Lenticular prints

Motivation

- Giving researchers the ability to present work in 3D in print and without glasses (autostereoscopic).

- Avoiding the need to take display hardware to conferences for poster sessions.

- Avoids the high cost (factor of 10) of holographic panoramagrams investigated in 2009-2010.
  http://paulbourke.net/miscellaneous/hologram/
  Do not require special lighting.

- Generally have better colour reproduction than laser based holograms and even better than holographic panoramagrams.

- Personal: Employing commodity technologies used for “frivolous” marketing to visualisation.
  Glass block engraving - 3D printing.

Brief history

Barrier Strip:

- 1692 the French painter G. A. Bois-Clair created paintings consisting of a pair of images with a grid of vertical slats in front.
- Photographic possibility discussed by Auguste Berthier in 1886.
- First evidence of construction by Frederic Ives in 1901.

Lenticular:

- One-dimensional arrays of cylindrical lenses were patented by Walter Hess in 1912
- Popular from the 1940 to create “flip animations” in the advertising industry.
- Popularised again in the 1960, for example, cover of the Rolling Stones “Their Satanic Majesties Request”.
- 2002: Sharp started manufacturing switchable 2D/3D displays barrier strip displays.
- Lots of autostereoscopic displays peaking around 2008.
- Philips created the WOWvx screens in 2009.

Digital Examples

- Suffered from insufficient resolution of panels, only a few products remaining.
- Barrier strip technology (see later) amenable to digital technology but the most problematic for narrow viewing zones.

