3D model and photographic capture: Applications in heritage visualisation

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OzViz 2017

Outline

- 3D model reconstruction from photographs
  - Will present an innovation that improves final model quality

- 360 video and high resolution stereoscopic panoramas
  - Will present solutions to the parallax problem

Motivation

- Desire to capture the highest quality data possible that is free of missing data or errors
  - Optimise archive quality
  - Leverage increasingly high quality display technologies for visualisation
  - Produce rich assets for exhibition

- Realities
  - Might only get one chance, eg: 360 recordings of cultural practices
  - Access to objects may be restricted, eg: national treasures
  - In situ capture may not be in ideal conditions

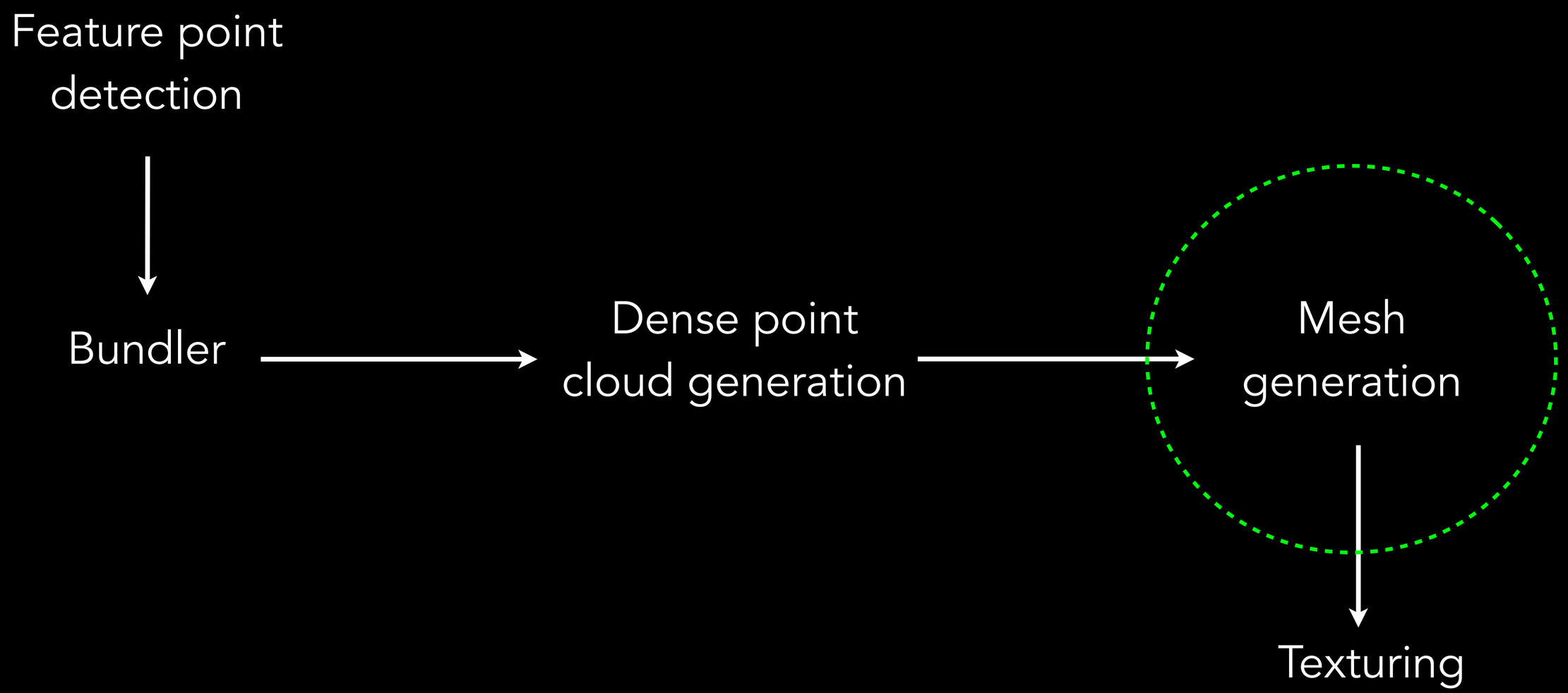
3D reconstruction from photographs

- Software has been around for some time
- Largely black box unless you want to get your hands dirty with the open source components of the typical pipeline
- Difficult to make an impact on the resulting quality without a serious development effort
- The improvement developed is applied to the conversion of point clouds to surface meshes
- This is generally the stage where photographic deficiencies reveal themselves.

