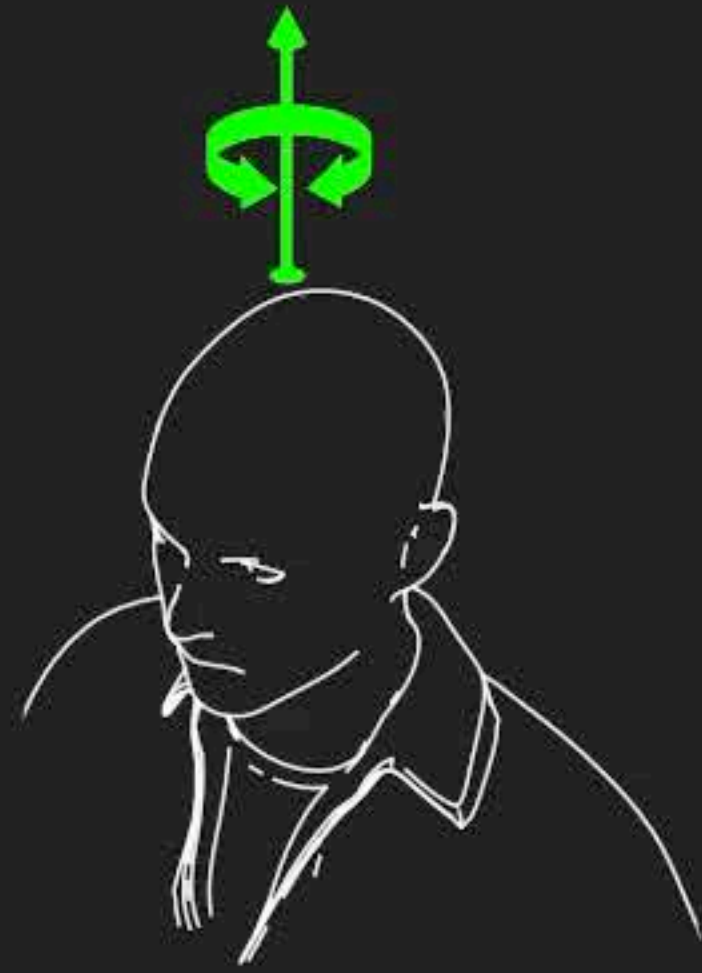


# Six Degrees of Freedom Video



Brian Cabral  
[Facebook](#)