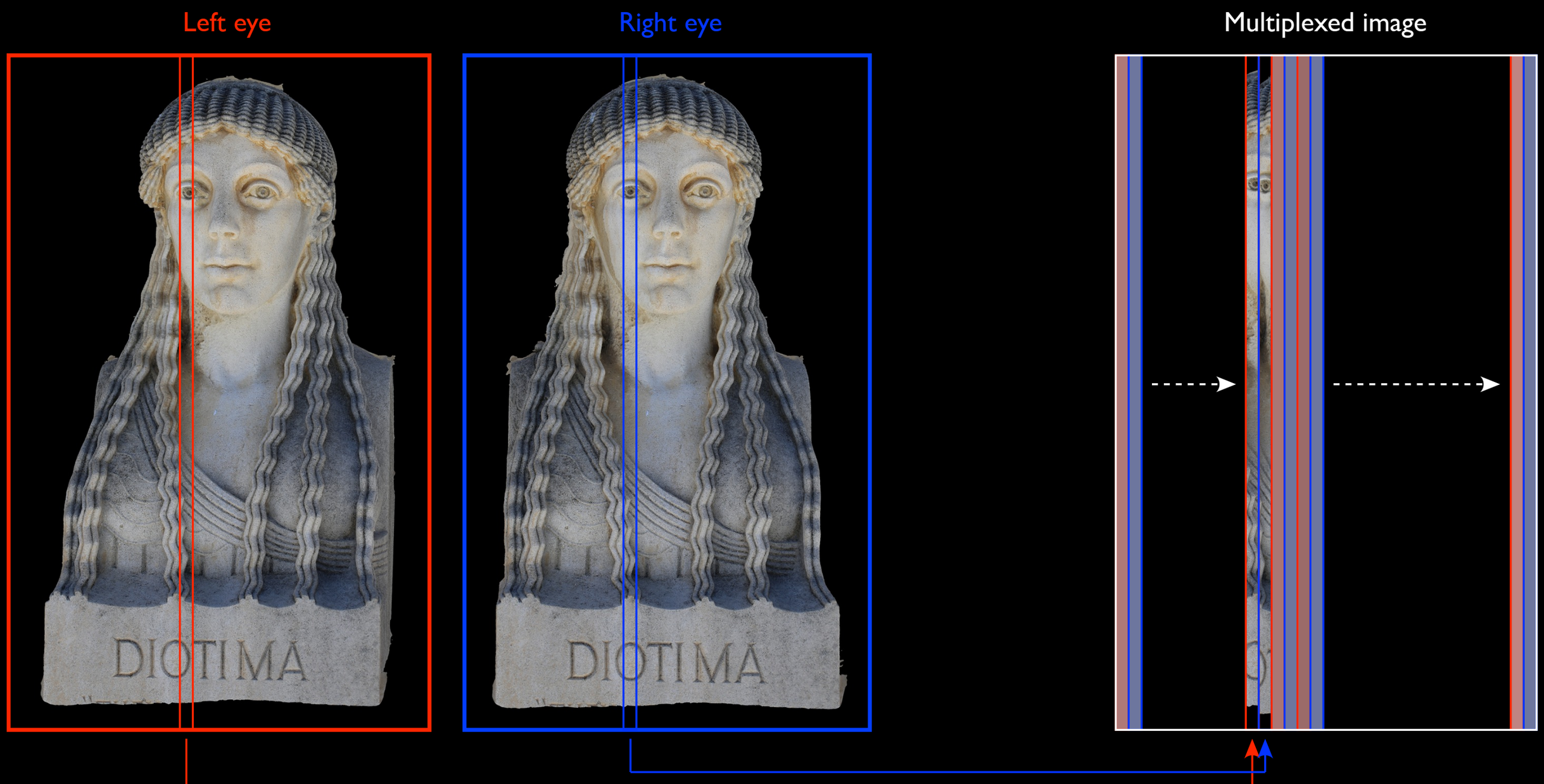
Sharp Sh251iS

Nintendo 3DS

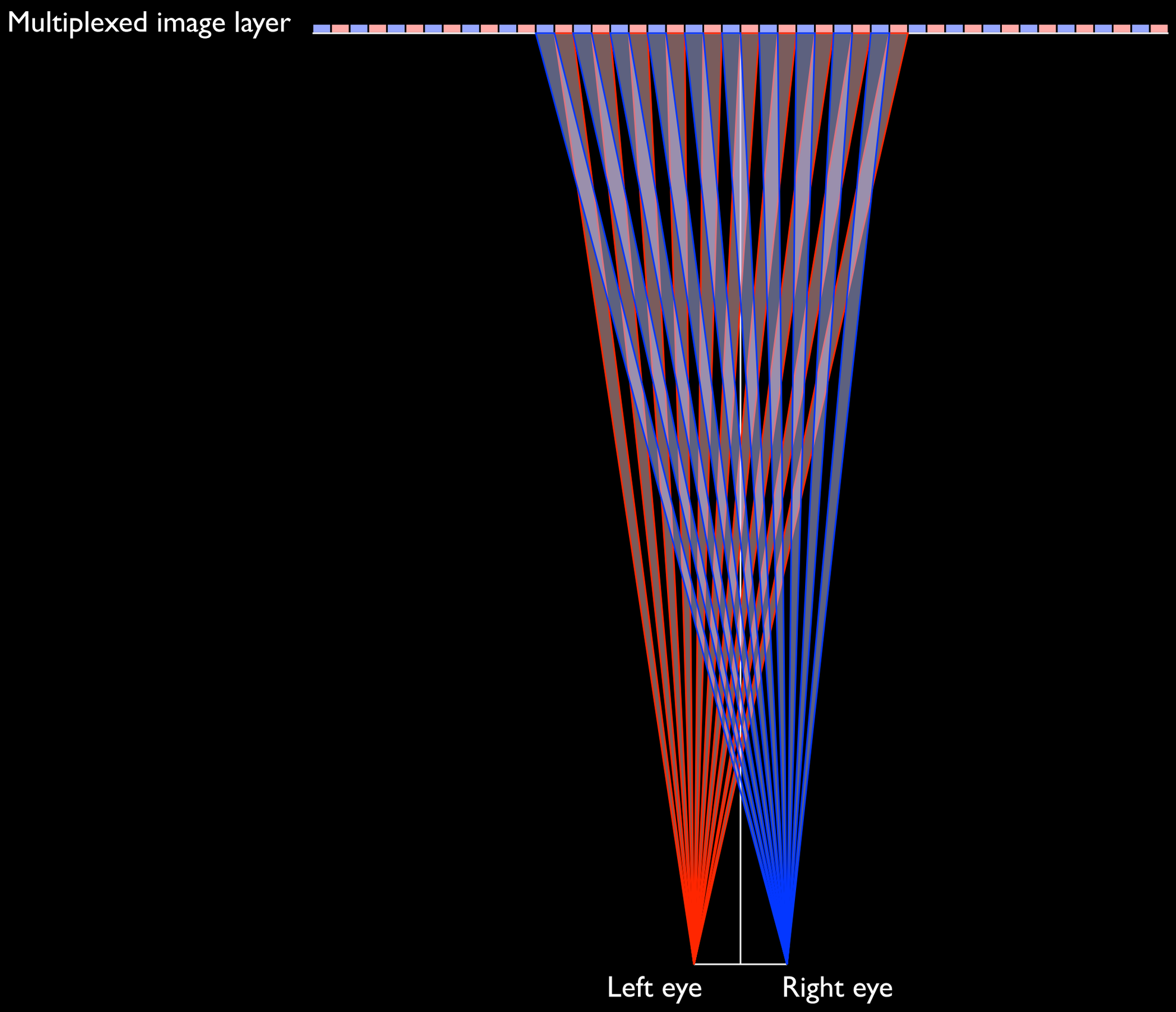
Fujifilm FinePix REAL 3D W3

Barrier strip autostereograms

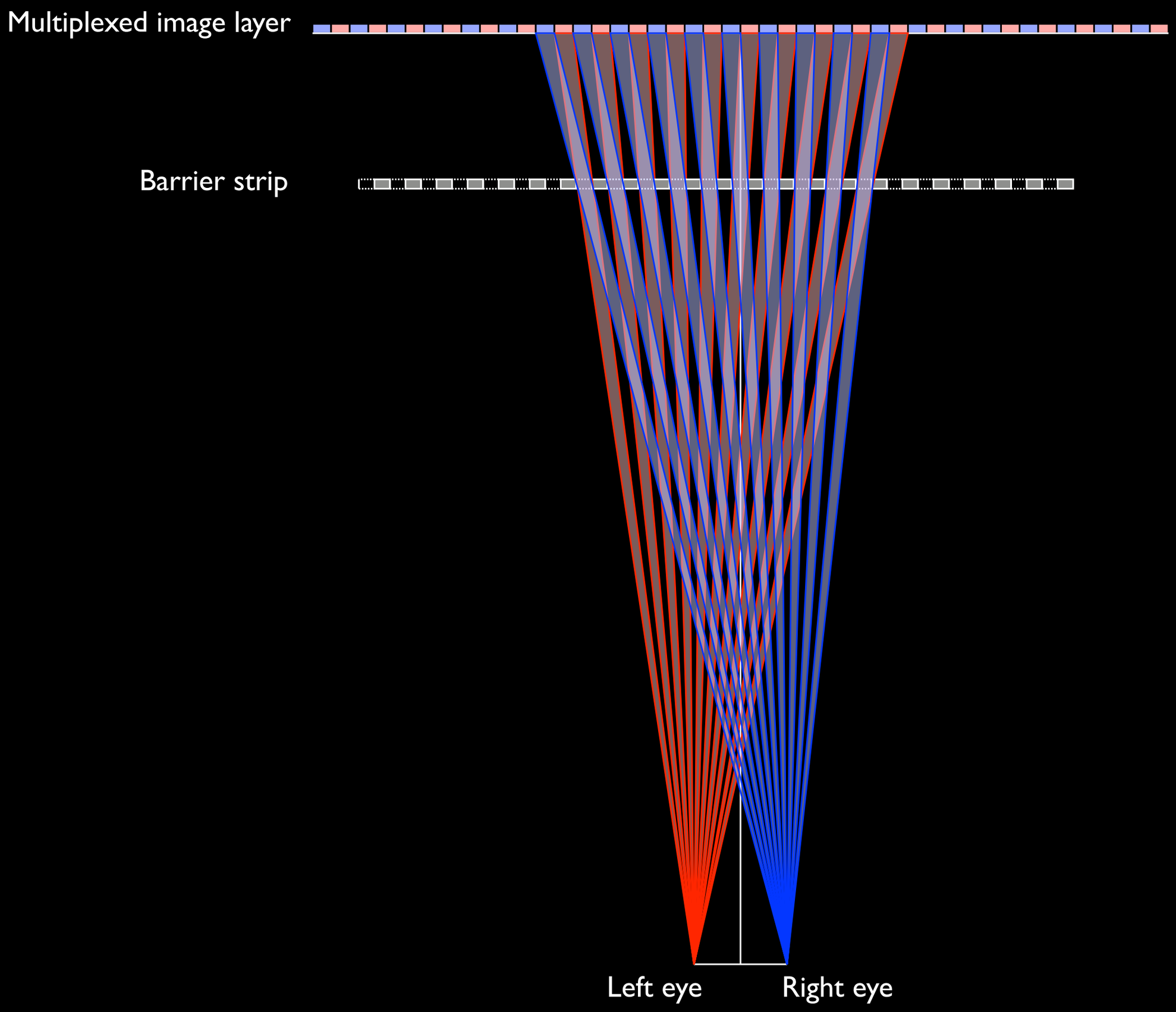
- As with all stereoscopic techniques we require a means of presenting an image independently to each eye.
- Barrier strip images start with an image column multiplexing.



