

# **Panoramic Photos**

“Images with elongated fields of view”

# Why create Panoramic Photos

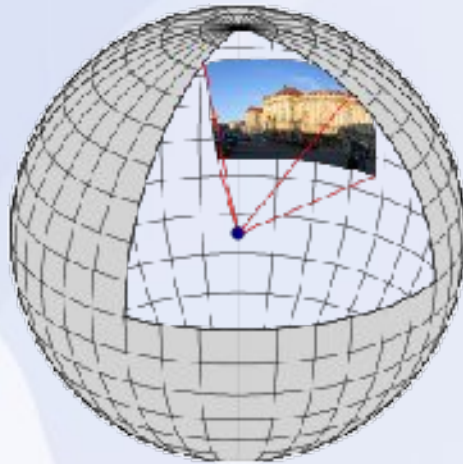
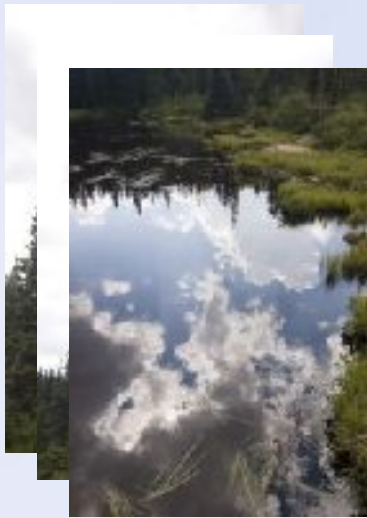
- Extremely wide or tall subject, like landscapes or towers
- Get higher resolution photos
- Capture higher field of view than possible with any lens, even capturing all 360°

# Ways to produce a Panoramic photo

- Crop an image taken normally
  - Lower resolution than you often want in a panoramic photo
  - Not a wide field of view as often seen in panoramic photos
- Combine pictures in the computer via a process called stitching
  - Often this software will combine different exposures for HDR (High Dynamic Range) photos, as well

# Workflow

- Capture
- Align
- Project and Warp
- Blend



# Capturing photos

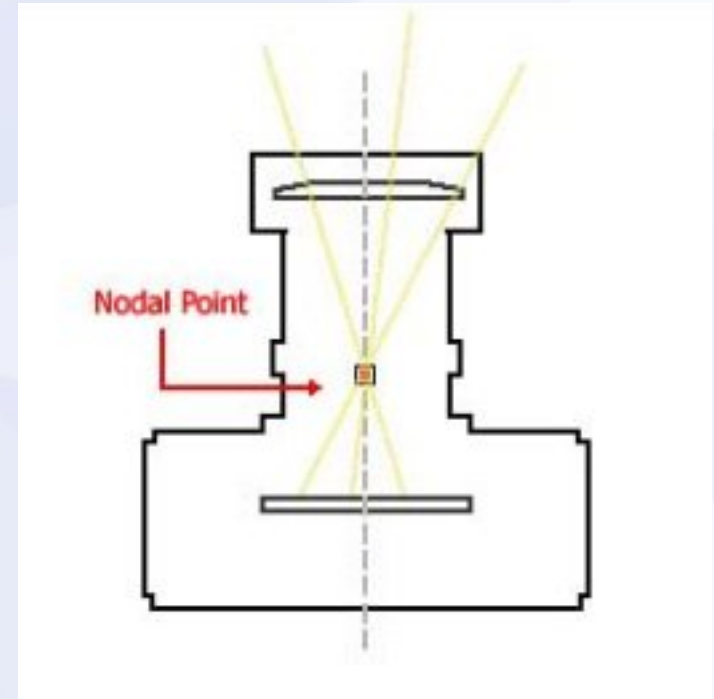
- Need to set the AWB, ISO, and exposure
- These photos will all be part of a larger photograph, so the settings for all need to be the same
- Need to use Manual settings on your camera
- Ensure you have sufficient overlap between photos
- **USE A TRIPOD**

# Capturing photos

- If all the objects in the scene are not in the distance, you need to eliminate parallax
- Parallax occurs when photos are taken from different vantage points, even if only slightly different