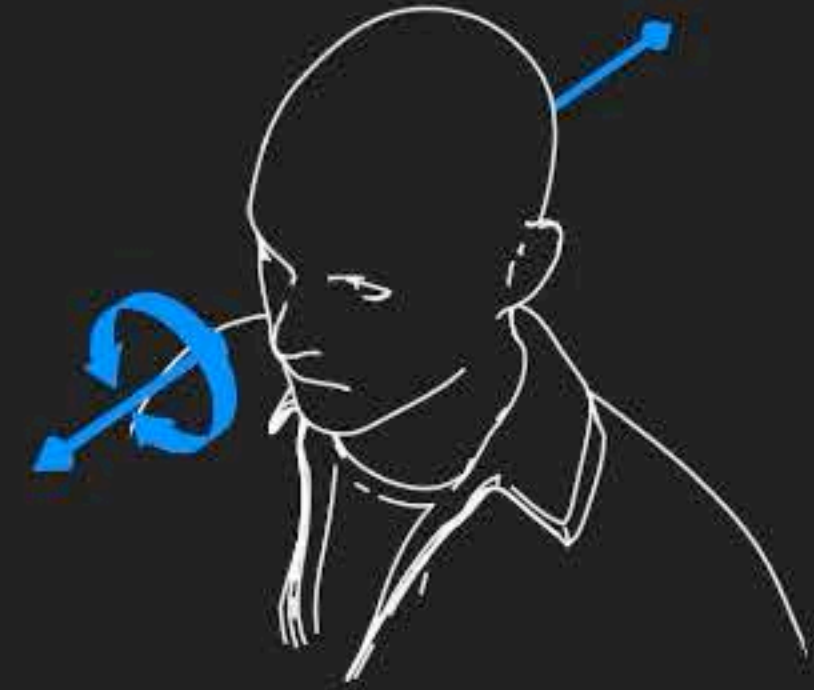




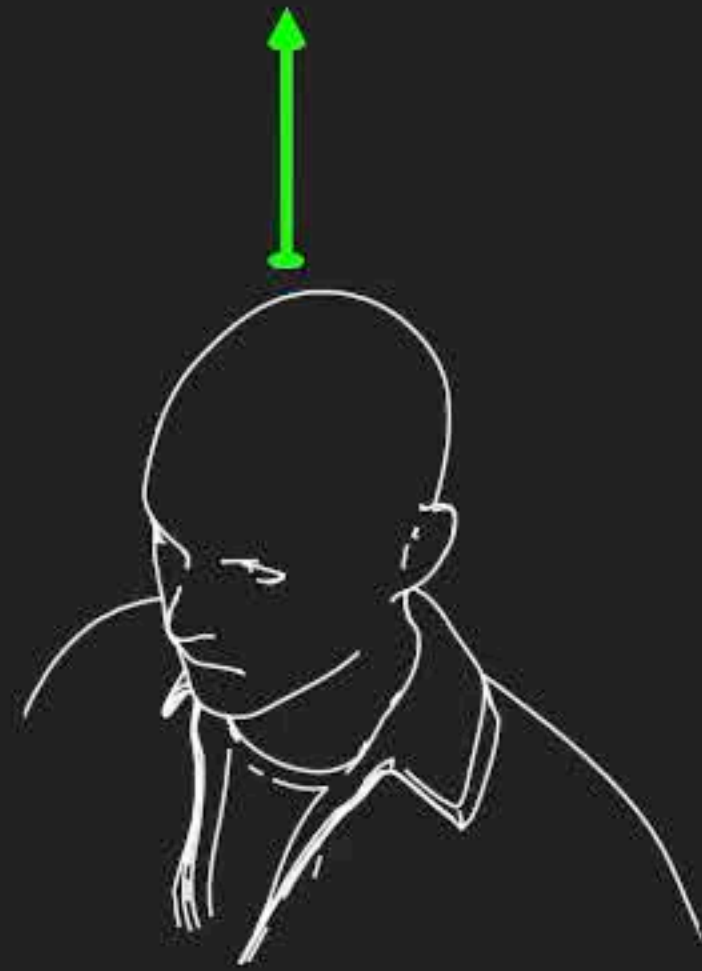
Y AXIS YAW



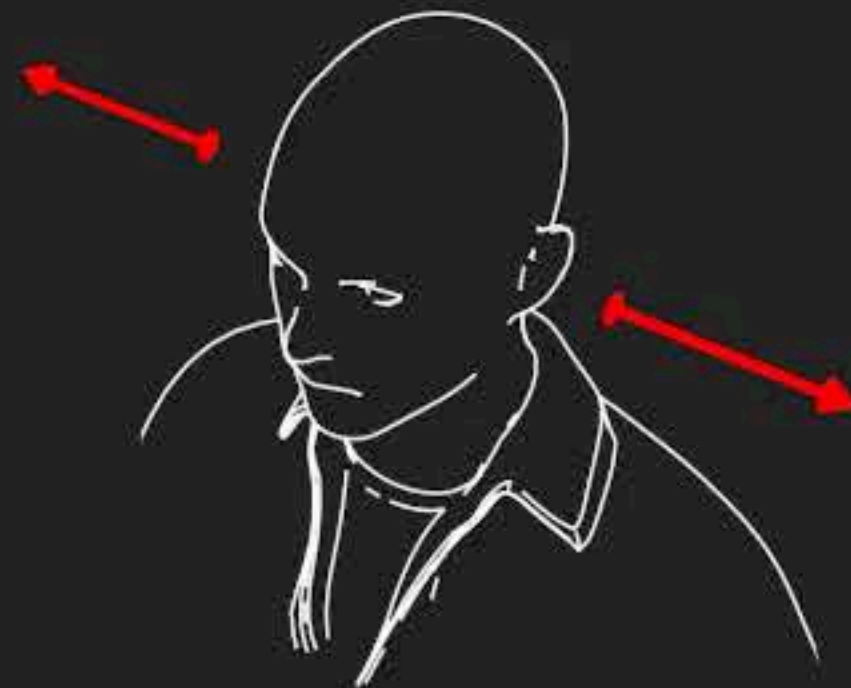
X AXIS PITCH



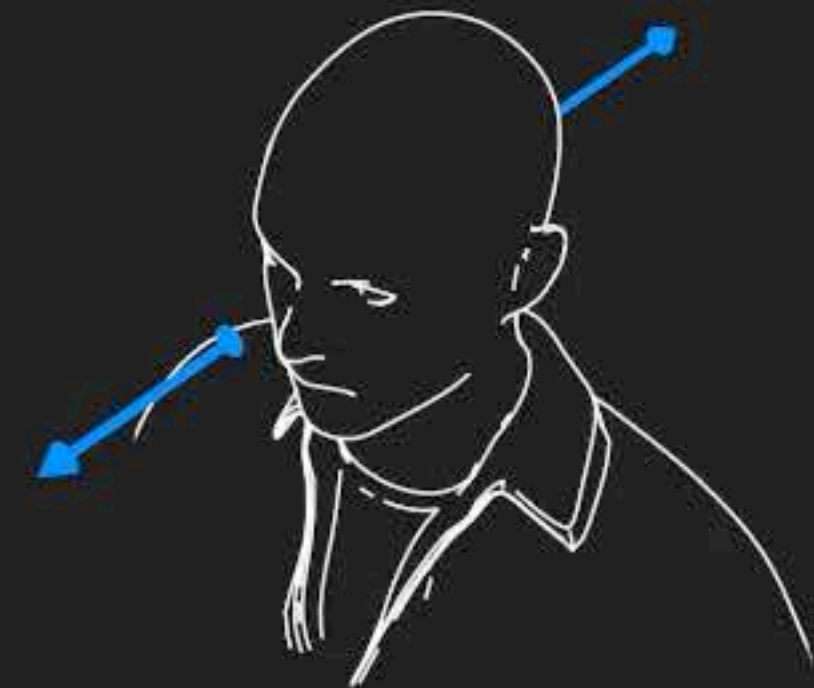
Z AXIS ROLL



Y AXIS UP/DOWN



X AXIS LEFT/RIGHT

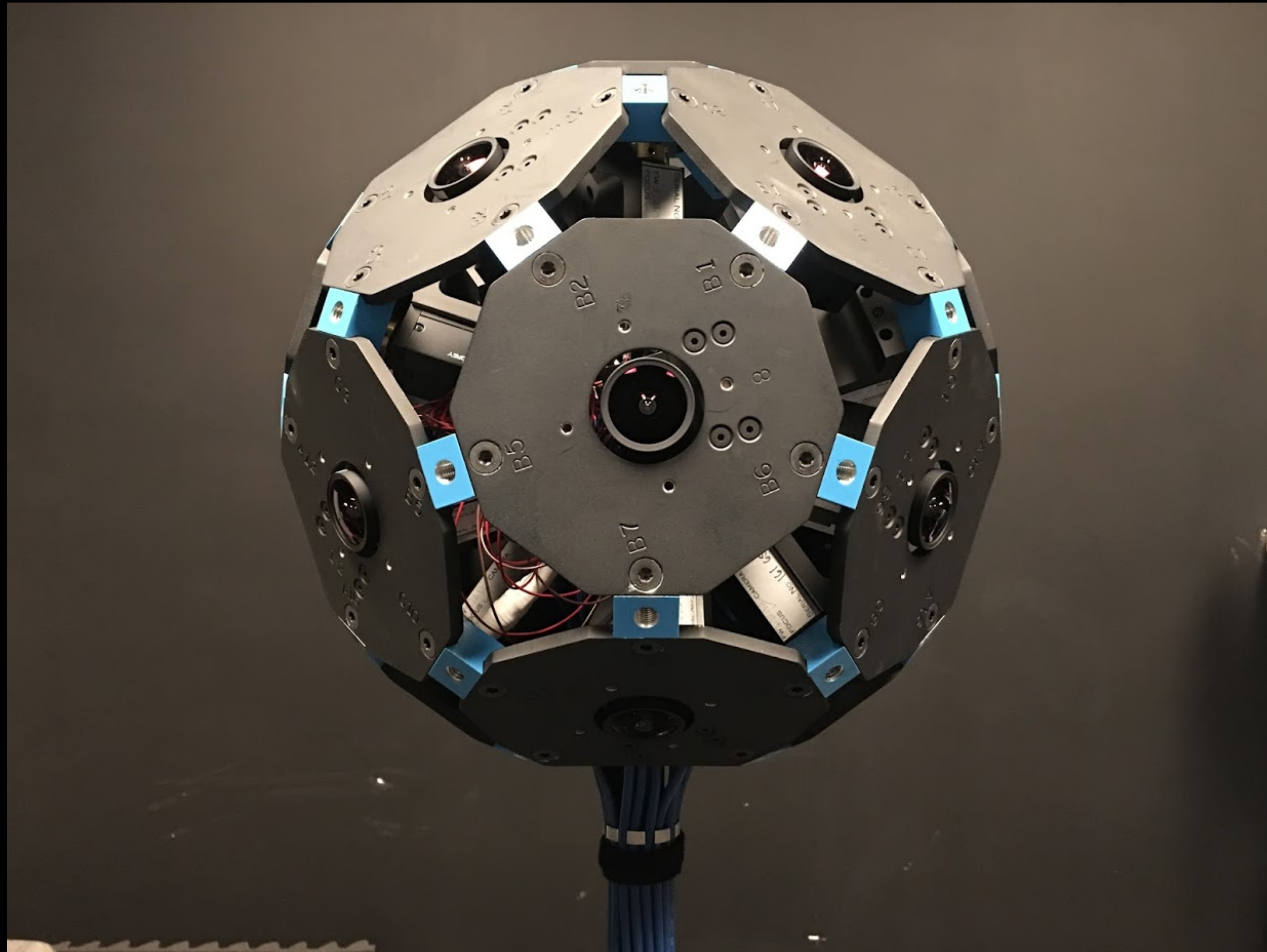


Z AXIS FRONT/BACK

This can't do 6DoF - why not?