Example

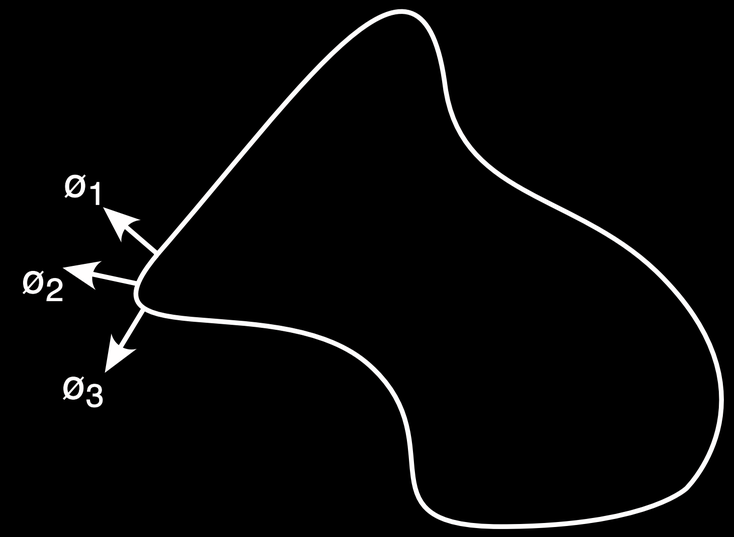
National Museum of Cambodia

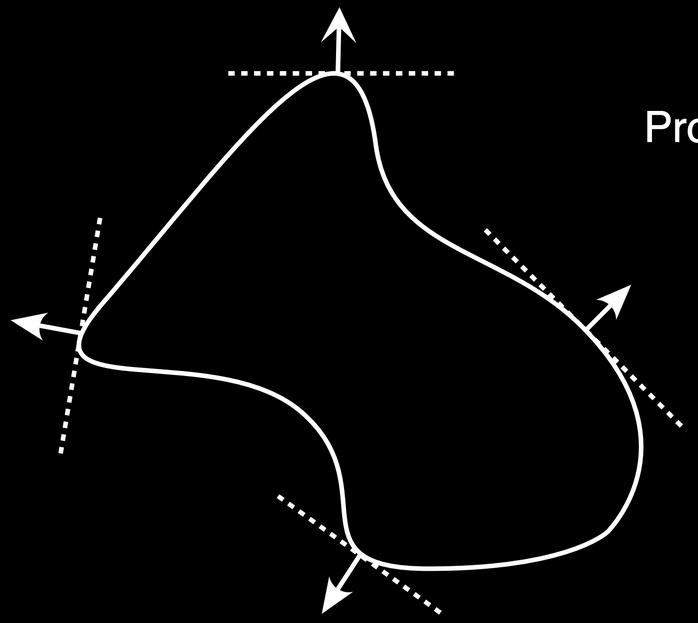
Typical pipeline

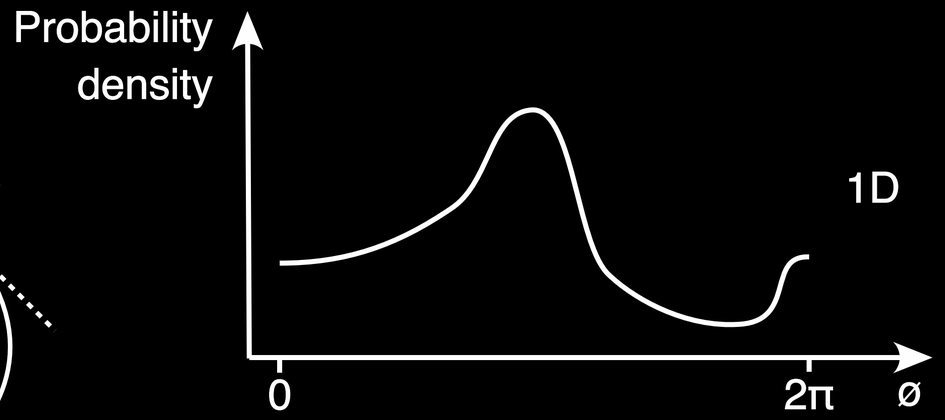


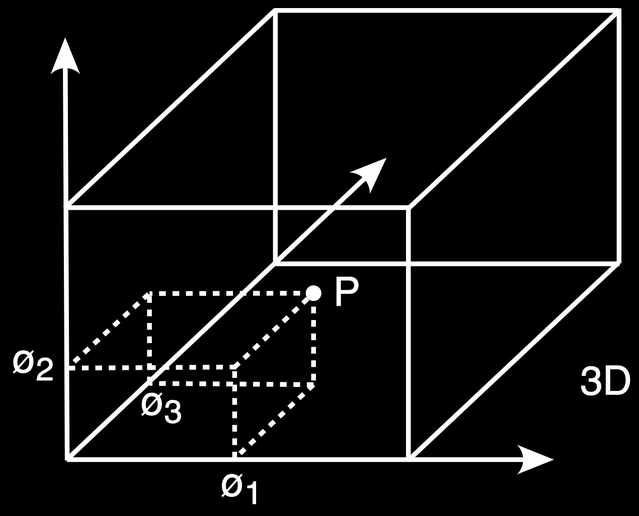
The basic idea

- Create surface gradient probability profiles
- These profiles can be used to assist the mesh generation process









Example 1

Abhayamudra

National Museum of Cambodia

Example 1

AutoDesk Recap

Example 1

Example 2

Tara

National Museum of Sri Lanka

Zephyr software

Example 2

The parallax problem for 360 video

- Every multicamera 360 camera on the market today suffers from the so called “parallax” problem.

