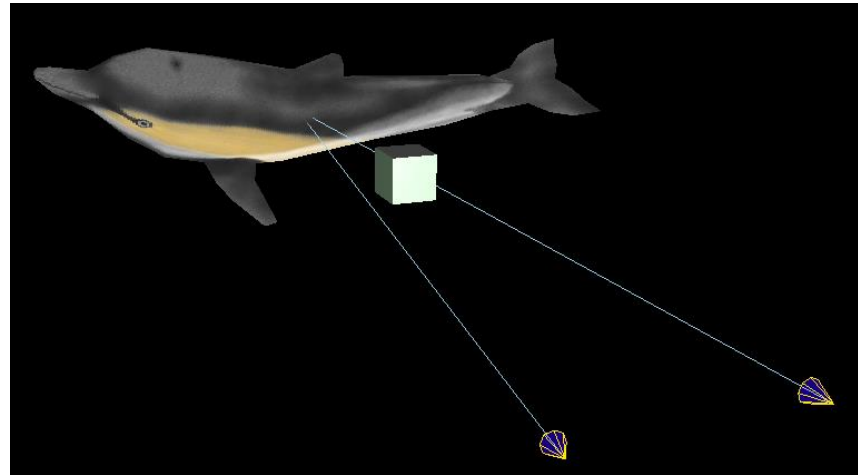
› Motion based
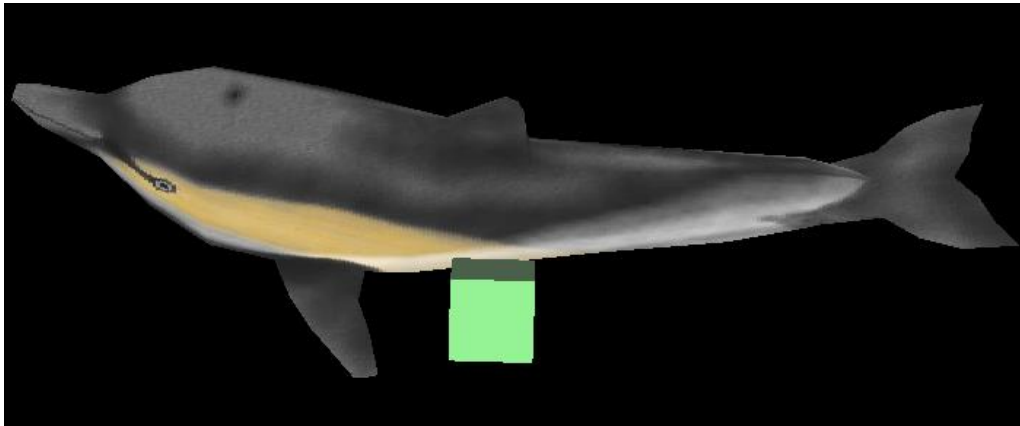 › Motion Parallax
  › Optical Expansion
  › Kinetic depth effect