# Eliminating Parallax

- Locate entrance pupil, or “nodal point” of the lens
- Rotate the camera and lens about this point



# Parallax Example



Parallax demonstration

*Courtesy Bernhard Vogl - <http://wiki.panotools.org/Image:Parallax.gif>*



# Finding the no-parallax point



Rotating behind no-parallax point



Rotating at no-parallax point

*Courtesy John Houghton - <http://www.johnhpanos.com/epcalib.htm>*

# Captured Images

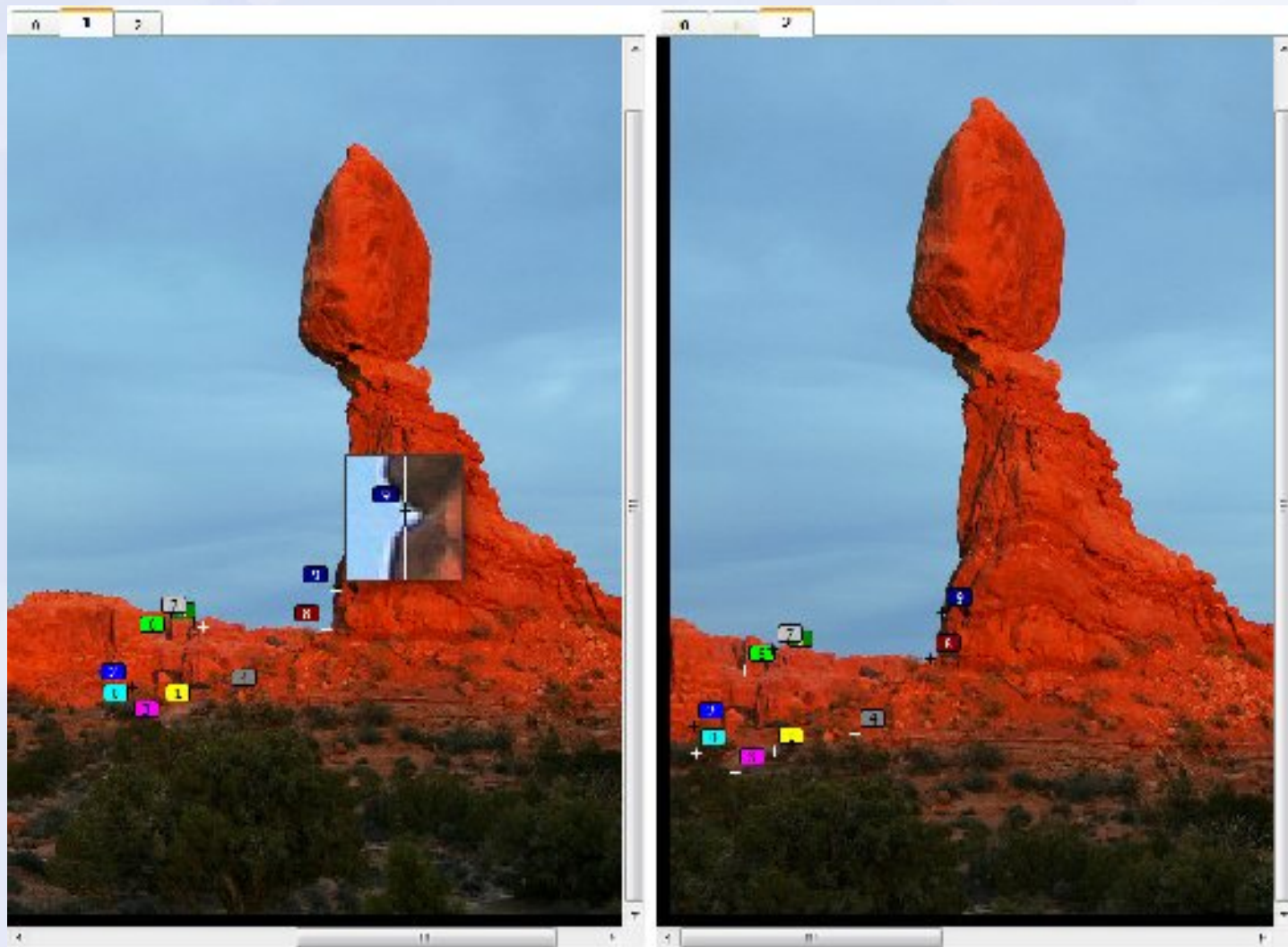


# Multiple Rows and Columns



# Align images in software

Find common points between adjacent images



# Other optimization and image correction

- Per image correction