This rig can do 6DoF - why?

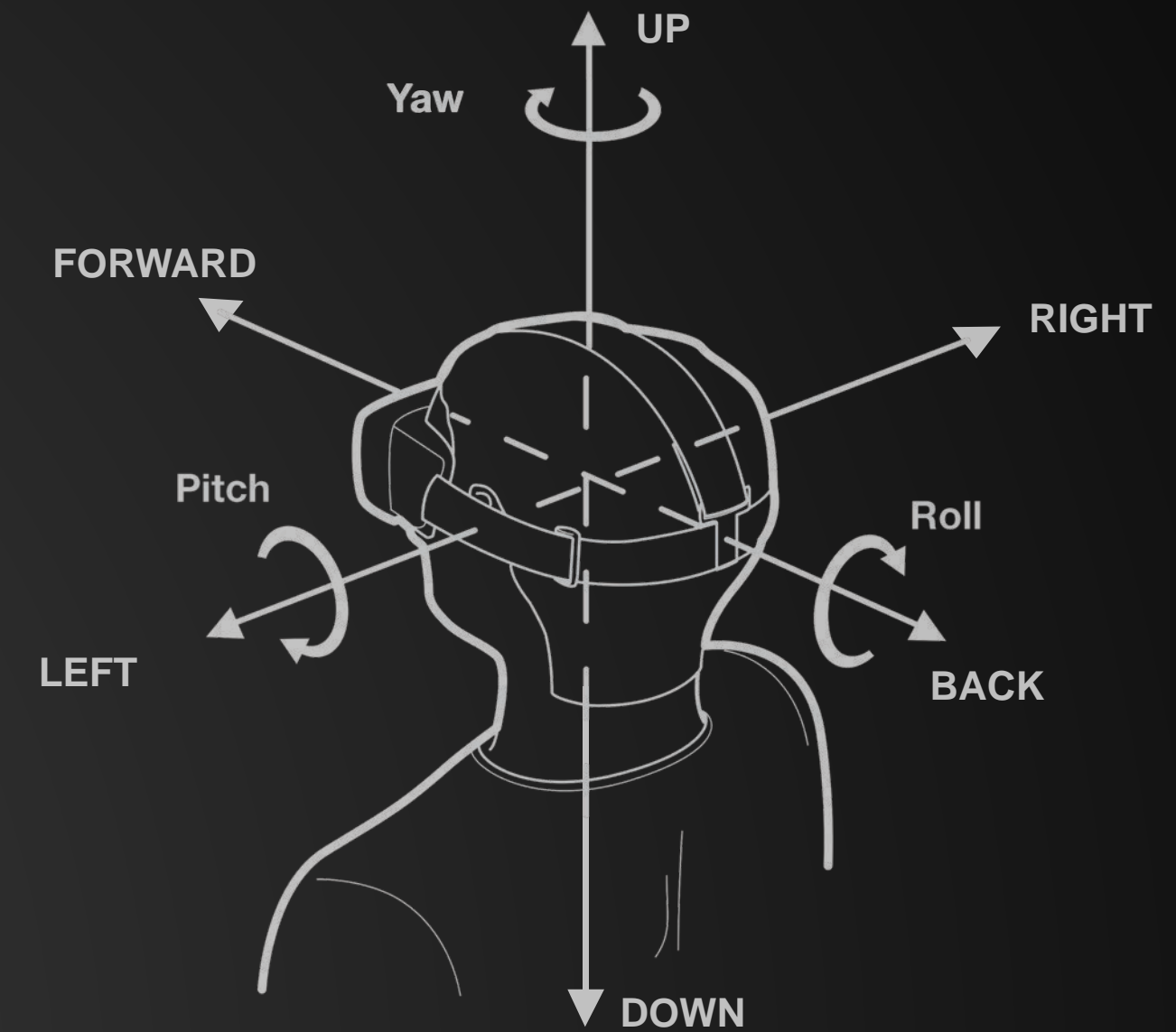


# 6DoF vs ODS



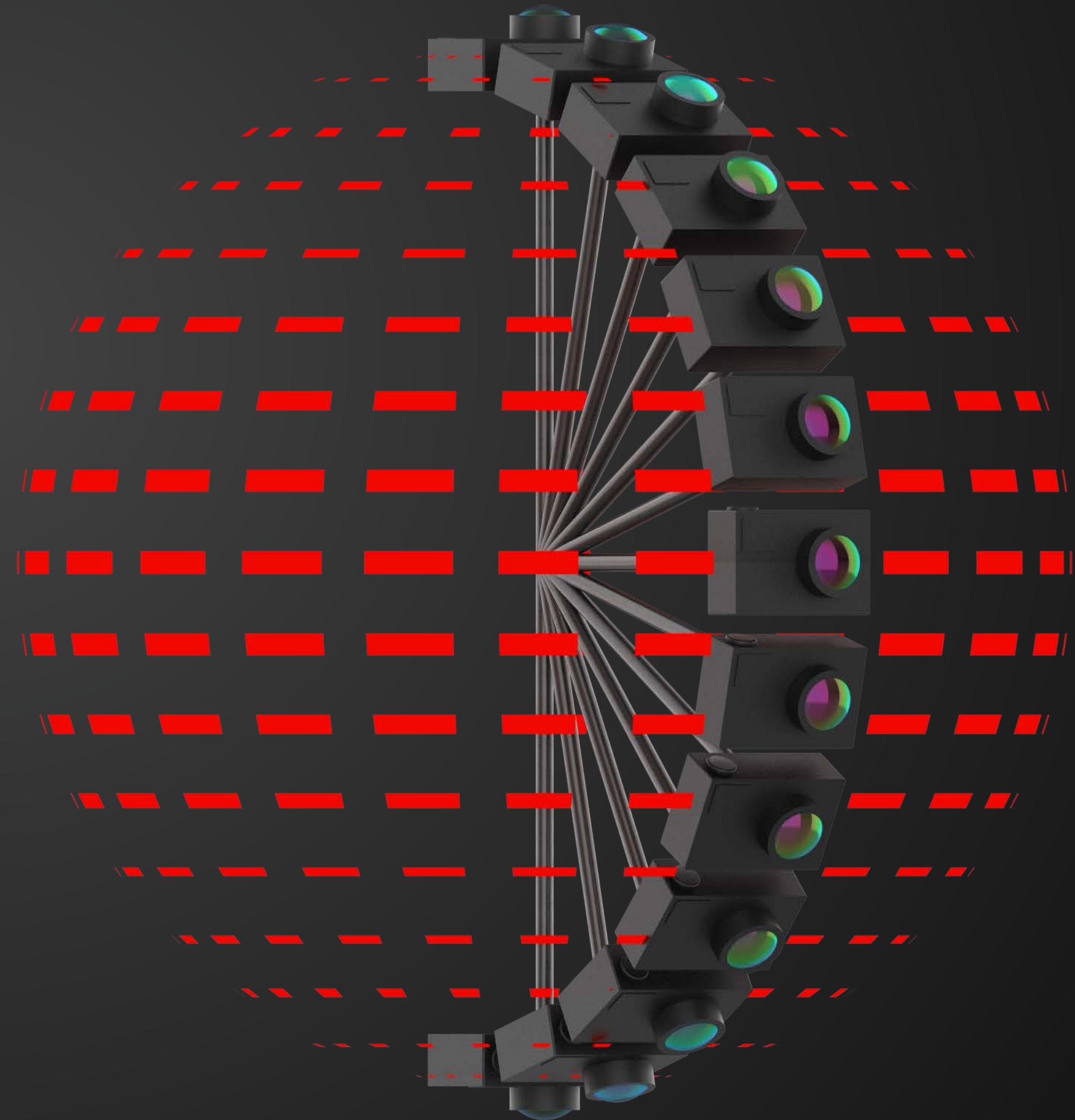
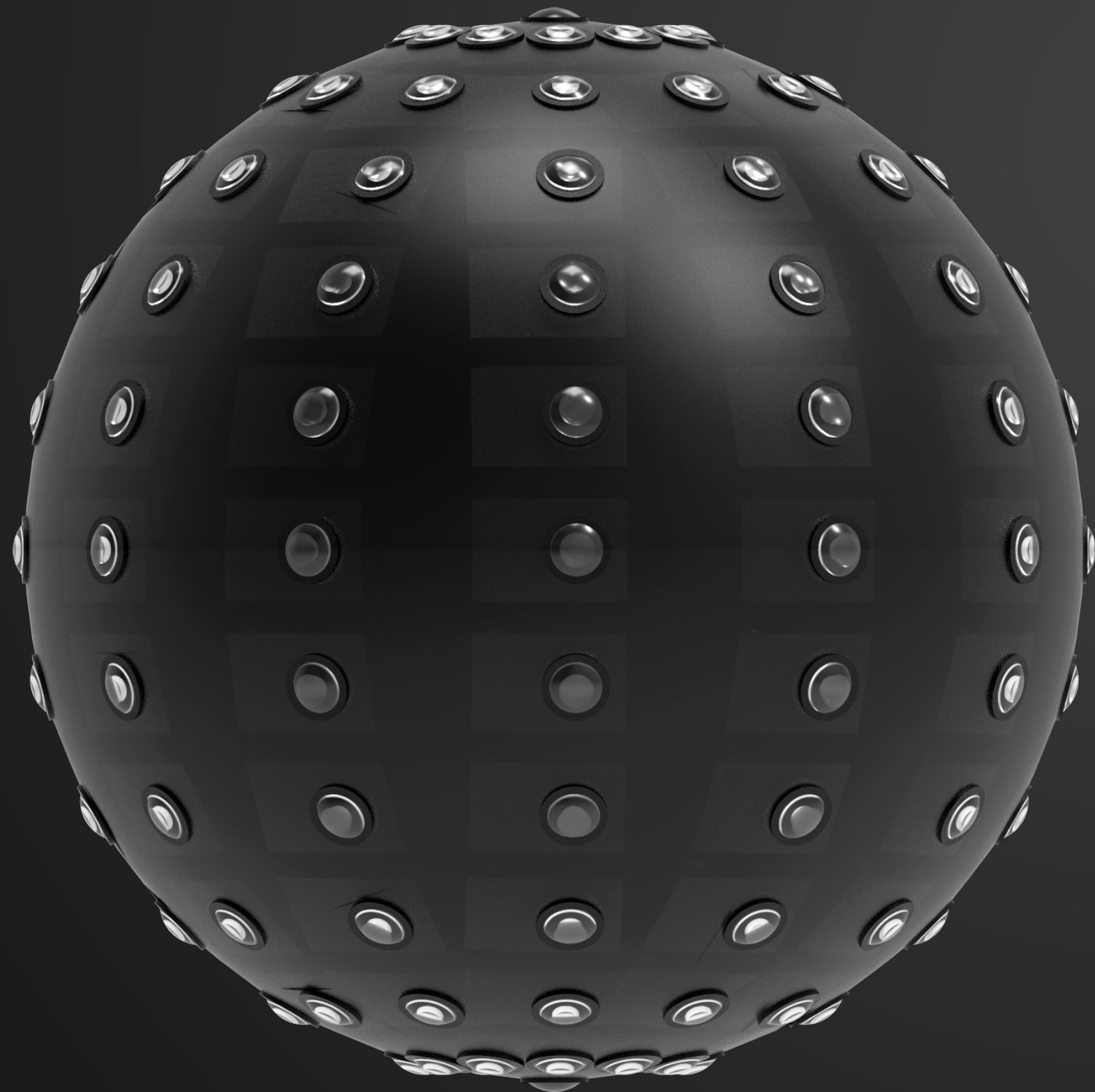
# The 6-DOF + time Challenge

- You need to capture a moving depth map
- Several approaches
  - Trades off between “angular” resolution and spatial
  - Light Field cameras use many sub-apertures to gain more angular resolution
  - We use more spatial resolution by assuming band-limited BRDF's & occlusions



# Spherical Lightfields

- A LOT, 100'S OF CAMERAS PLACED IN A SPHERE
- USE A SPINNING GANTRY OF ONE OR MORE CAMERAS
  - GOOD FOR STILL LIFES - STUNNING RESULTS
- HARD TO DO FOR VIDEO