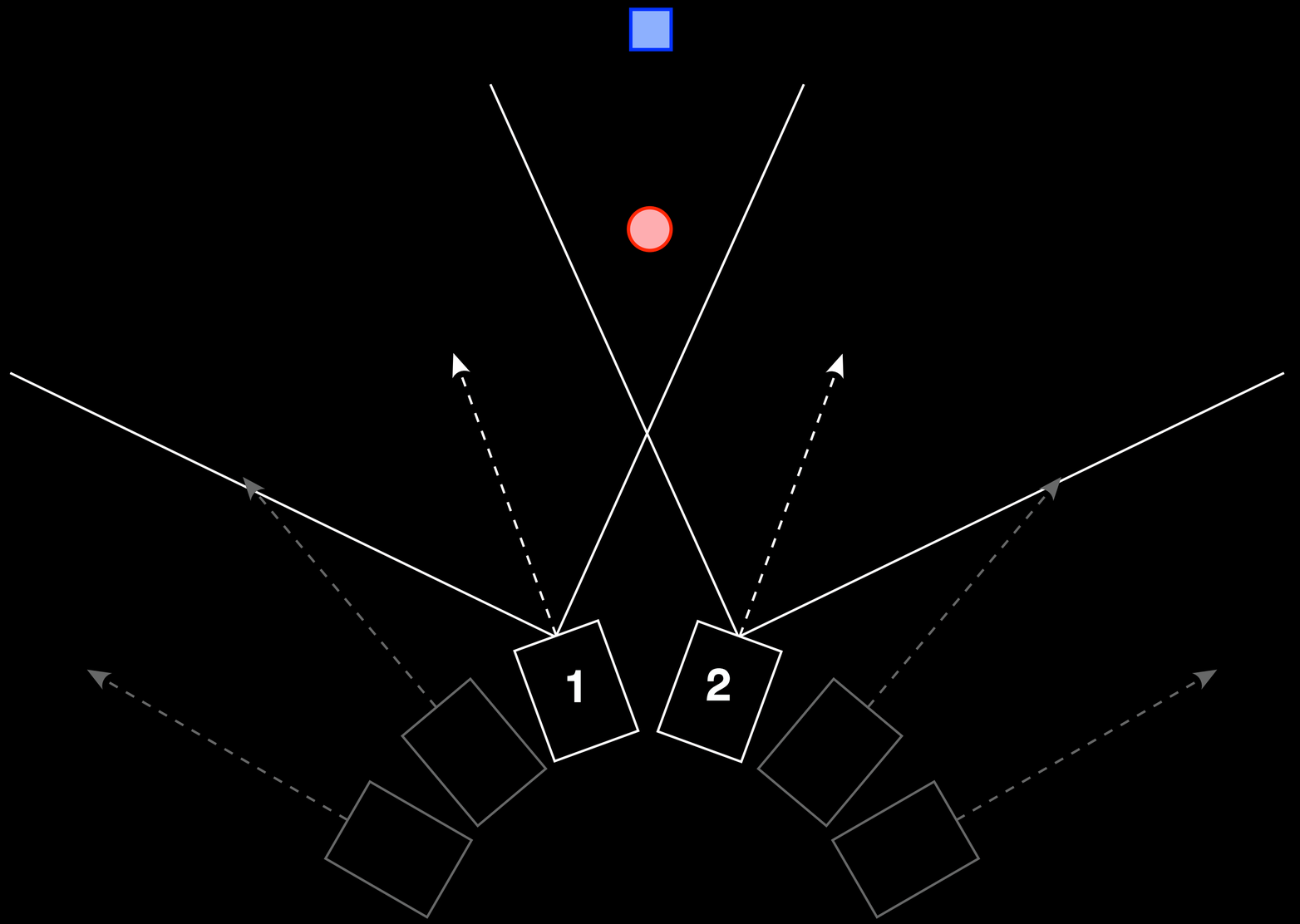
- Why do we want multi camera? Answer: Only way to scale in resolution.

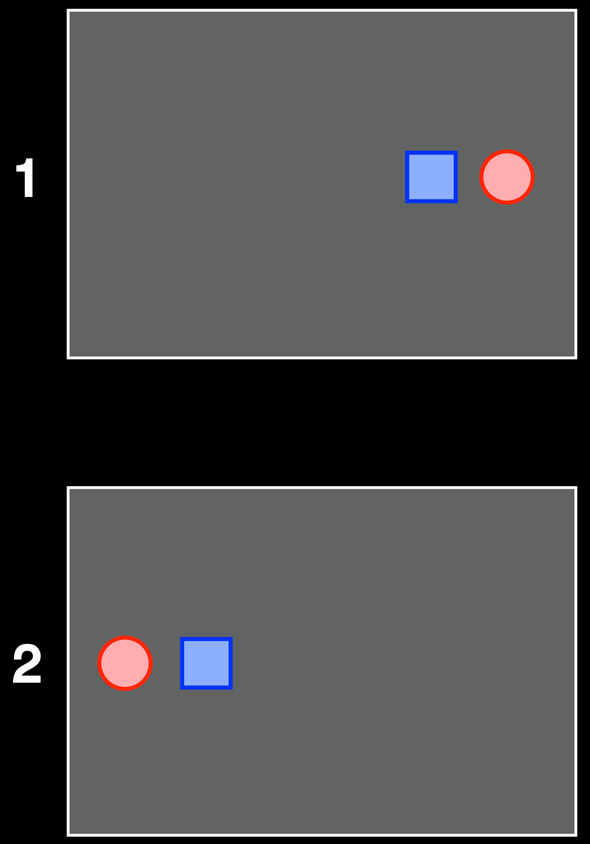
- To date the only hardware solution dates back to the 60’s.