  - Yaw
  - Pitch
  - Roll
- Global Lens Parameters
  - Field of View
  - Radial Lens Distortion
  - Horizontal and Vertical Shift

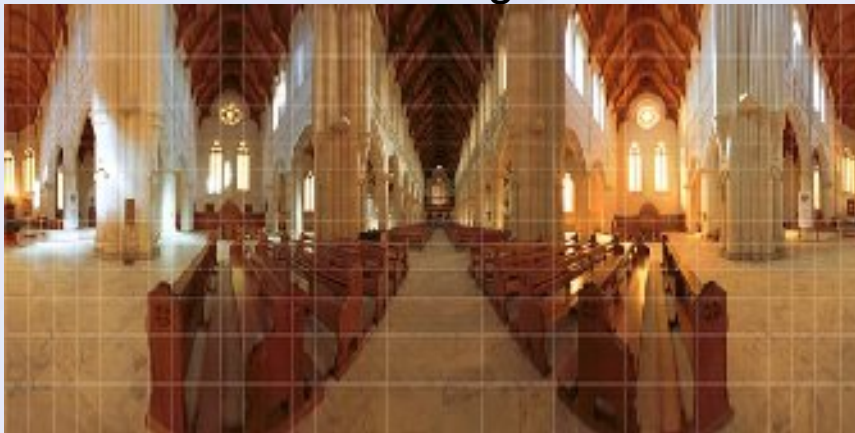
# Projections and Warping

Mapping a 3-D world onto a 2-D plane

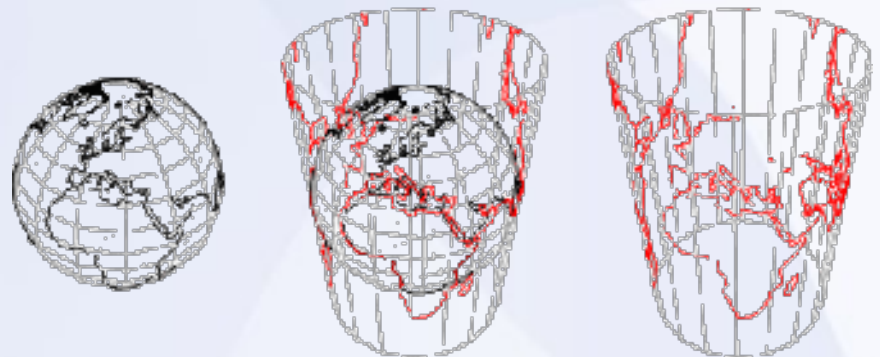
- Equirectangular – “non-projection”
  - Horizontal is direct longitude
  - Vertical is direct latitude
- Cylindrical
  - Extend sphere to tangent cylinder
  - Horizontal is direct longitude
  - Vertical is tangent latitude



Equirectangular Projection



Cylindrical Projection



# Blend

- Vignetting (lens and optical)
- Moving objects (clouds and people)