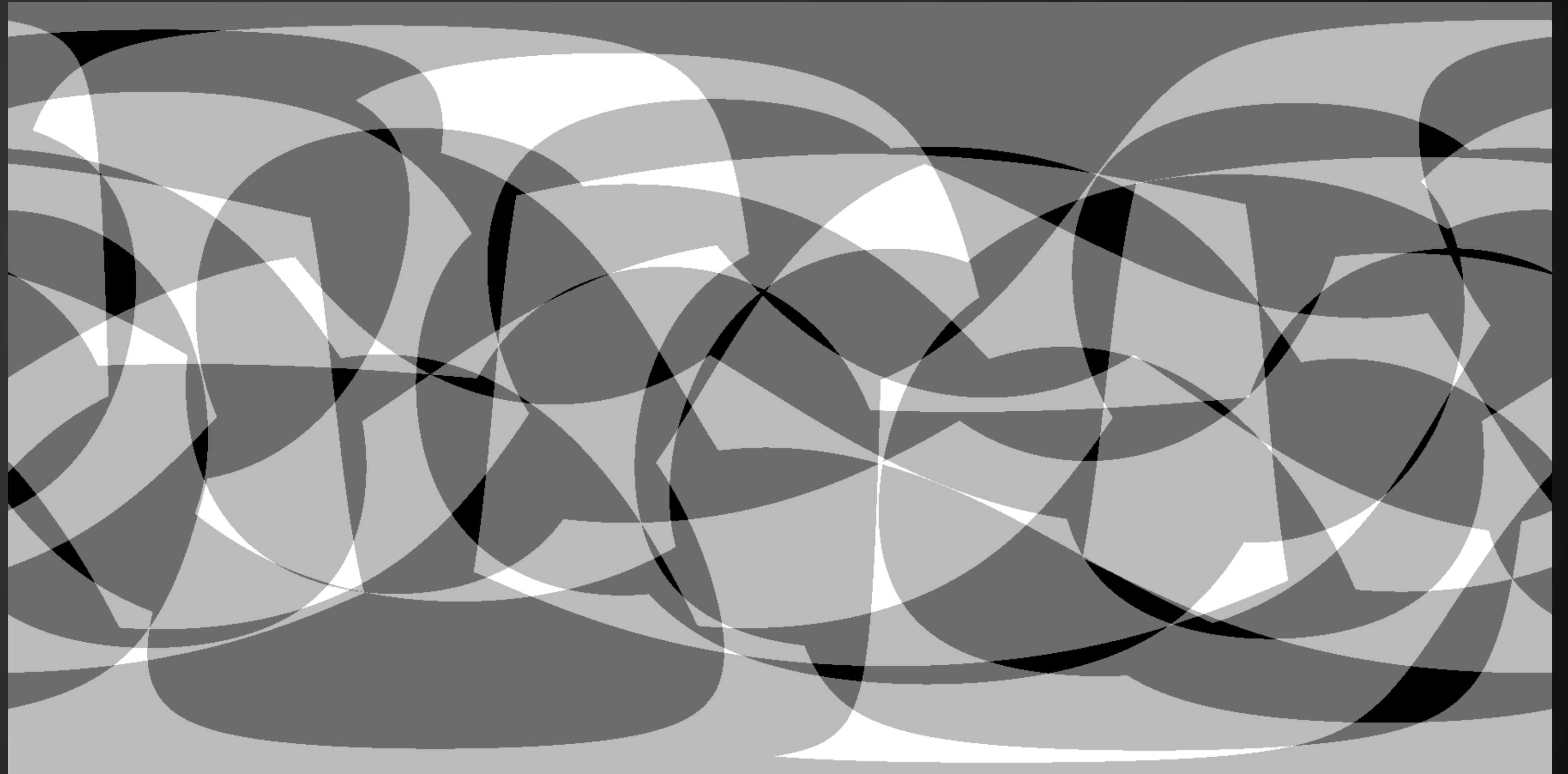
# The alternative is to use a sparse, high resolution array

- We need to solve the novel view synthesis problem
- One approach: estimate depth and re-project
- This not the only approach
- Depth estimation is hard ill-posed problem



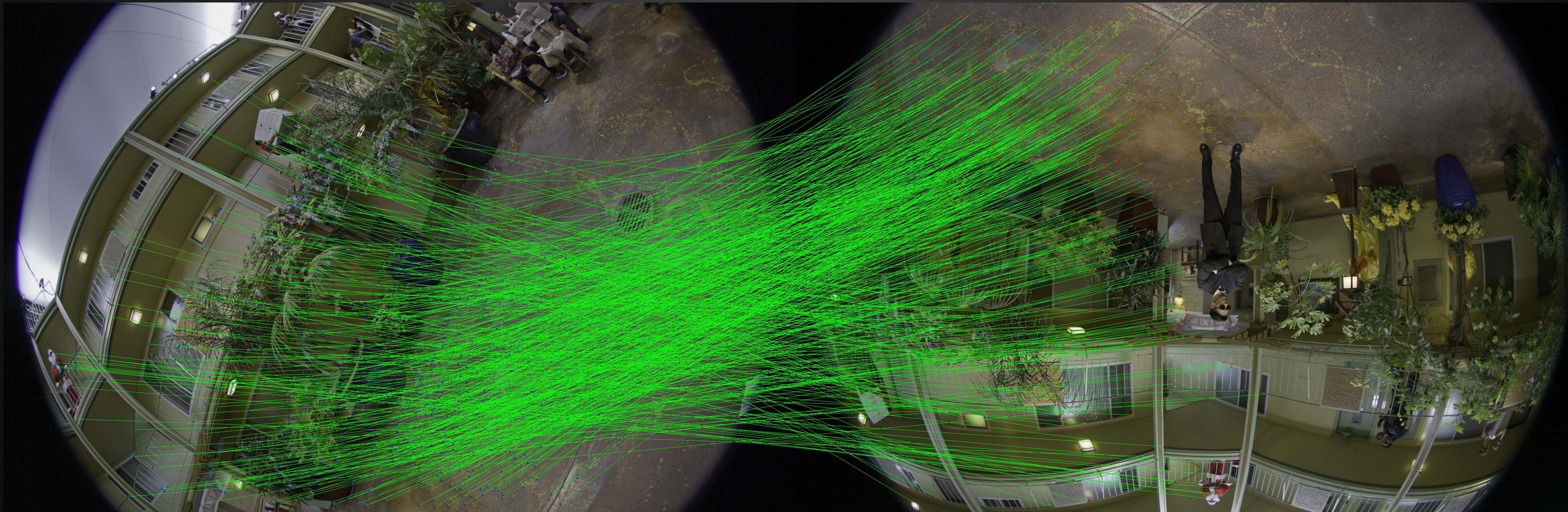
# How do build such a camera

- Maximize camera overlap
- Minimize camera count
- Maximize head-box
- Minimize weight
- Deal with thermal issues
- Posses high reliability
- Have live preview
- Have great pixels (high SNR)