- Solutions today include
  - Careful orientation of camera and restrictions on action
  - Optical flow (limited success)
  - Various (eg: AI) scene depth reconstruction (limited success)
  - Teams of skilled “stitchers” cleaning footage

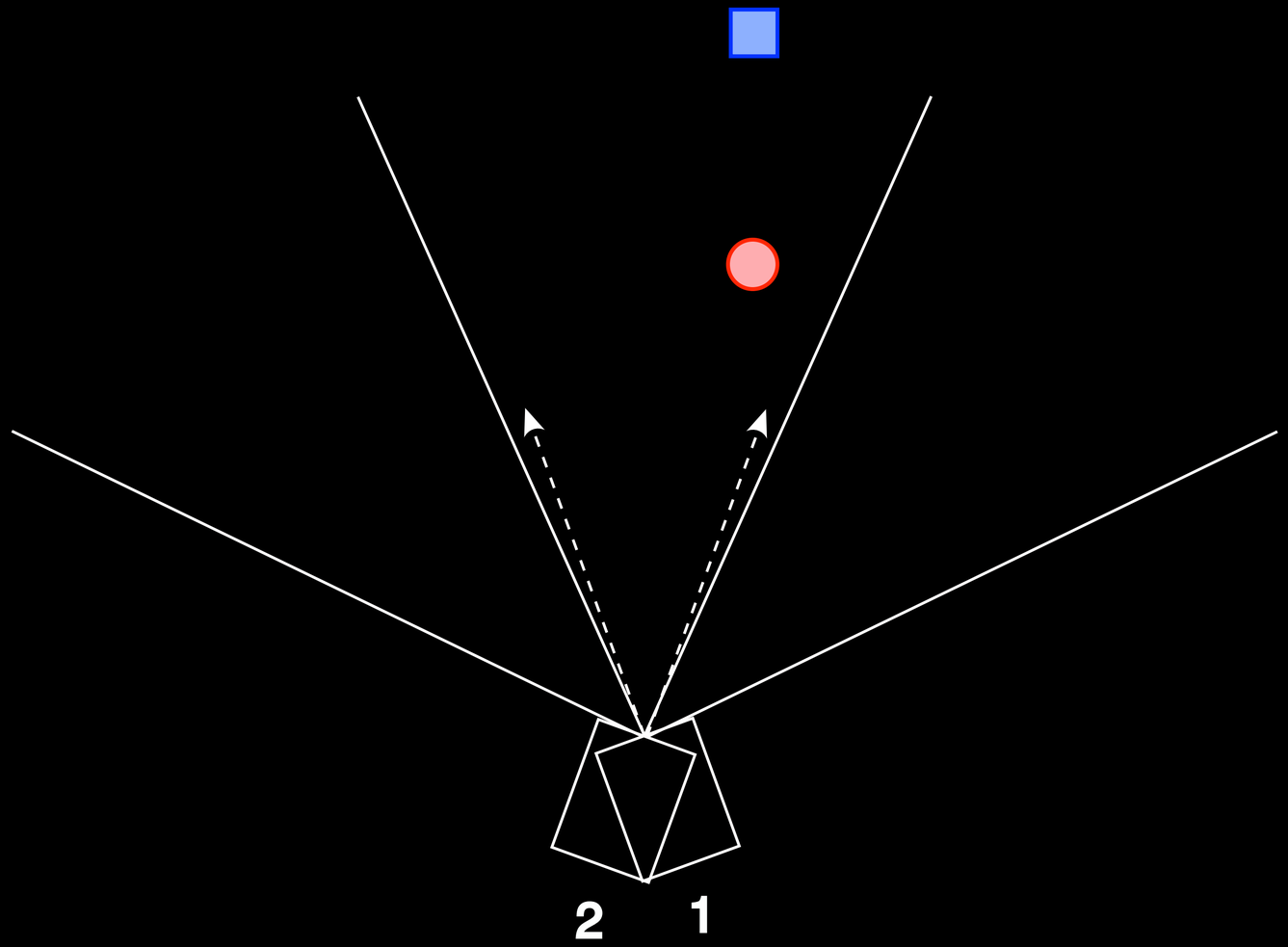
- Main reason why it isn’t a bigger problem is that most displays (eg: HMDs) are the limiting factor, not the content quality.