Depth perception – stereopsis
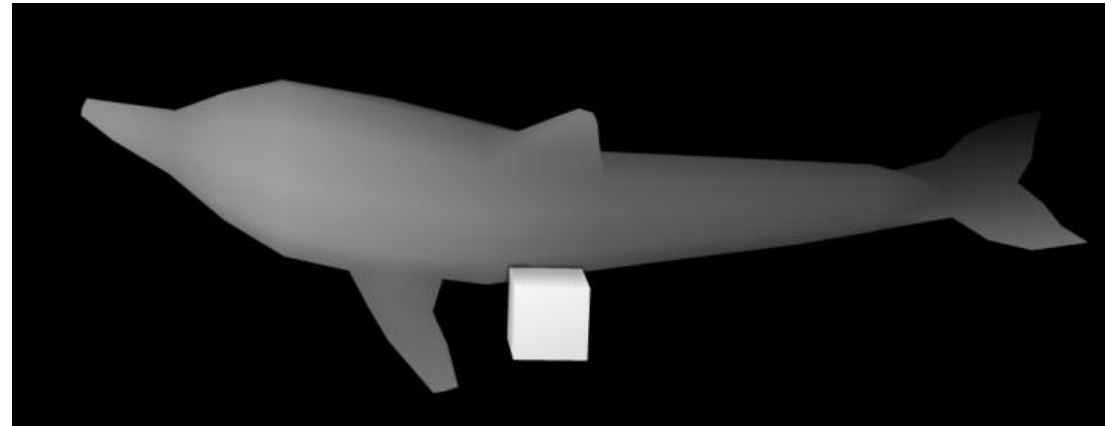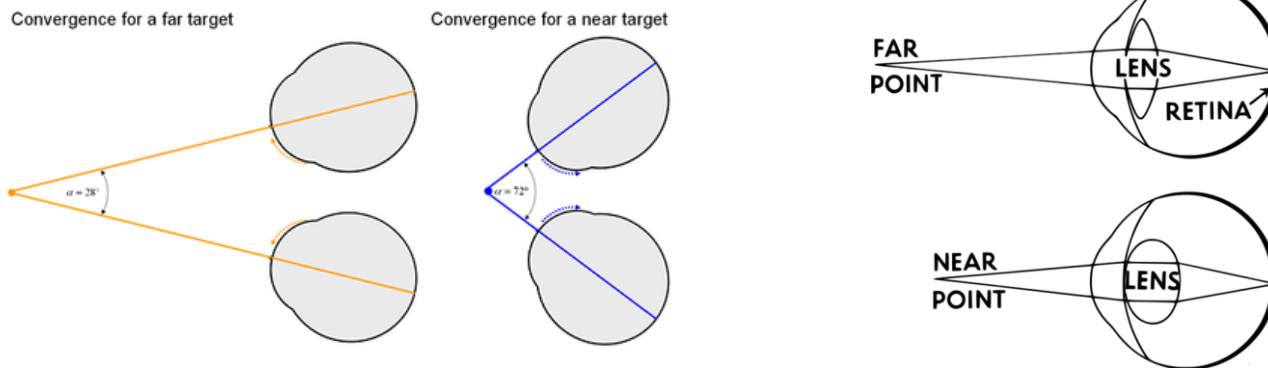
Depth perception – stereopsis

Cyclopean Image

Depth Map

Creating a "3D feel" using a 2D screen

› Good graphics handle the monocular cues we're used to (if not filming/ photographing).

› For stereopsis, present a different image to each eye!
  - **Stereoscopy**

› Remaining problem: accommodation - vergence conflict

Convergence for a far target   Convergence for a near target

FAR POINT   LENS   RETINA

NEAR POINT   LENS

Stereoscopy methods – side by side images
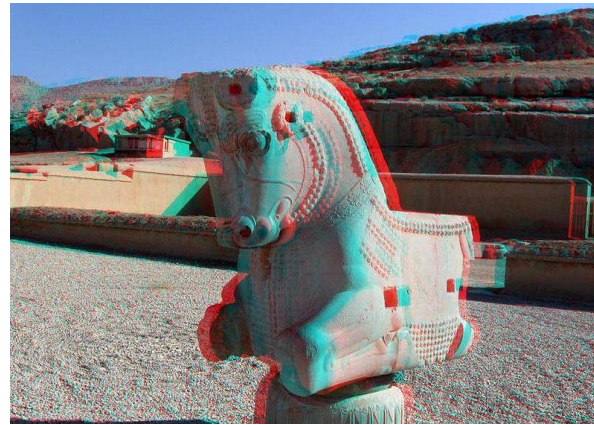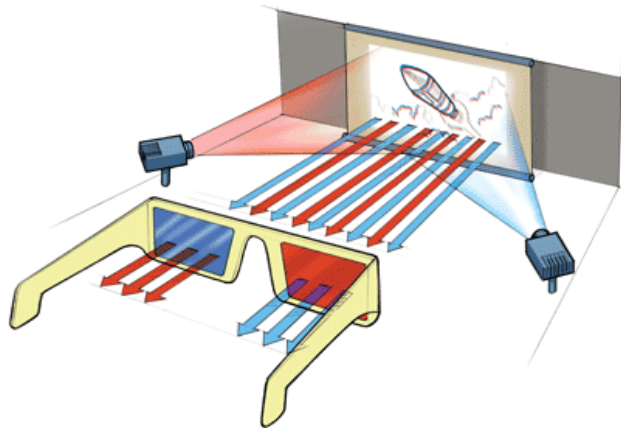
› Viewed with stereoscope.

