Editing historical stereoscopic photographs

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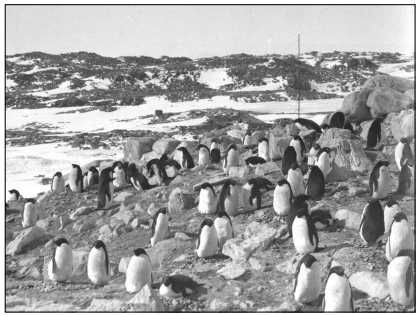
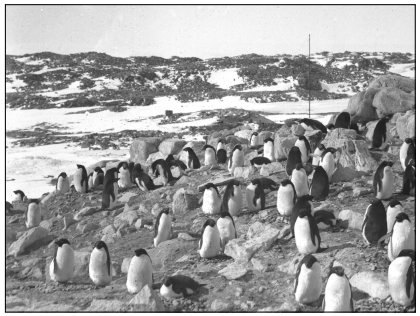
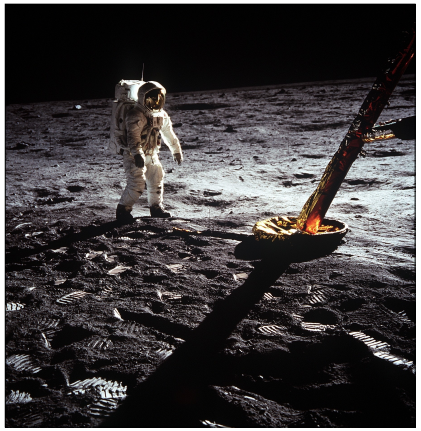
- Examples…

Paul Bourke, March 2023
Slides: http://paulbourke.net/stereographics/stereo2023/



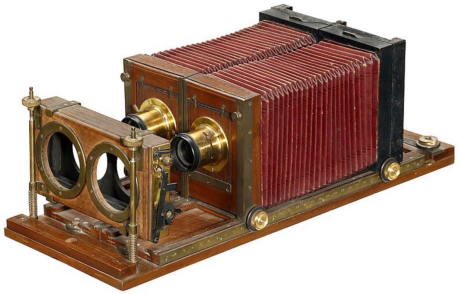




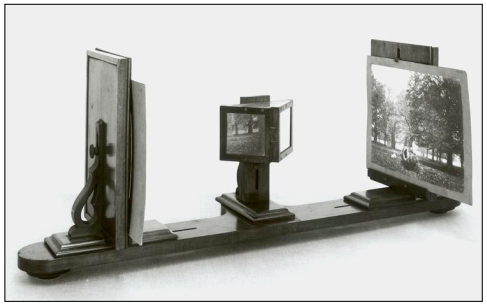
Cameras

1864

2022



Viewers



Sir Charles Wheatstone stereoscope

1850

VIVE VR headset

2022

Brewster stereoscope

1870

Google cardboard

2014

Take home message: head mounted display vs screen base viewing

There are differences between creating stereoscopic content for a head mounted display vs a screen based presentation.