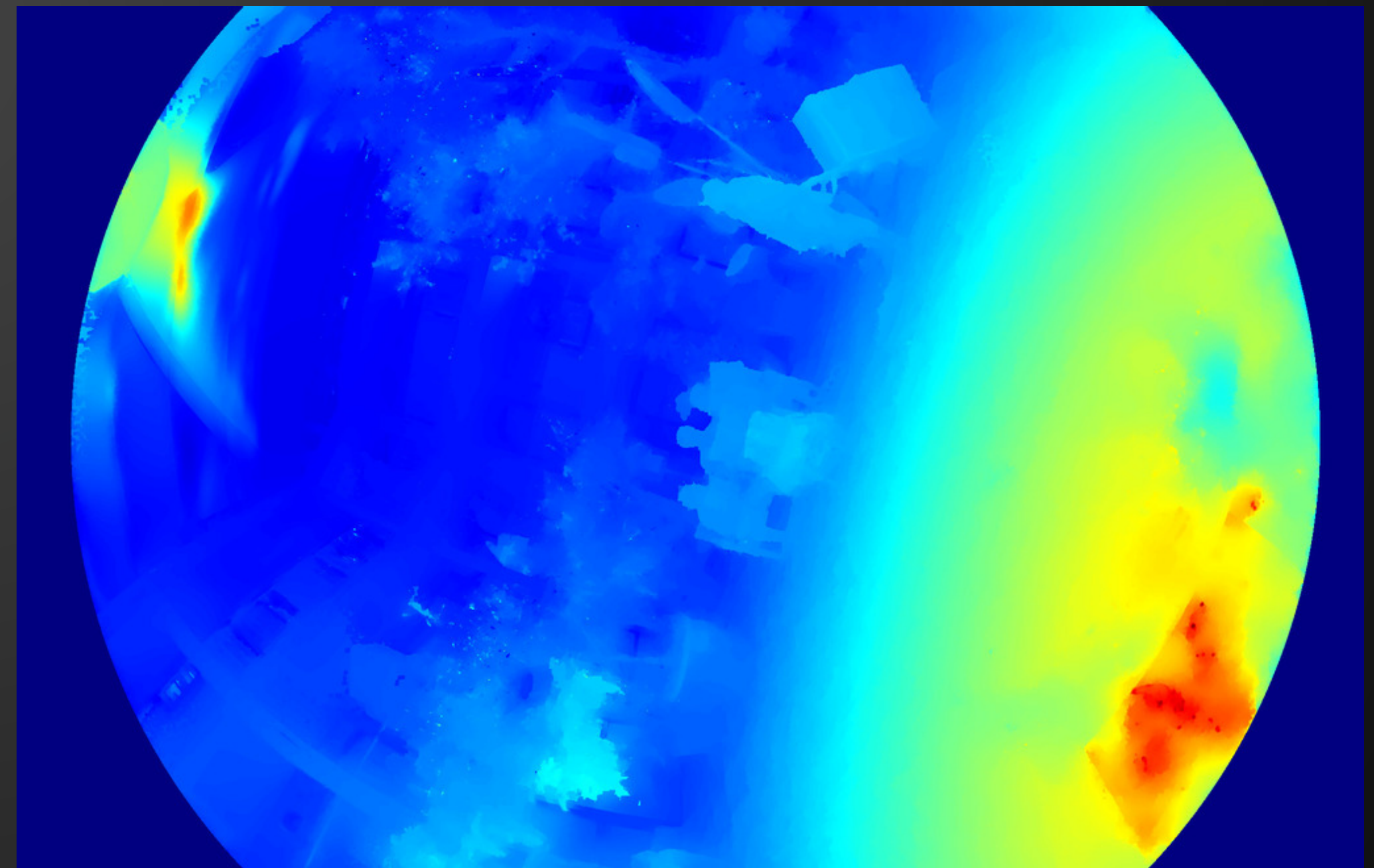
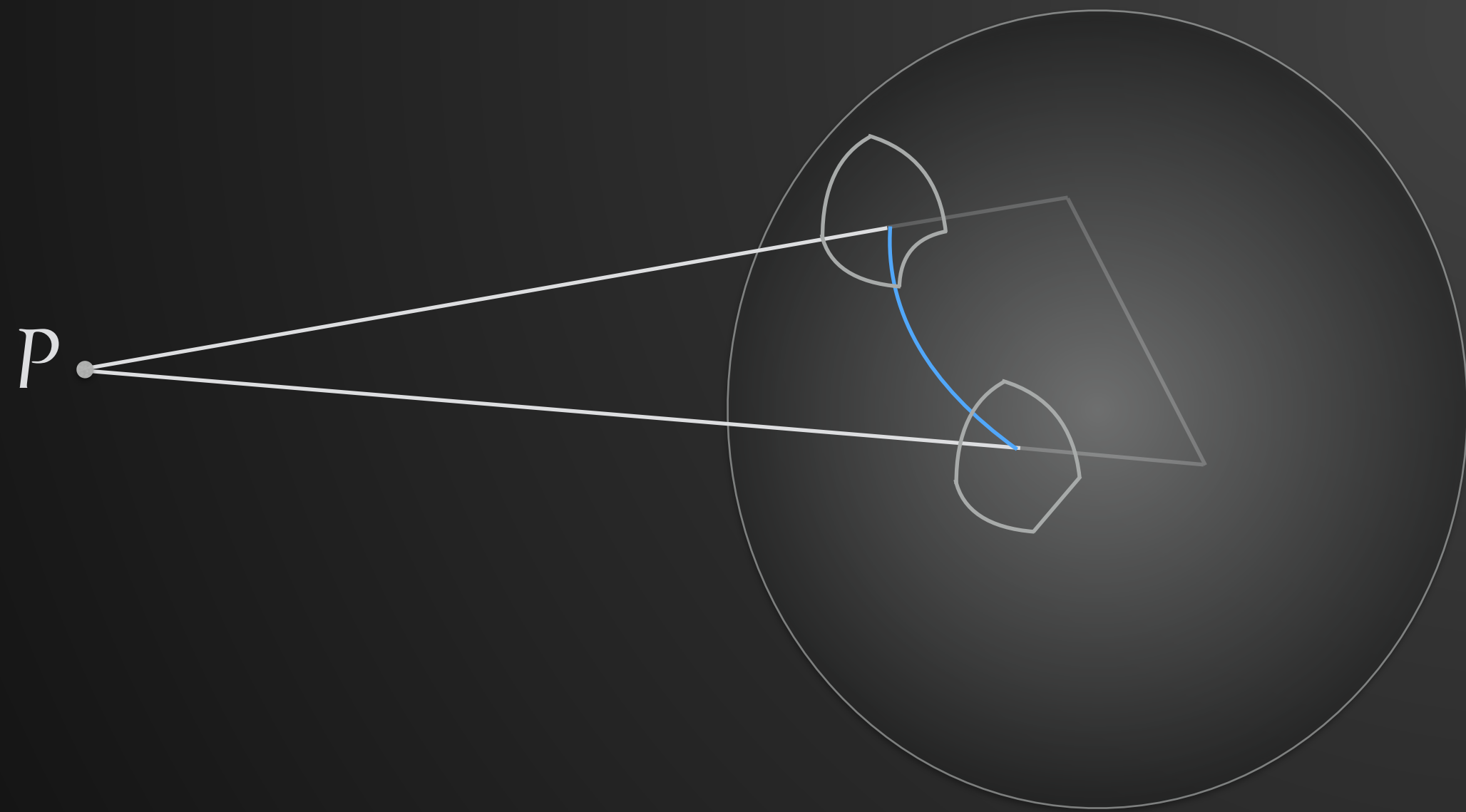
# Calibration is critical