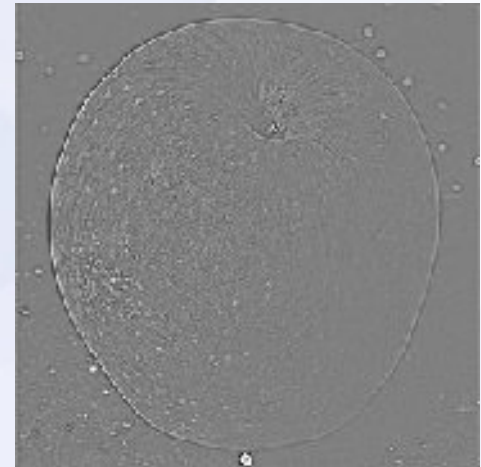


# Blending Methods

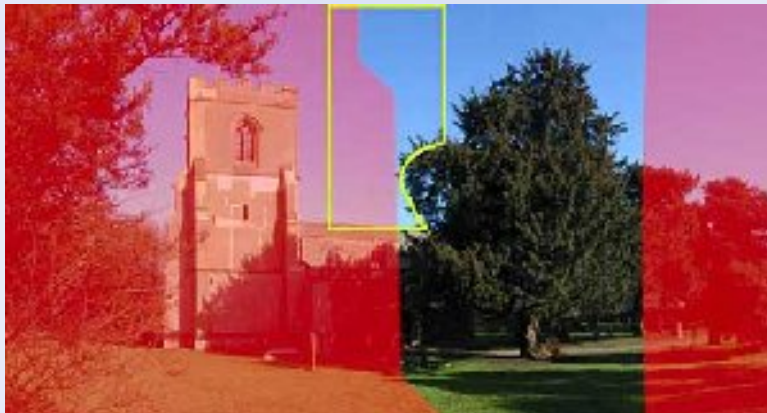
- Manual
  - Photoshop Layer Masks
- Automatic
  - Feathered Edges
  - Multi-Resolution Spline



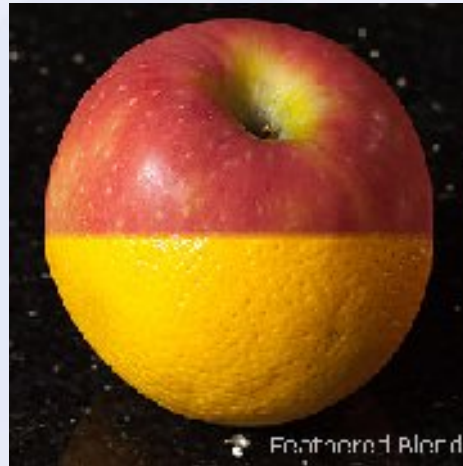
Low spatial resolution



High spatial resolution



Manual Layer Mask Blending



Feathered Edges



Multi-Resolution Spline



# Software packages

- PT GUI <http://www.ptgui.com/> Around \$110
- AutoPano <http://www.kolor.com/> Around \$130
- Photoshop
- Sometimes cameras come with software
- Free options
  - Pos Panorama Pro
    - <http://www.photopos.com/Pos-Panorama-Pro-Panoramic-Image-Software.asp>
  - Others available on the web, for instance:
    - <http://www.thefreecountry.com/utilities/panorama-photo-stitching.shtml>
    - [http://en.wikipedia.org/wiki/Comparison\\_of\\_photo\\_stitching\\_applications](http://en.wikipedia.org/wiki/Comparison_of_photo_stitching_applications)

# Hardware

- Tripod heads
  - Panosaurus
    - <http://gregwired.com/pano/Pano.htm>
- GigaPan
  - Automatically takes photos for you in the rig for your camera



# Panoramic Photo References

- PanoTools Wiki - <http://wiki.panotools.org>
- John Houghton - <http://www.johnpanos.com>
- Sean McHugh - <http://www.cambridgeincolour.com>
- Panosaurus - <http://gregwired.com/pano/Pano.htm>
- GigaPan - <http://gigapansystems.com/>
- PT GUI <http://www.ptgui.com/>
- AutoPano <http://www.kolor.com/>
- Pos Panorama Pro  
<http://www.photopos.com/Pos-Panorama-Pro-Panoramic-Image-Software.asp>
- <http://www.thefreecountry.com/utilities/panorama-photo-stitching.shtml>
- [http://en.wikipedia.org/wiki/Comparison\\_of\\_photo\\_stitching\\_applications](http://en.wikipedia.org/wiki/Comparison_of_photo_stitching_applications)