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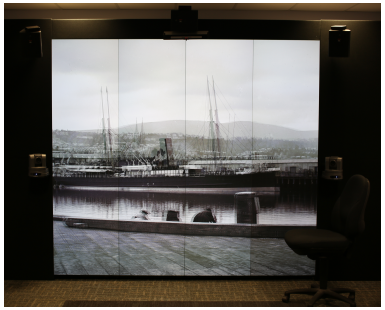
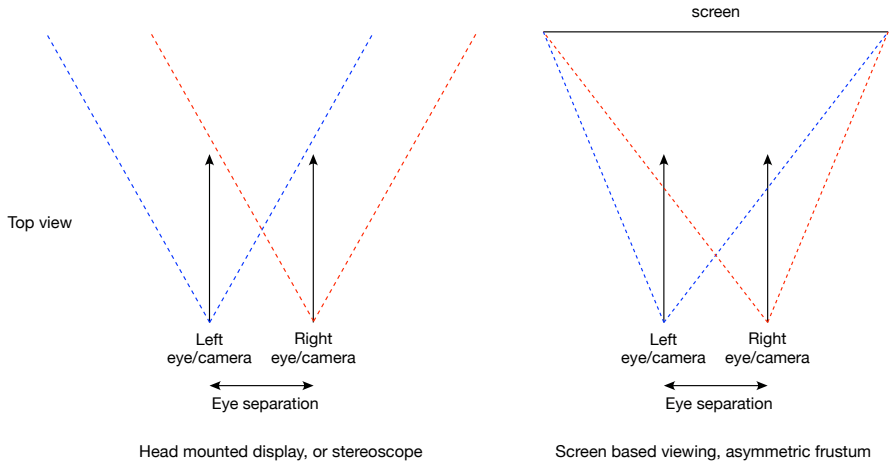
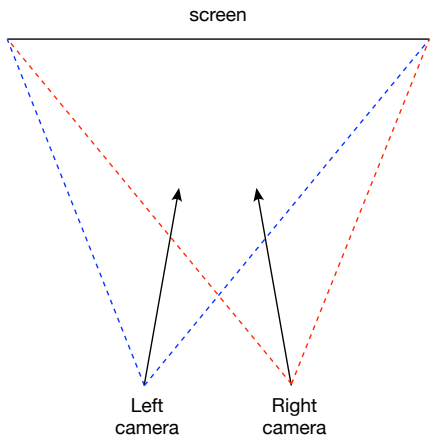
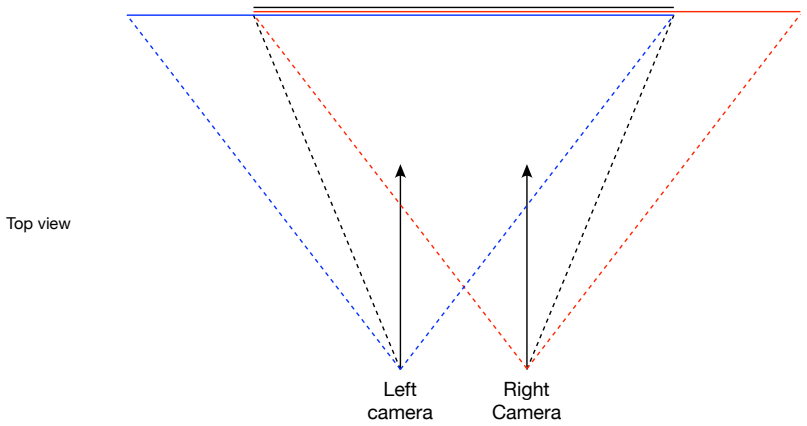


VR displays vs screen based displays

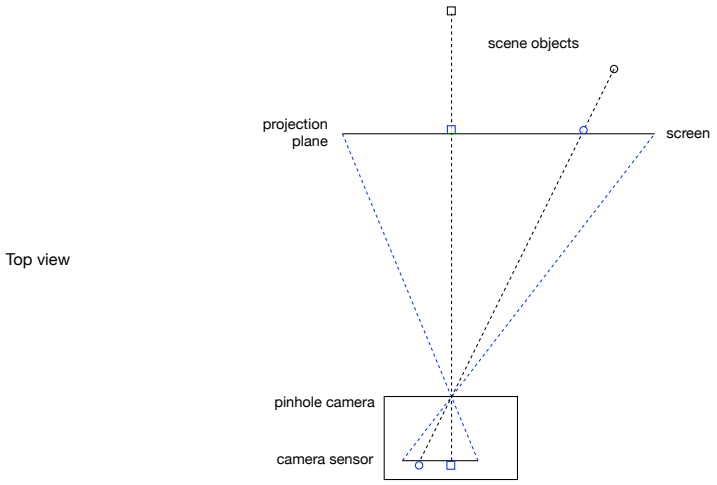




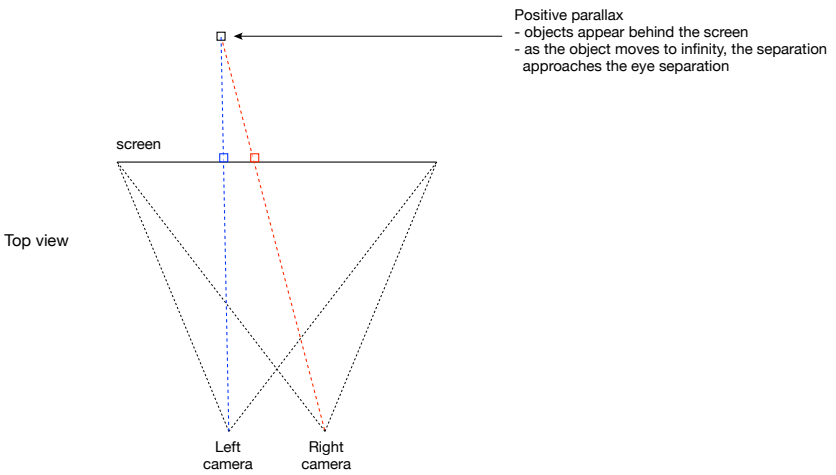
Creating asymmetric frustums from parallel cameras