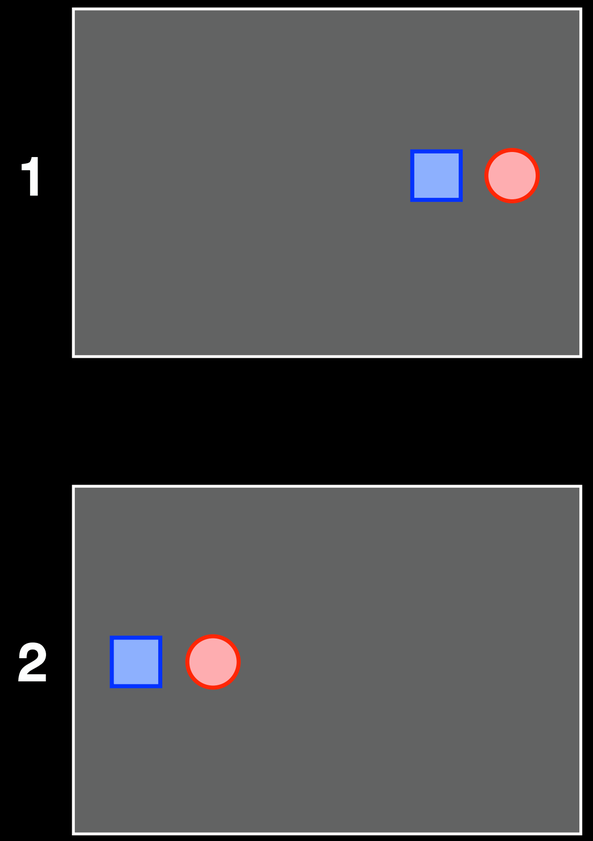
Parallax problem in a nutshell



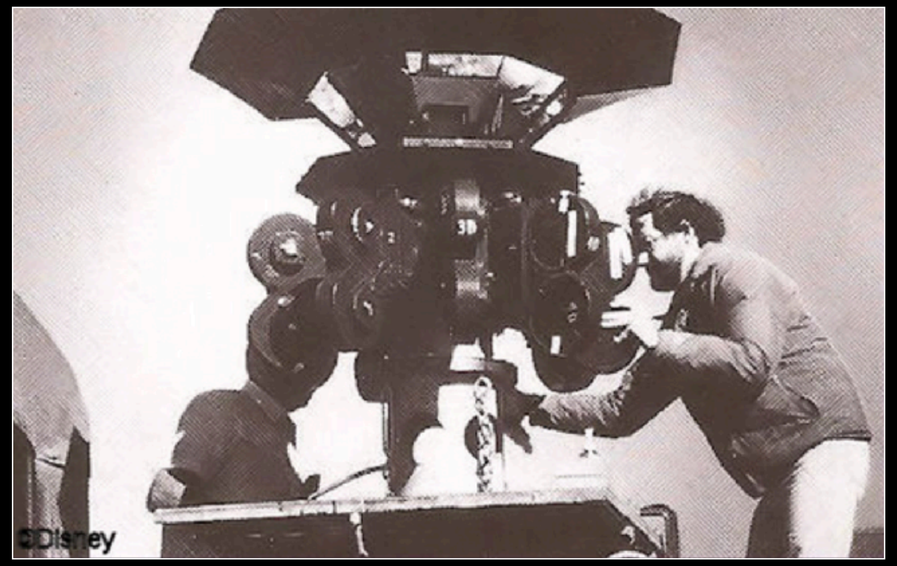


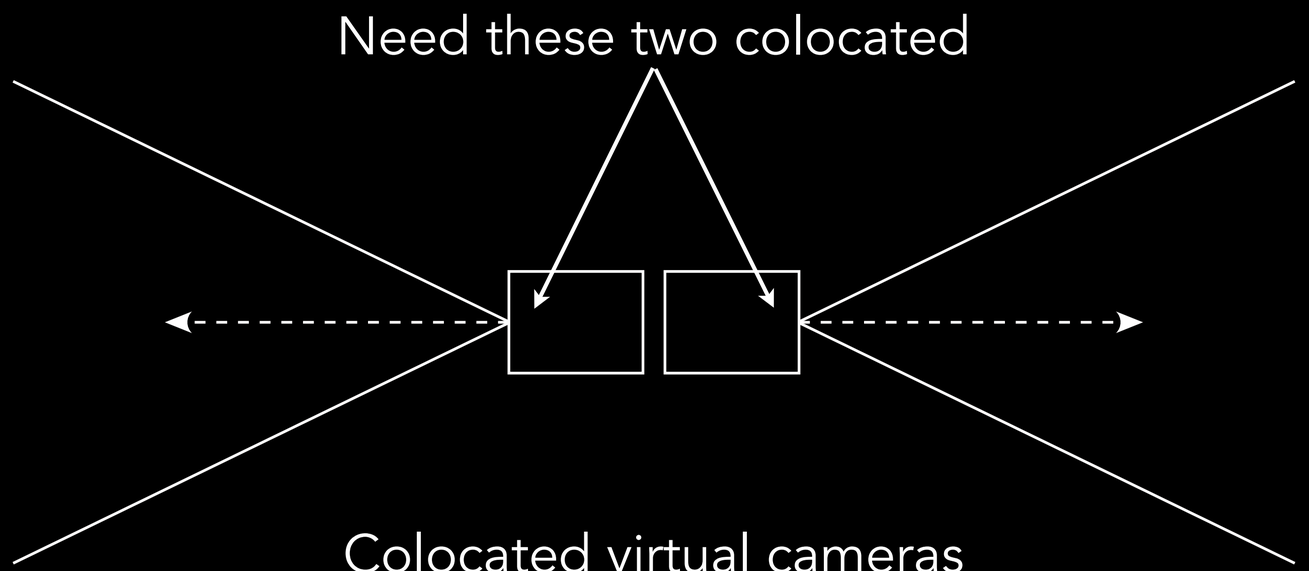
Parallax problem in a nutshell

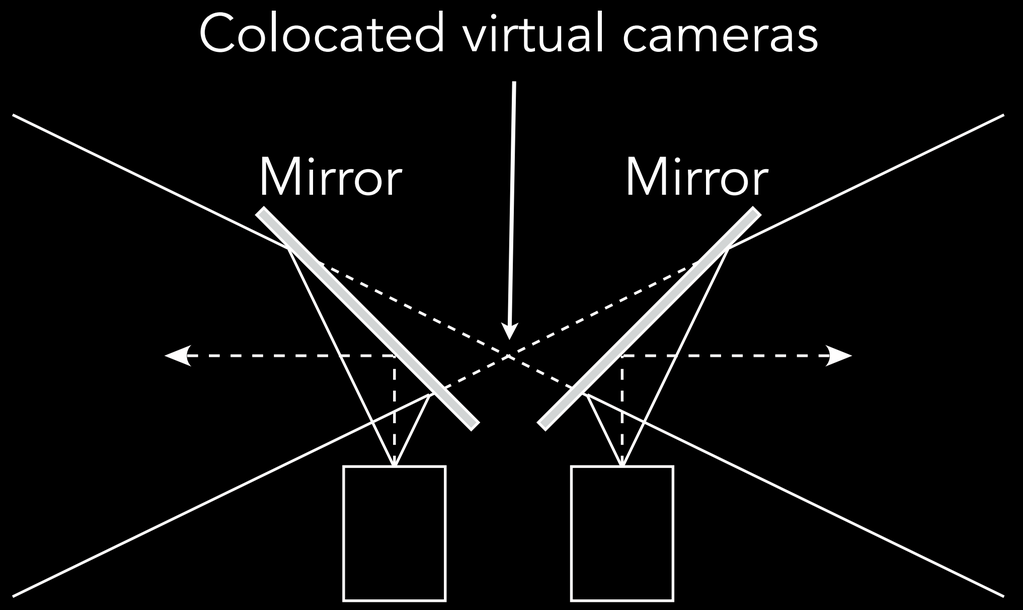




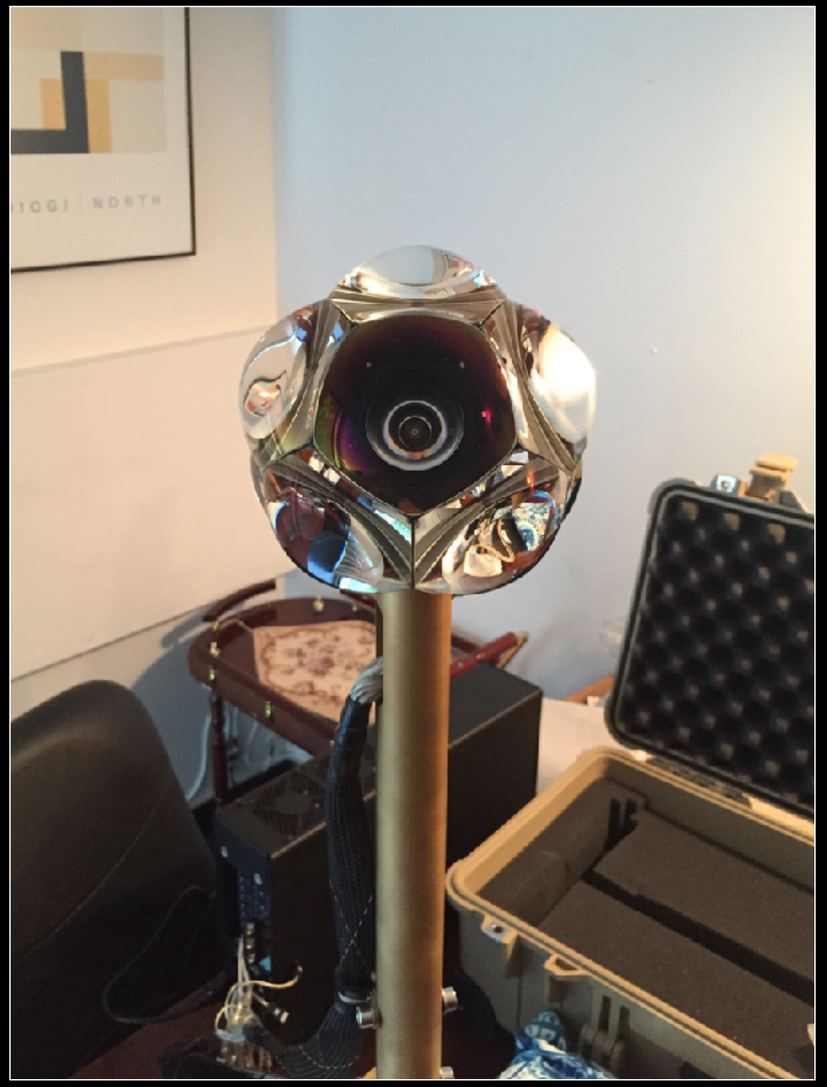
Solution in the 60's





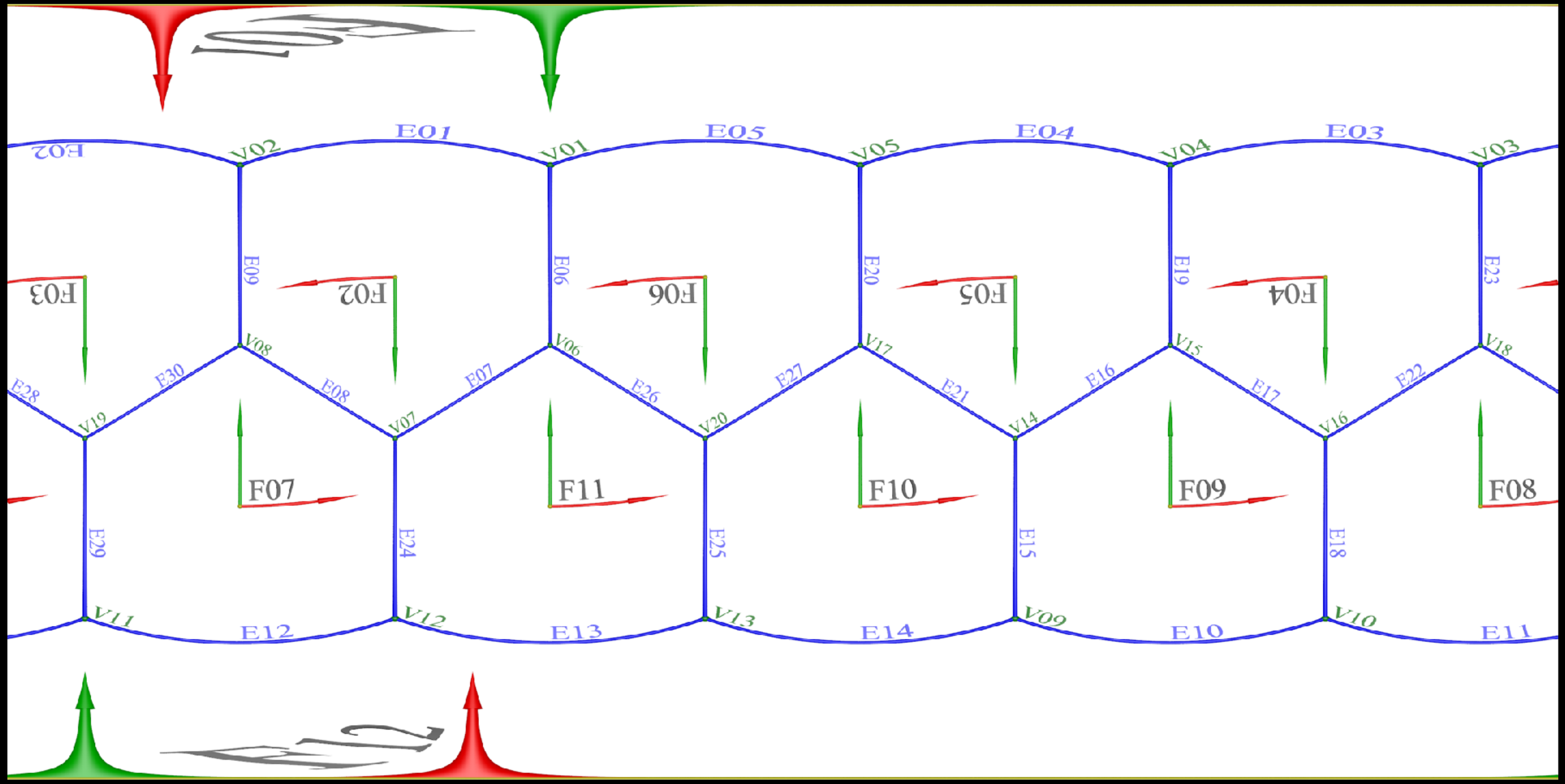


Solution being developed



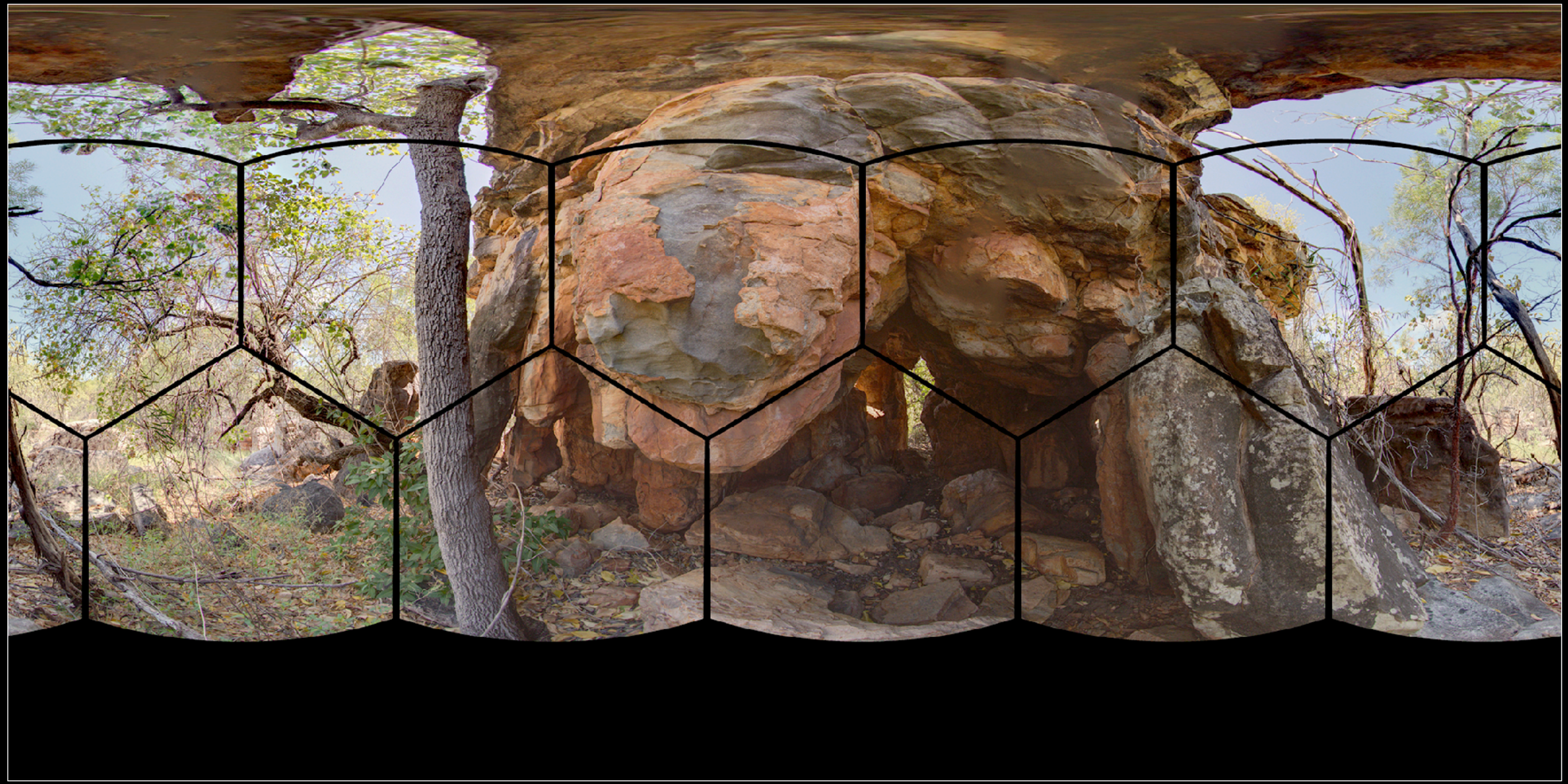
Circle Optics

Equirectangular layout