› Available from mid 19th century.
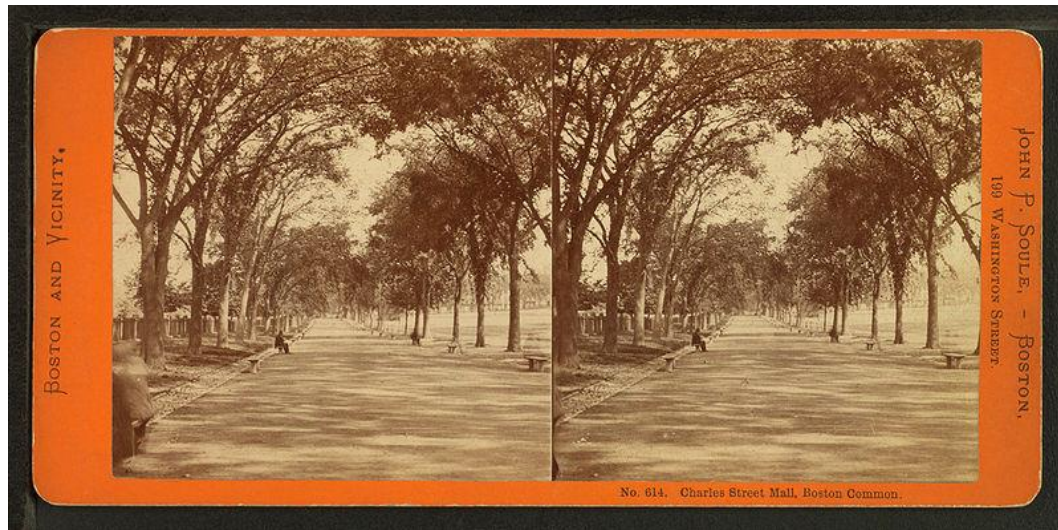
Stereoscopy methods – anaglyph 3D

› Encode each eye's image using a different color.

› Use different filter for each eye.

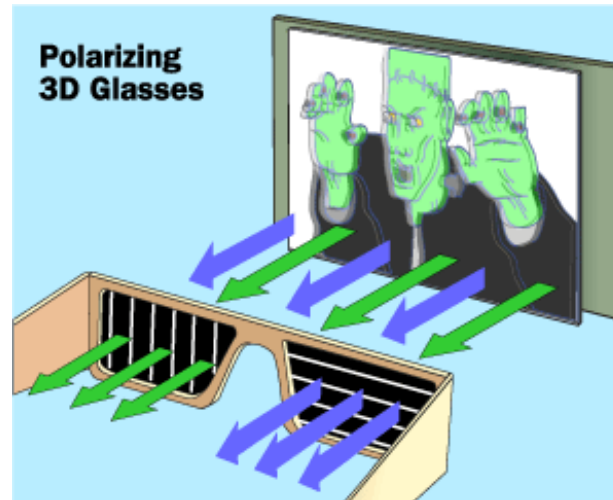› Images appeared in mid 19th century, film in early 20th

› Cheap to view but colors can be distorted.