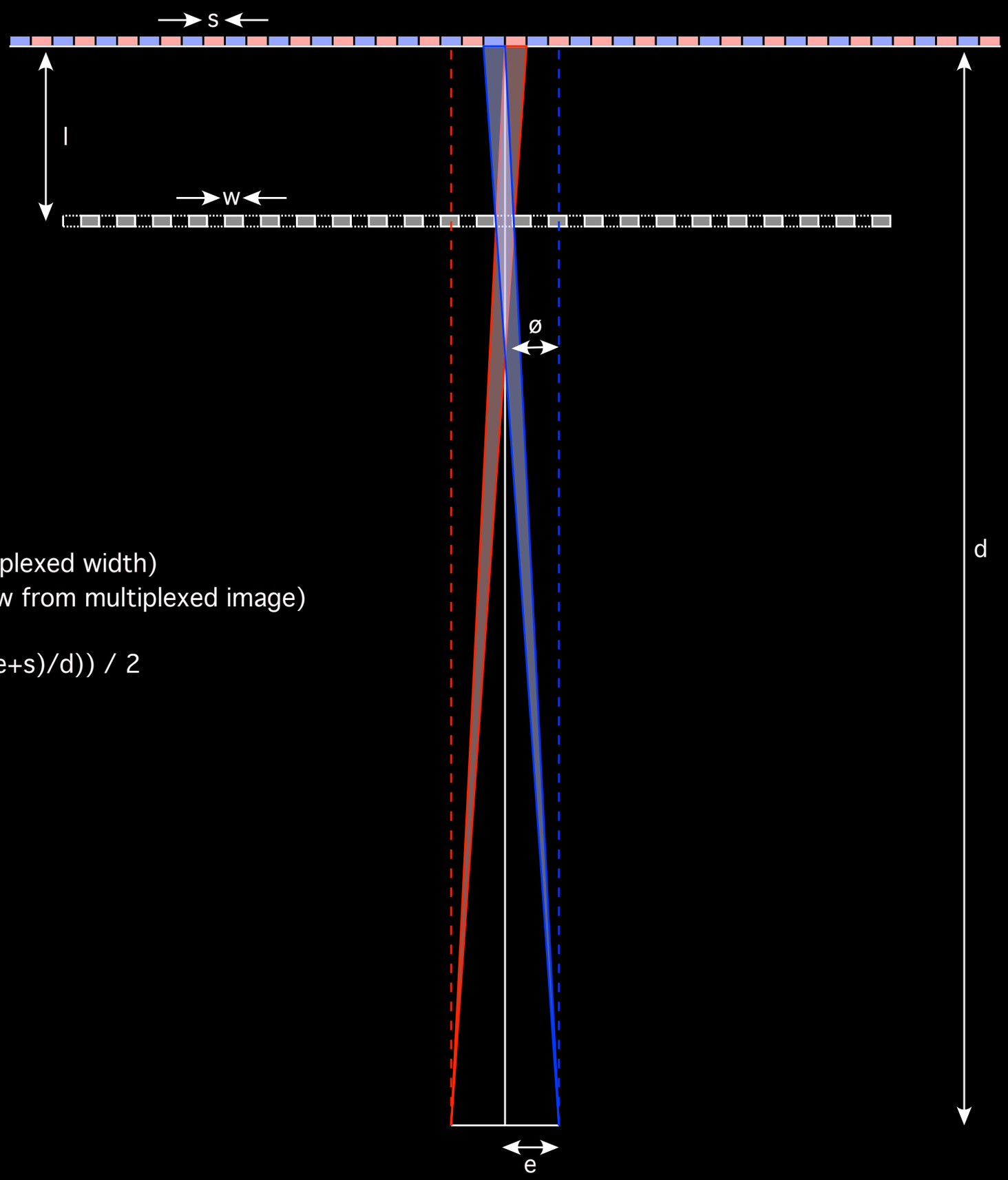
Basic geometry



Barrier strip position



Derivation



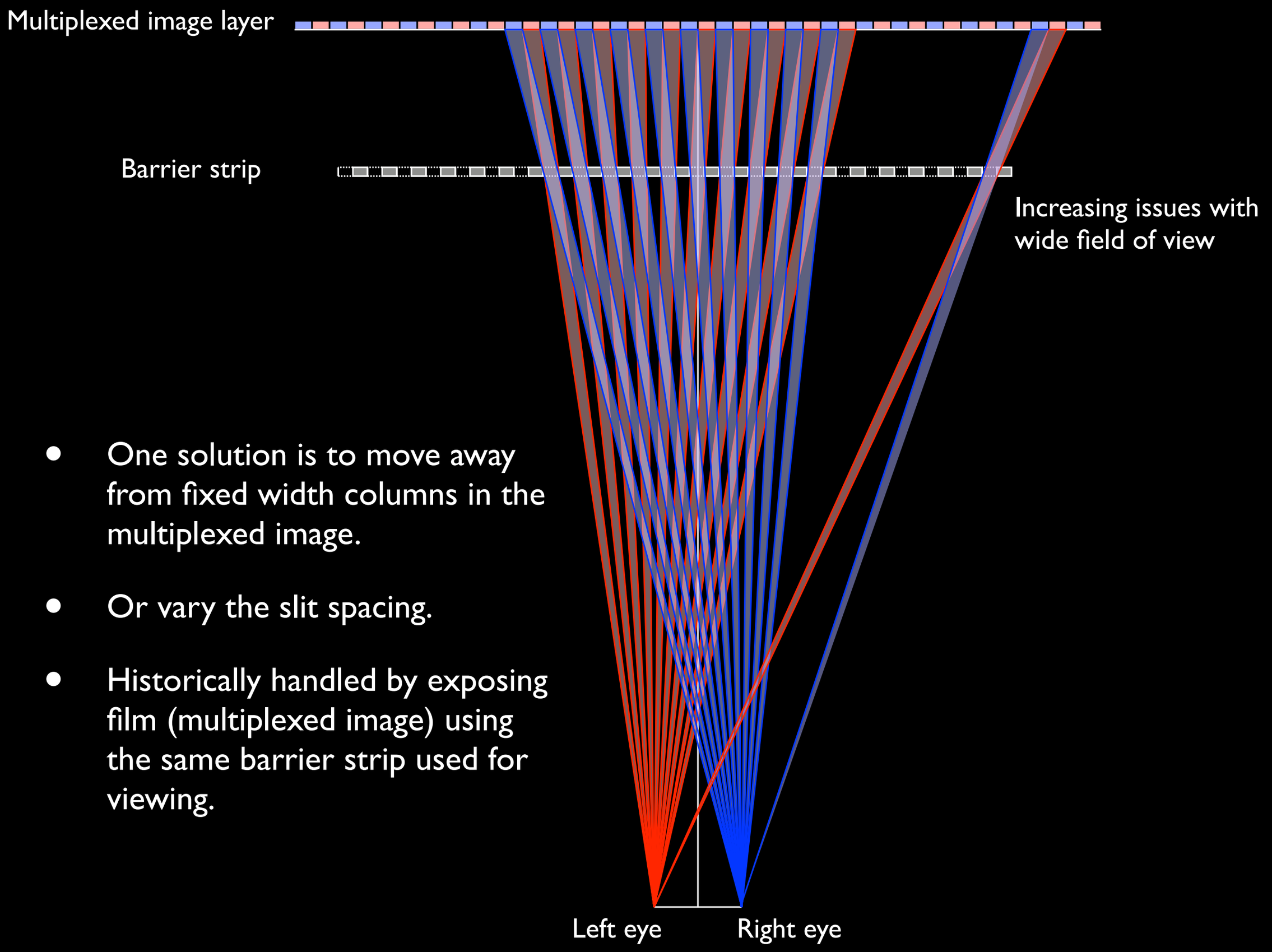
Choose "s" (image multiplexed width)
and "d" (distance of view from multiplexed image)
Then

ø = (atan(e/d) + atan((e+s)/d)) / 2

l = d - e / tan(ø)

w = (d - l) s / d

Extreme angles



- One solution is to move away from fixed width columns in the multiplexed image.
- Or vary the slit spacing.
- Historically handled by exposing film (multiplexed image) using the same barrier strip used for viewing.