Example

Example



Example

Parallax problem for 3D 360 panorams

- Similar problem occurs for stereoscopic panoramas
- Traditionally for monoscopic panoramas one rotates a single camera around the so called “nodal point” of the lens, better known as zero parallax point.
- Typically from 3 to 12 shots, many more for gigapixel panoramas.
- Problem, traditional feature point and stitching can apply non-linear local distortions that are independent of each stereo pair
- Again, often not a problem for low resolution VR devices but generally revealed on high resolution displays

Past Solution

- Targeting high resolution immersive displays (eg: cylinders), goals:

  - 30,000 pixels across 360 degrees

  - 90 degrees vertical FOV

  - suitably portable for field work

  - capture still image in <10 seconds

RoundShot (Zeiss)

Roundshot

Left eye

Right eye

Turkiye, Sarah Kenderdine

Current solution

Slit covers on lens

Two Voiglander wide angle lenses 10.5mm, F0.95

Two GH5 cameras

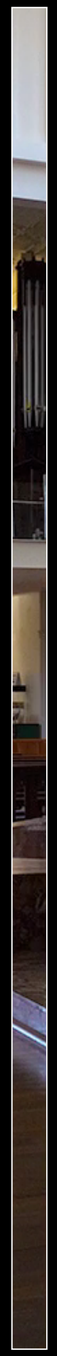
Miscellaneous rigid mount parts

Accurate motorised rig

Precise leveller

In portrait mode: 5184 pixels high

Example 1



Example 1

Left eye

Right eye

45,000 pixels

40 degrees vertical FOV

St Marys Cathedral, Perth

Example 2

Left eye

Right eye

22,000 pixels

110 degrees vertical FOV

Thank you