Stereoscopy methods – more glasses

› **Polarization** instead of color filtering
  › Special display/projector but glasses are simple and cheap
  › Possible issues: head tilting, resolution

Stereoscopy methods – more glasses

› **Active shutter** system – present image for one eye at a time and block the other eye.
  › Better 3D quality but more expensive and possibly uncomfortable.
  › Synchronization is needed.
  › Framerate effectively halved.
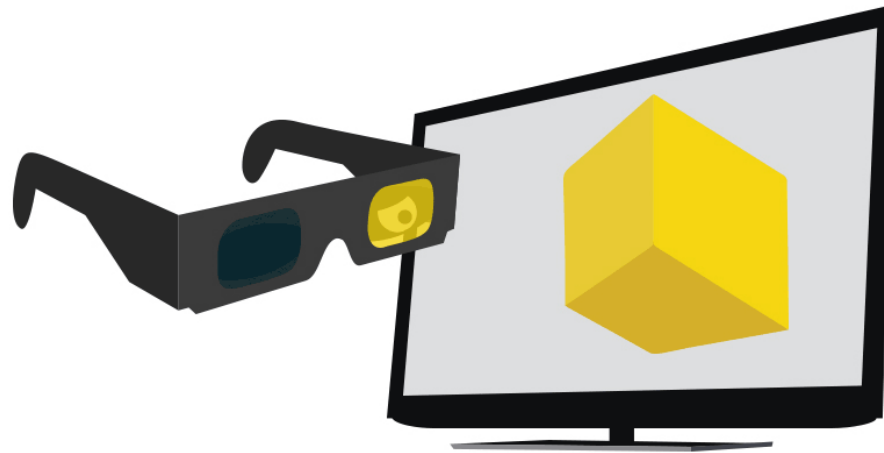
Stereoscopy methods – head mounted display

› Separate display and lens for each eye

› Lenses need to fill up field of view and make the screen look far away

› Software corrections

› Motion tracking
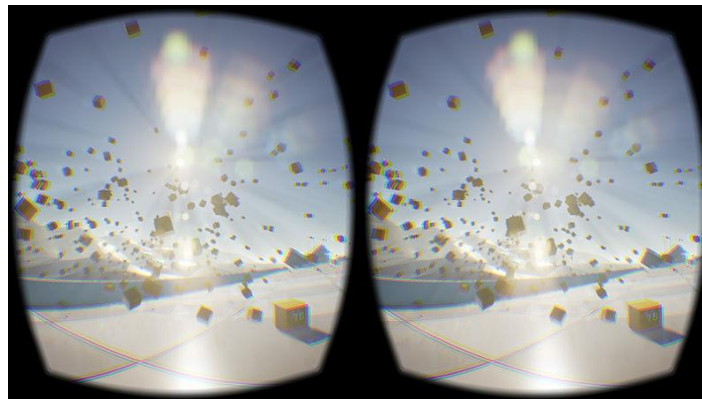
VR applications in manufacturing

› Virtual prototyping

› Production line/workflow evaluation

› Customer presentation

› Operator training

https://www.youtube.com/watch?v=IcmX_XtmZHg

VR applications in manufacturing

Hospital design

VR applications in manufacturing

› Ergonomic evaluation - https://www.youtube.com/watch?v=dRq1nh5P1Fg

   › Safety

› CAD in VR - https://www.youtube.com/watch?v=2Ccst01uQzw

› …

Thank you

Hope you slept comfortably ☺

Figure References

› Motion parallax - https://en.wikipedia.org/wiki/Parallax#/media/File:Parallax.gif

› Kinetic depth effect - https://commons.wikimedia.org/wiki/File:Spinning_Dancer.gif

› Stereopsis - https://en.wikipedia.org/wiki/Stereopsis#Geometrical_basis

› Convergence - http://cse.csusb.edu/tongyu/courses/cs621/notes/3dmovies.php

› Stereoscope - https://commons.wikimedia.org/w/index.php?curid=48038451

› Anaglyph and polarization 3D glasses - http://science.howstuffworks.com/3-d-glasses2.htm

› Active shutter glasses - https://en.wikipedia.org/wiki/File:Active-3d-shutter-technology.gif

› Head mounted dispay - https://en.wikipedia.org/wiki/File:Sample_screen_capture_of_Oculus_rift_development_kit_2_screen_buffer.jpg

› Doctors without borders hospital - https://3dprint.com/128695/msf-virtual-reality-3d-printing/