Characteristics

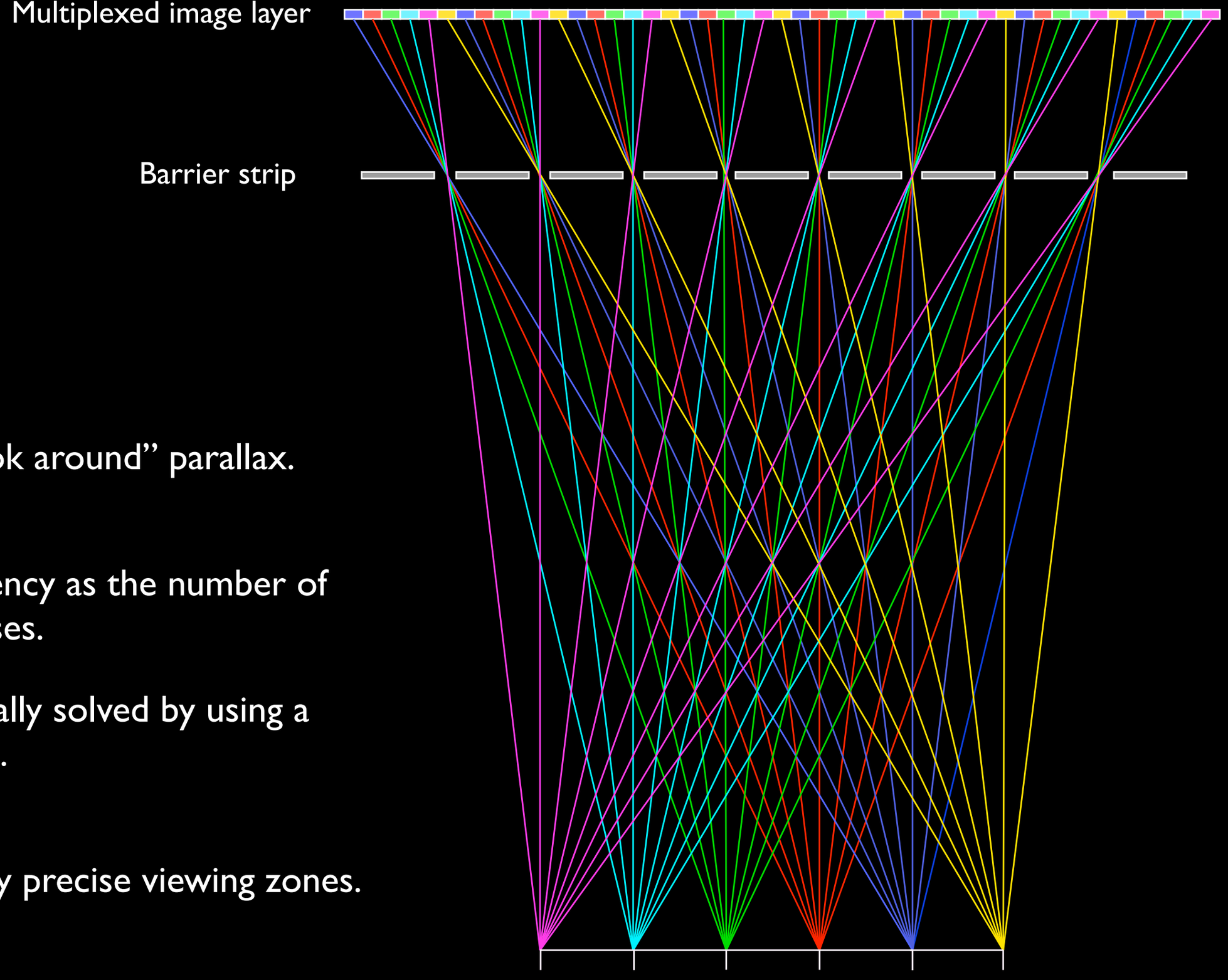
- Main disadvantage is the precise position of the viewer.
  Slight variation and the left/right views are flipped.

- Very precise printing processes required.

- For digital displays one solution is to use head tracking camera and vary the barrier (or image) to retain alignment, still requires very still and precise viewing (Unnatural).

- Viewer sees a 3D view but there is no “look around” parallax.

Multiview parallax barrier



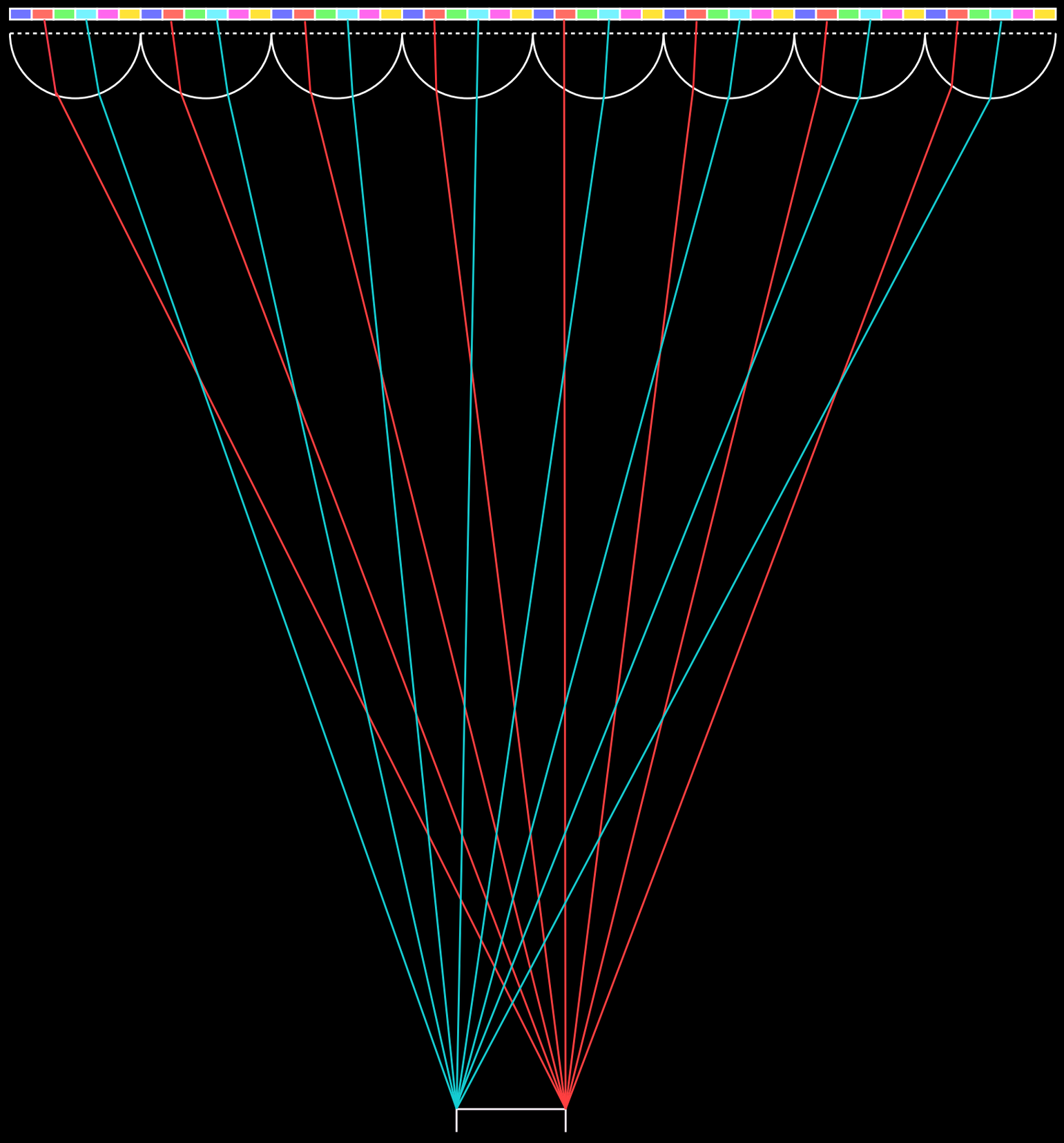
- Provides “look around” parallax.
- Light inefficiency as the number of views increases.
- Can be partially solved by using a backlit image.
- Still have very precise viewing zones.