- You would like to make it easy to do in the field
- We developed a marker-less system
- Use classic bundle adjustment (good up to “scale”)



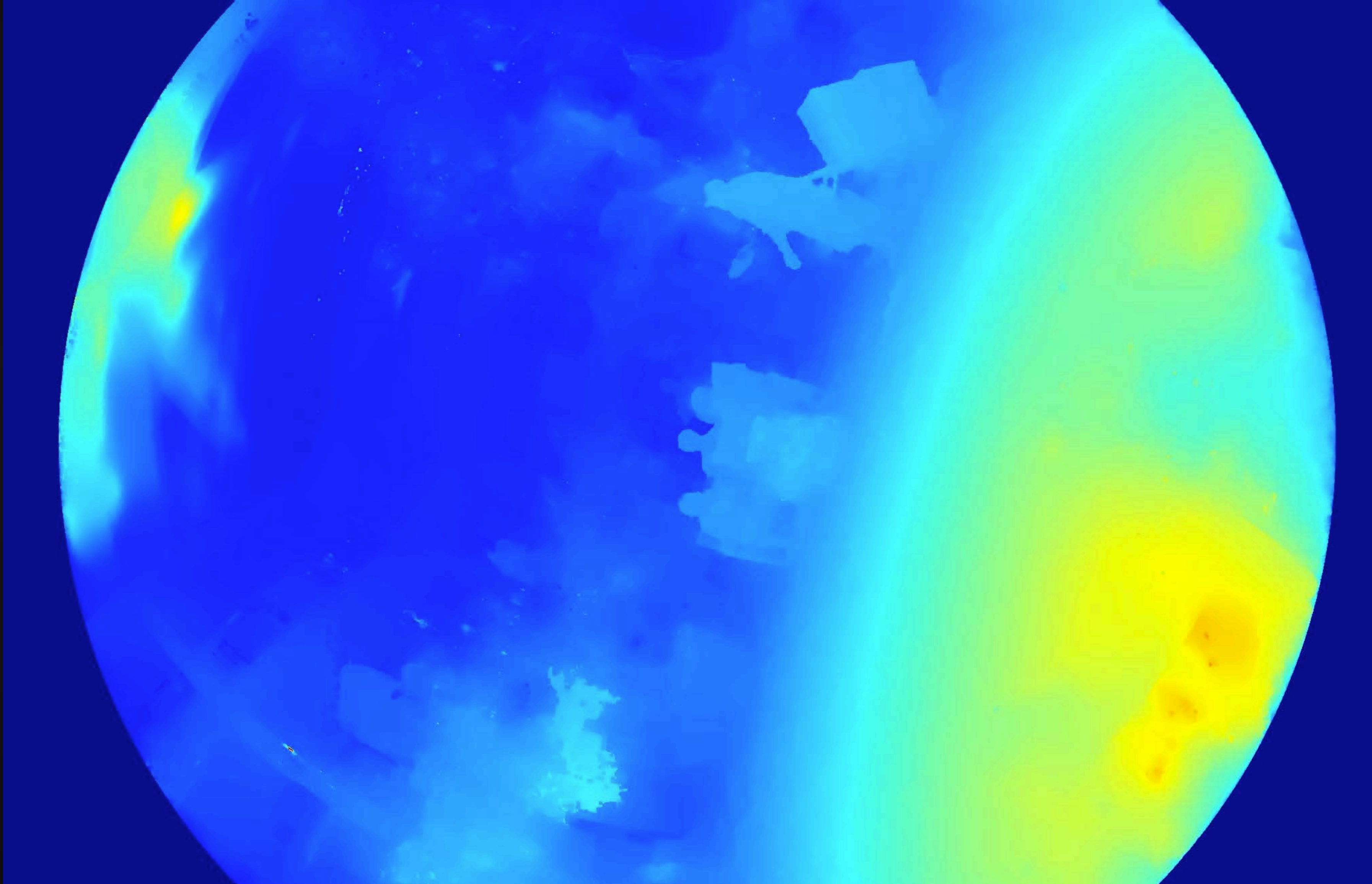
# Create depth maps per camera

- Even though our mapping is non-linear all the homographic properties hold
- Epipolar “lines” become great arcs and curves
- A depth map per camera