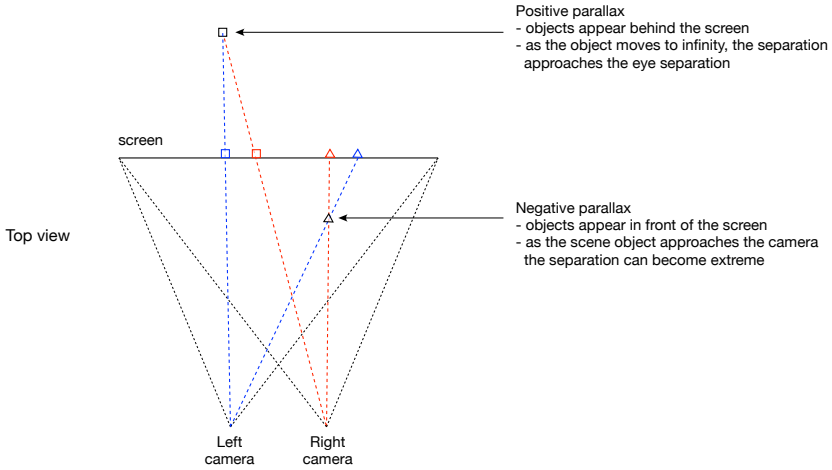
Perspective projection = pinhole camera



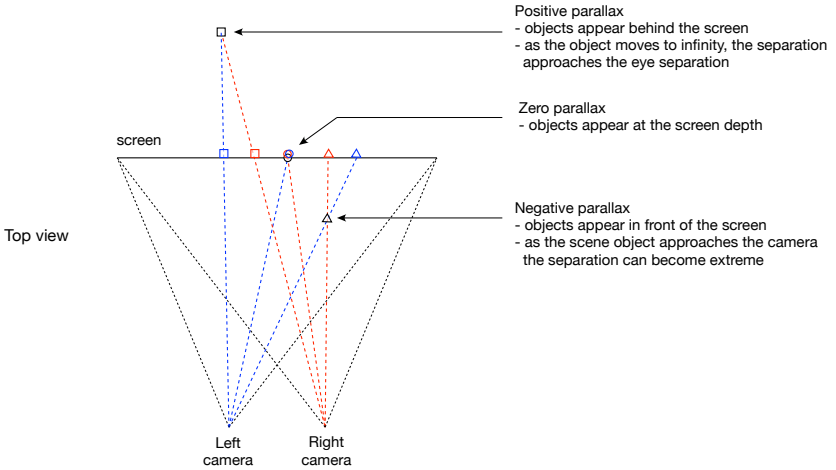
Take home message: Understand stereoscopic parallax



Take home message: Understand stereoscopic parallax



Take home message: Understand stereoscopic parallax

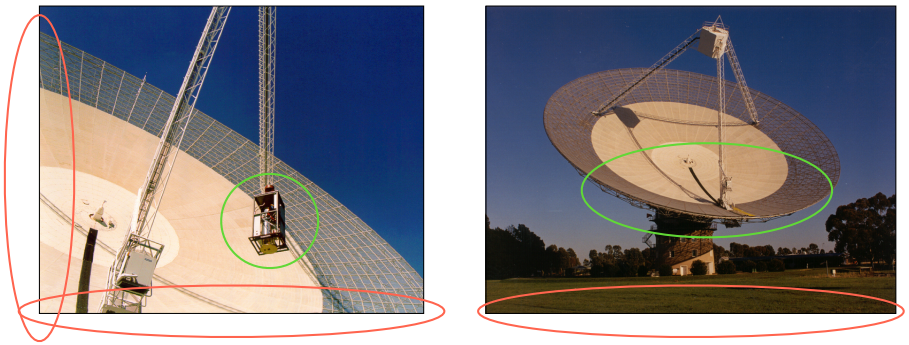


Adjusting zero parallax

- Slide the two images horizontally until the scene object that is to be at zero parallax overlay exactly.
- Crop the two images within their respective frames.