Each viewing pair is a valid stereo pair

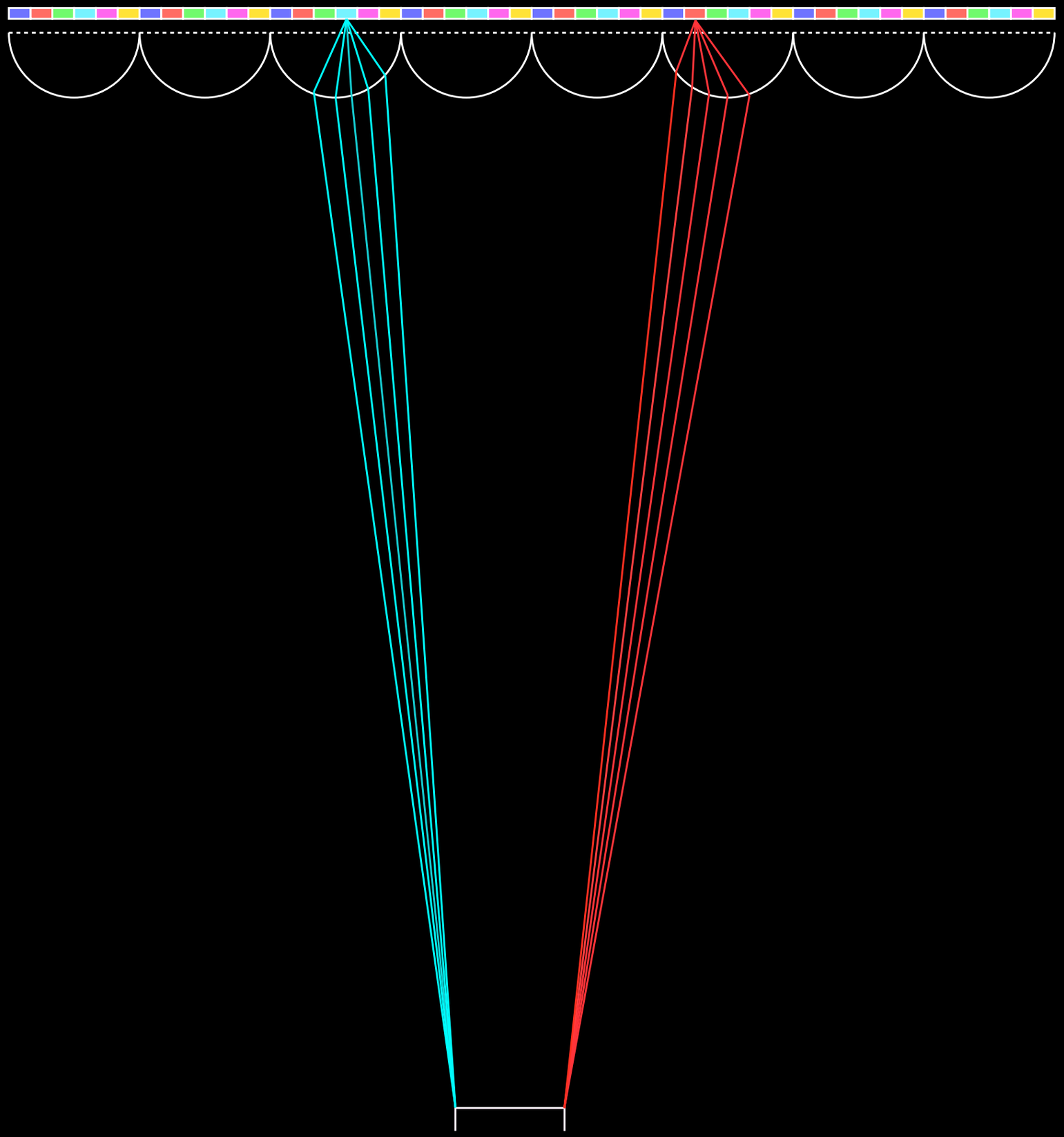
Lenticular

- Barrier strip is replaced by a cylindrical lens.
- Lenticular = pertaining to lenses, lenticule = plastic lenses used
- Same idea though, the lens selects two of a number of images, each image pair is a valid stereo pair.
- Can be used to present animation sequences as well as flipped images.
- When used to present stereo3D viewing one can present “look around” parallax views.