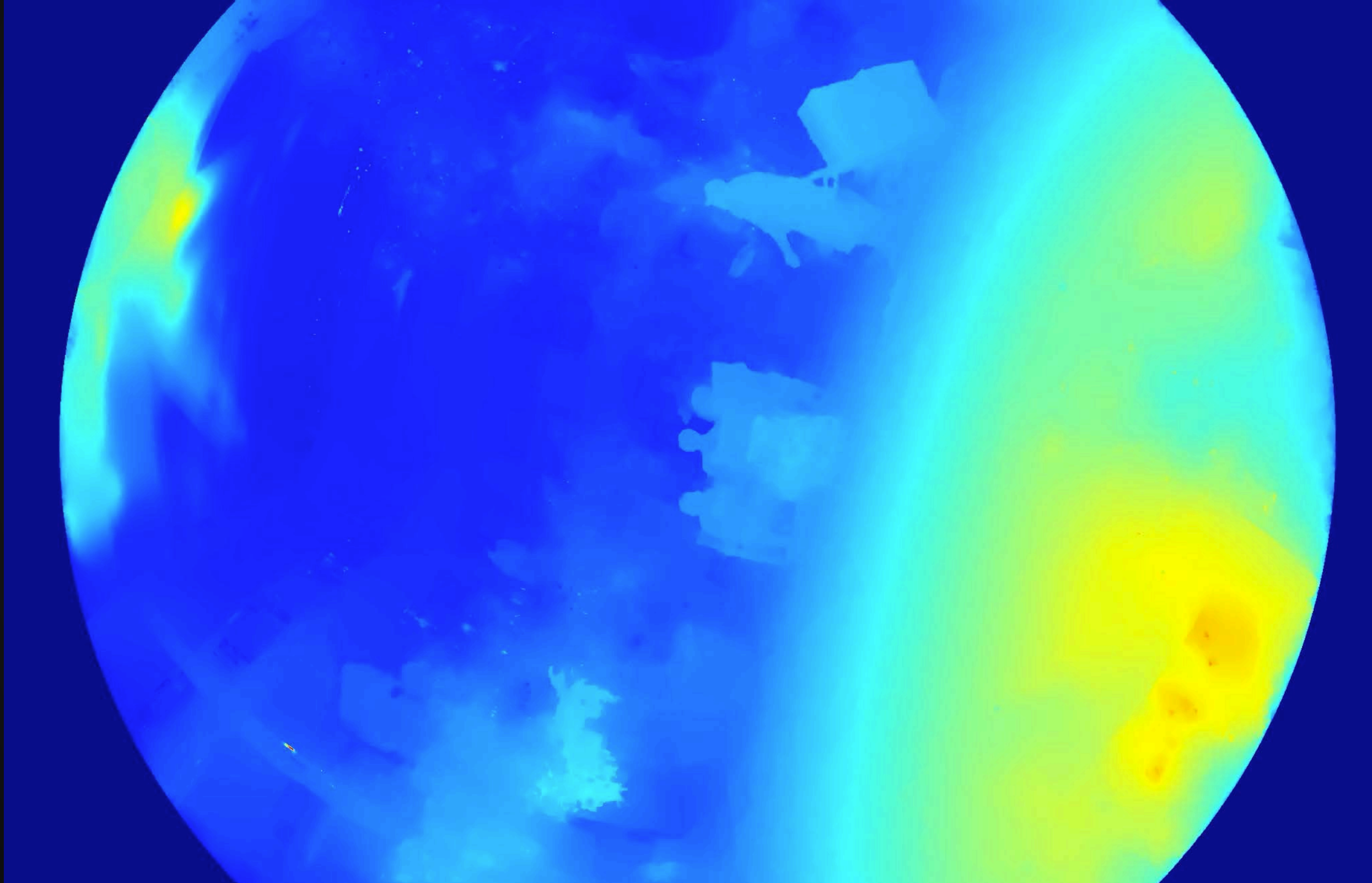
# Must filter in time

- Without temporal filtering



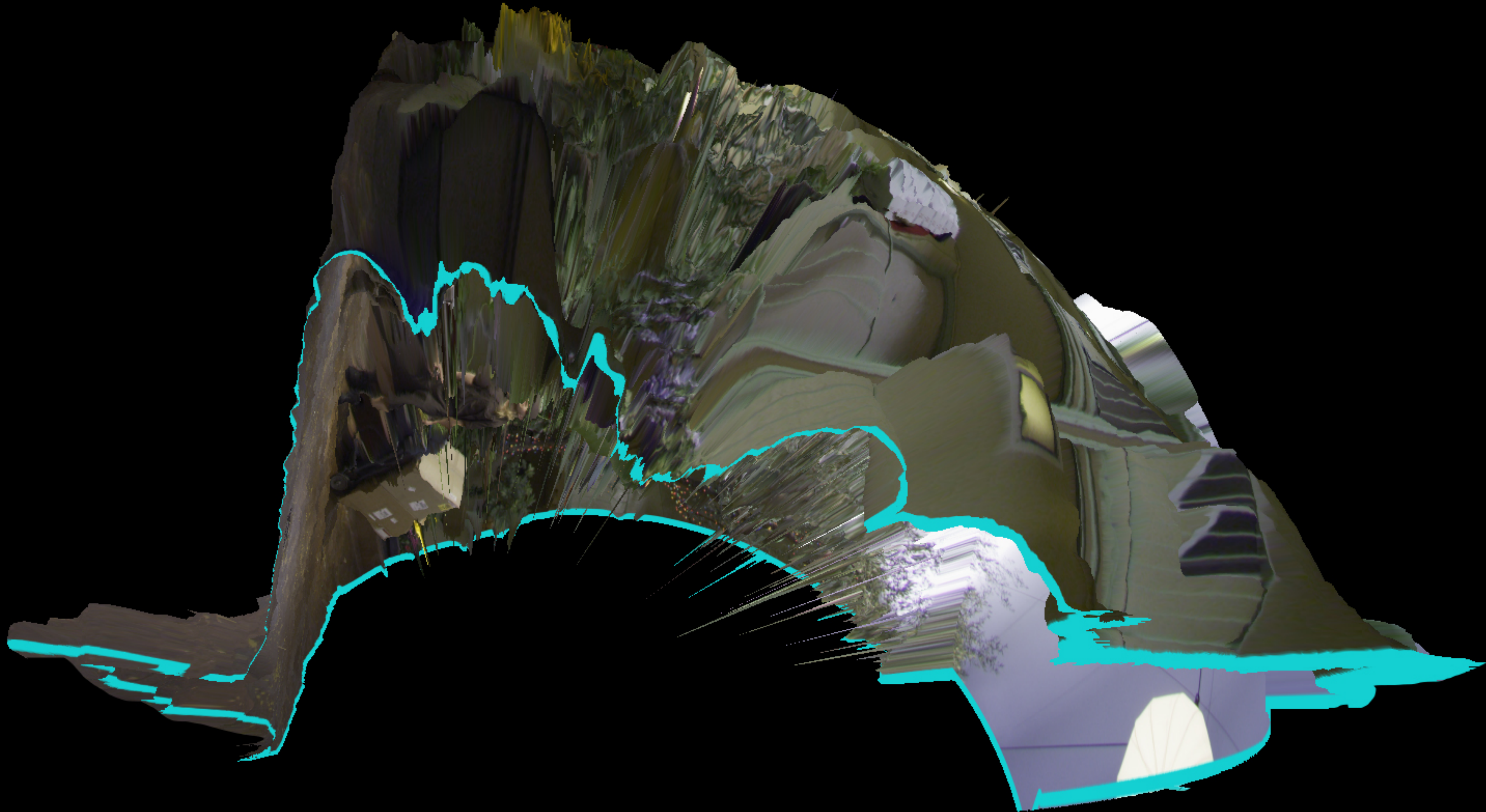
# Must filter in time

- Without temporal filtering



We can re-project this into a single space

- Each camera's view creates a draped canopy



We can re-project this into a single space

- Streaky triangles induced by depth discontinuities







# The 6-DOF + time Challenge

- Closing notes

- You often still need edge and depth/disparity info to clean up edges for pure light field approaches
- Sparse cameras don't preclude image based approaches
- Good, reliable, calibrated cameras are a necessary for professional capture