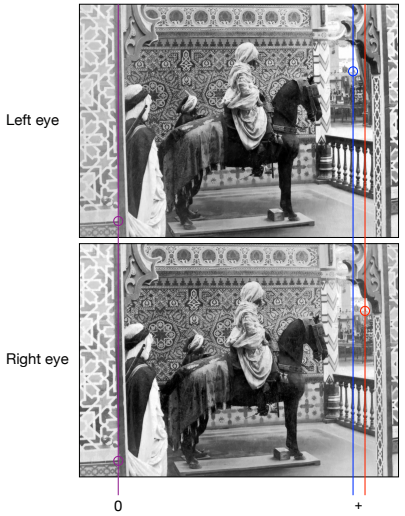
Guiding principles

- There should be no vertical parallax, our eyes are only horizontally offset.
- Negative parallax (objects appearing in front of the screen) should be modest.
- Negative parallax objects should (ideally) not cut the frame of the display. For a flat screen this applies to all edges, for a cylindrical screen it only applied to the top and bottom edge.
- Scene objects at infinity should not be separated by more than human eye separation (6.5cm). If they do then our eyes need to diverge, which they are not designed to do.

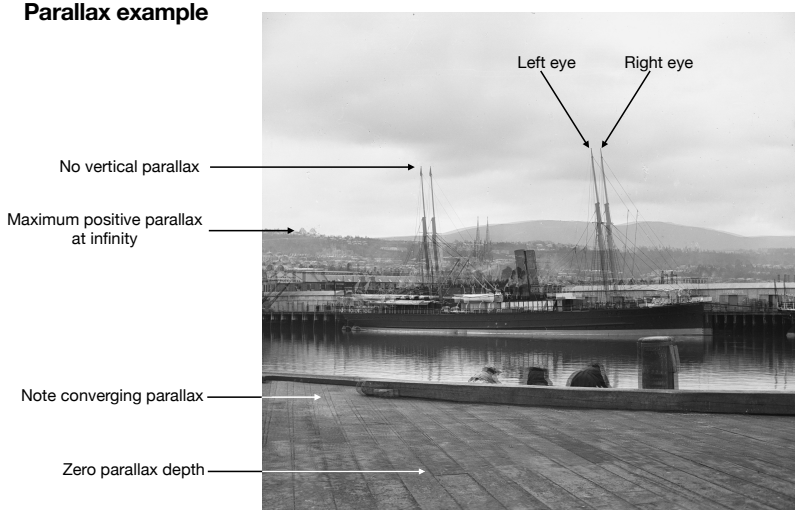


Parallax example

- The vertical line labelled “0” shows that a point in the scene that should appear at the screen depth has zero parallax,
- The two vertical lines labelled “+”, positive parallax, illustrate that a distant object in the left eye (blue) appears to the left of the corresponding scene object in the right eye.
- In this example there are no scene objects placed closer than the screen distance, exhibiting negative parallax.



Parallax example



Typical characteristics of historical stereoscopic photographs

- Monochrome.
  A limit of photography of the day, colour photography (Paget) was another 40 years after monochrome.
- Low resolution.
  Glass plates are better resolution that prints, but plates were fragile and often didn't survive.
- High contrast, low dynamic range.
- Often over exposed.
- Left-right eye exposure differences. This can be stressful on our eyes since it rarely occurs in real life.
- Noisy.
- Damaged. For example, cuts, creased paper, hairs, mold ….
- Sometimes extreme stereo separation.
  Most likely a pair created from two separate cameras manually offset.
  The stereoscope was already a compromised viewing environment so if separation was too wide it wasn't necessarily noticed.