Geometry

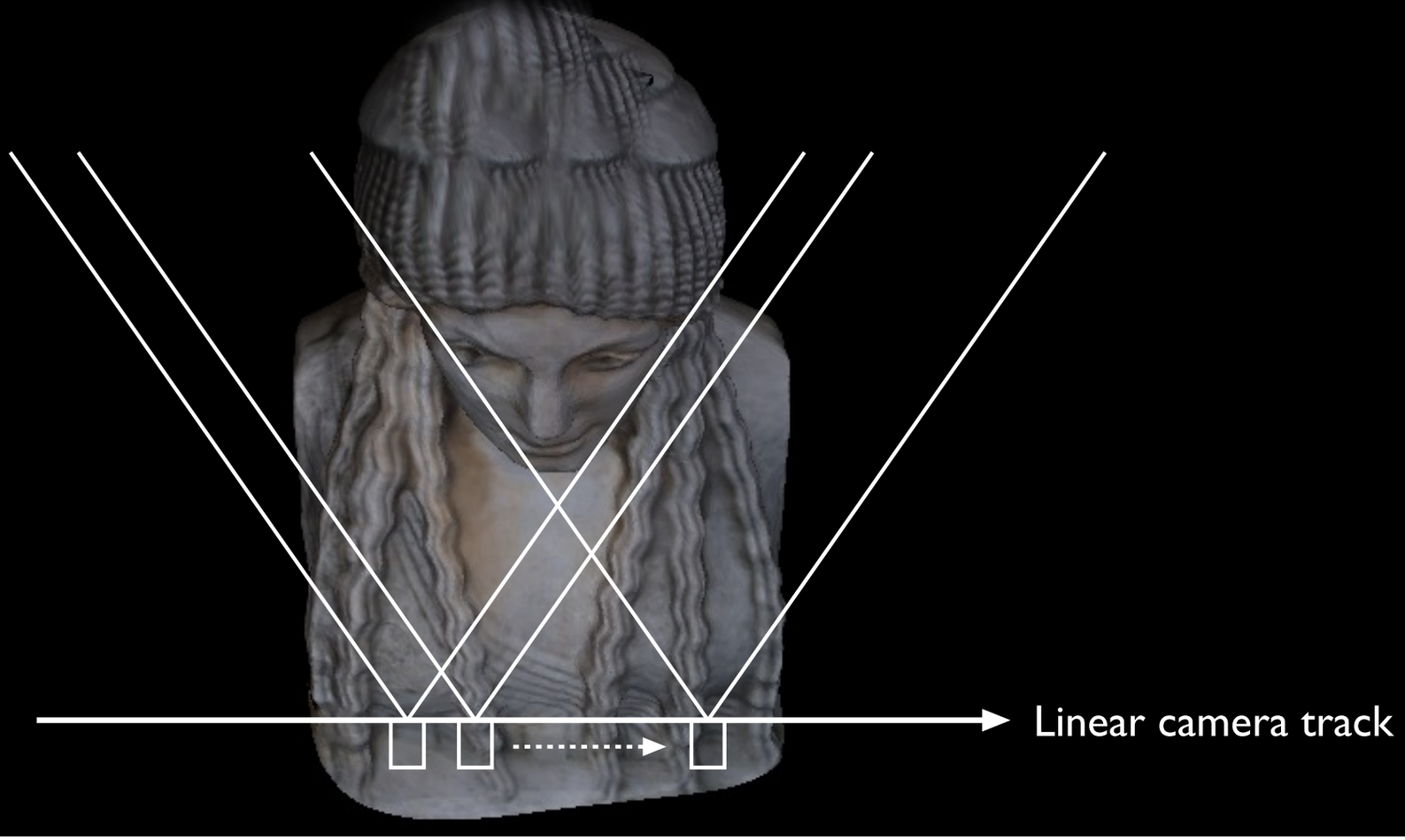


Geometry



Generation

Typically between 10 and 40 images



Generation

movie

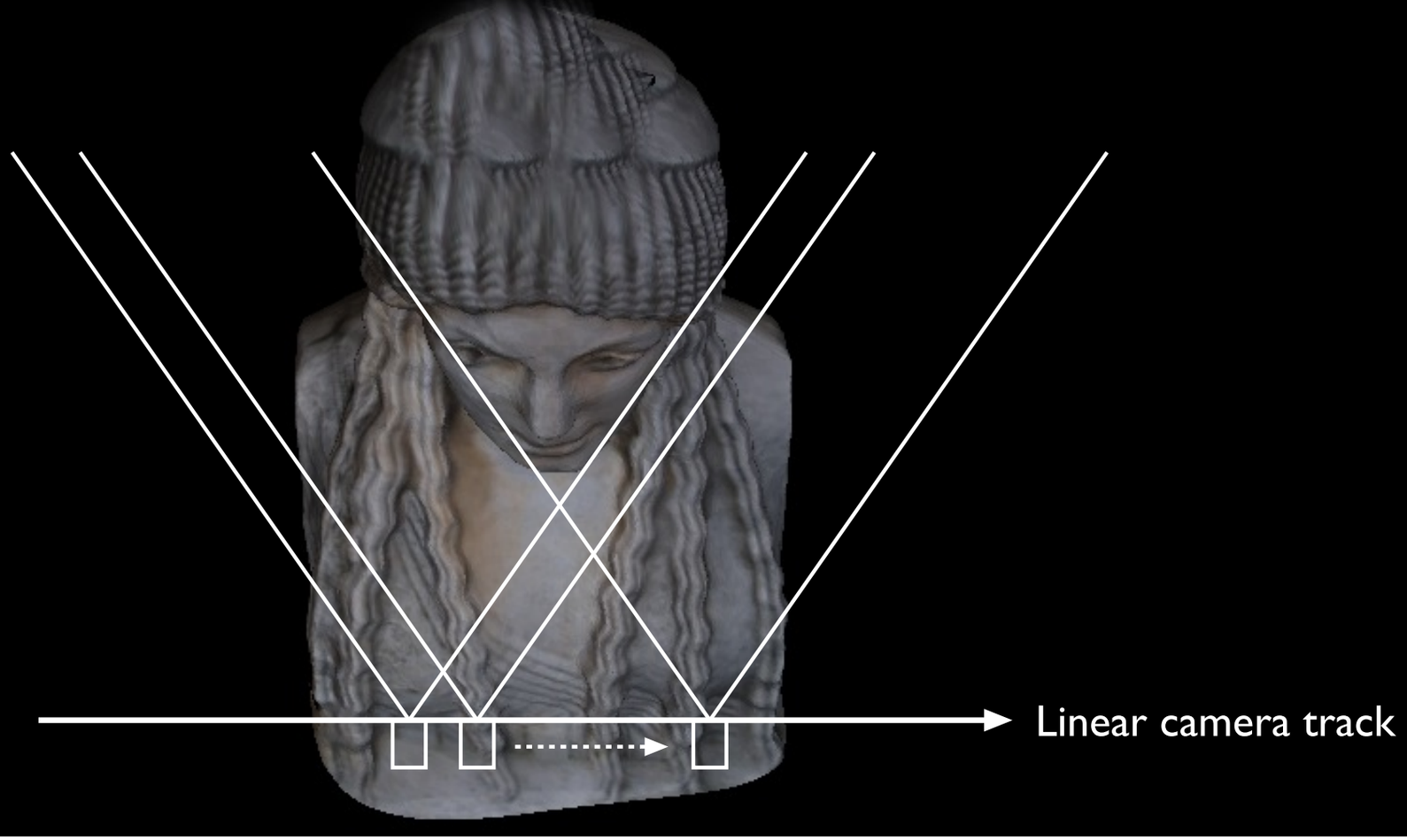
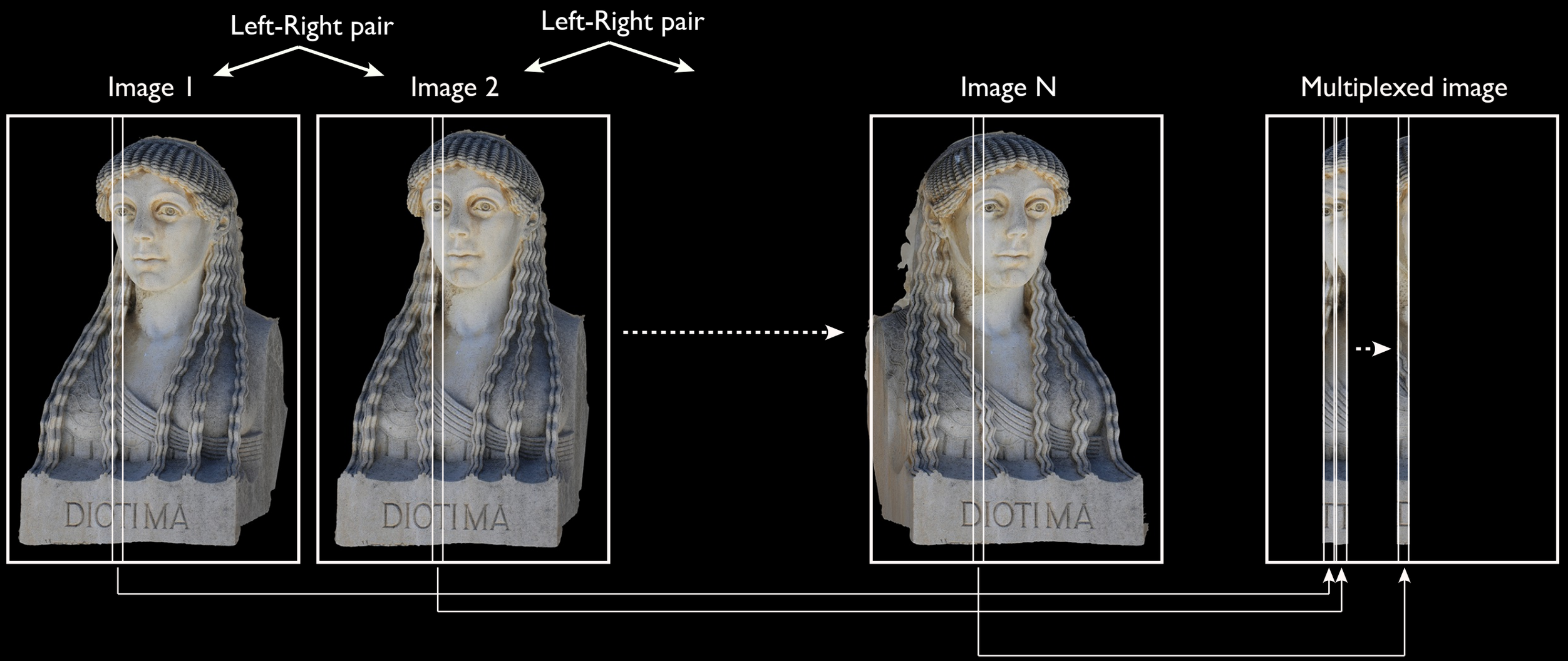


Image multiplexing



- Each adjacent pair of images is a valid stereo pair.
- Typically 10-40 images for a 42 lenticles per inch.

Characteristics

- Provides multiple viewing zones with stereo eye flipping when transitioning between zones.
- Manufacturing of the lens is straightforward and low cost.
- Challenging for realtime displays due to high rendering load, most panels limited to between 8 and 16 images.
- No vertical parallax. (There is an option for this but the lens sheets are much rarer).
- Ideally suited to printing processes but high resolution is still required for printing and high accuracy mounting for alignment with lenticules.
- Defects due to lens damage or dust are very obvious.

Challenges

- Achieving a wider viewing zone.
  Currently only perhaps ±10 degrees, would like to reach ±25 degrees.

- It is a tradeoff between lenticule size - resolution - viewing distance.

- Hard to find print companies prepared to do volumes under 1000.
  Hard to find a company prepared to create large images, larger than playing card.
  A reflection that the traditional market is mass produced promotional material.

References

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