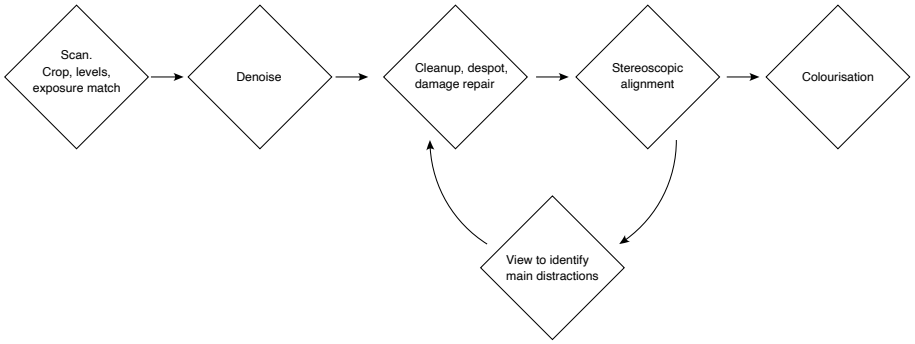
Processing pipeline

- Scan (16 bit greyscale), crop and perform intensity/exposure match between the pairs if there is a difference.
- Denoise and sharpen.
  Traditional denoise filters are limited. The AI based denoisers perform better.
- Cleanup of spots, crinkles, hairs, mold and so on.
  This is a manual process, typically with clone tool in PhotoShop.
  One trick for damaged stereoscopic slides is one can copy from one eye to the other, at least for flat objects at a constant depth.
- Stereo alignment
  - Sliding images left and right horizontally to optimally align zero parallax.
  - Possibly rotate slides with respect to each other.
  - Vertical shift to remove any vertical parallax.
  - Possibly scaling one image with respect to the other to compensate for optical differences.
  - Apply cropping keeping each image the same aspect.

  Recommend SPM: StereoPhotoMaker
- Apply colourisation (optional).

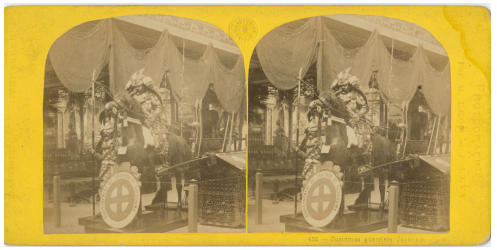
Take home message: Editing stereoscopic pairs must be performed with a viewing system

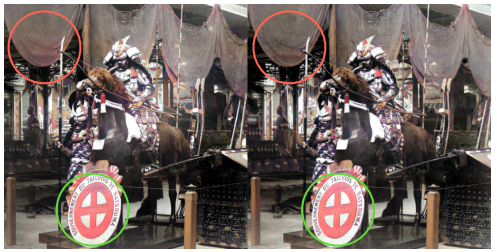
Stereoscopic photograph processing must be performed with a stereoscopic display available

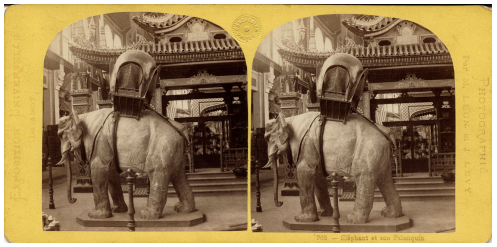


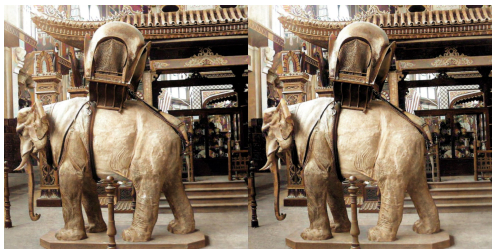
AI techniques

- Denoise
  There are traditional image processing technique as well as AI.
  With image processing or AI the key is to be conservative so as not to loose details.
  Topas denoiser
  VanceAI
  Adobe Photoshop
  ….
- General enhancement, eg: scratch removal, damage restoration
  I haven't found a solution that adjusts the two views identically, therefore adding depth artefacts.
  Most solutions focus on restoring faces only.
  Need to be stereoscopic aware.
  This is the main human processing time involved.
- Colourisation
  The risk is that each eye will not be coloured the same.
  The colour is not necessarily correct.
  Deoldify
  Adobe PhotoShop Neural Colorize
  MyHeritage
  HotPot AI
  DeepAI
  …









Original

Cropped, grey scale, intensity matched

Denoise

Manual cleanup

Stereoscopic alignment, cropping to 1:1

Colourisation

Transformation

Demonstration