Everything you need to know about "fulldome", and some more

Paul Bourke

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Questions can be directed by email to
paul.bourke@gmail.com

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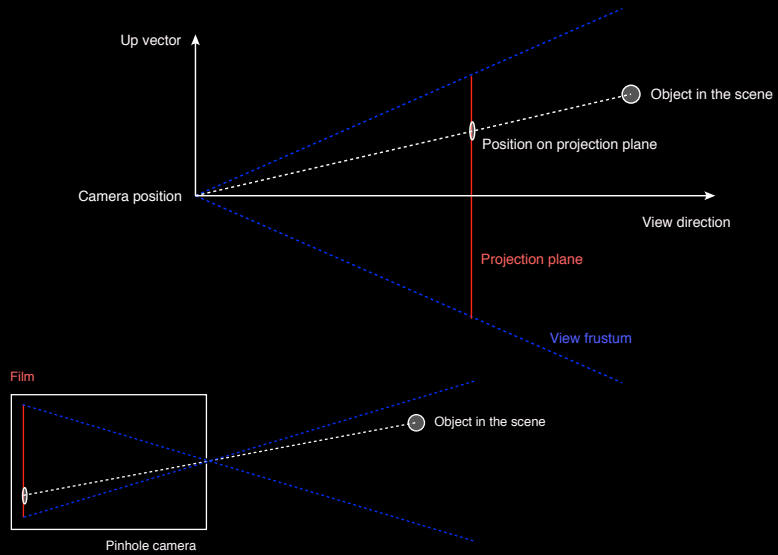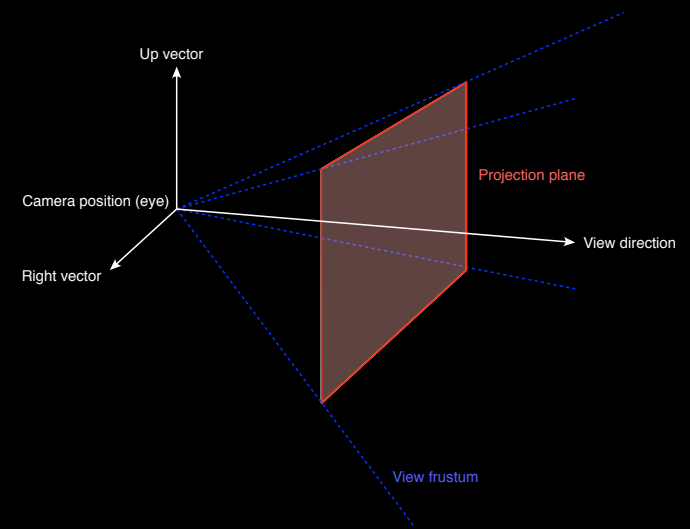3D -> 2D image mappings (projections)

Dome environments

Content creation

3D -> 2D image mappings (projections)

- Perspective

- Cylindrical

- Equirectangular (spherical)

- Cubemaps

- Fisheye

Perspective Projection

Up vector

Camera position (eye)

Projection plane

View direction

Right vector

View frustum

Up vector

Object in the scene

Position on projection plane

Camera position

View direction

Projection plane

View frustum

Film

Object in the scene

Pinhole camera

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60 degree horizontal field of view

120 degree horizontal field of view

140 degree horizontal field of view

160 degree horizontal field of view

Cylindrical Projection

45 degrees vertically

Up vector

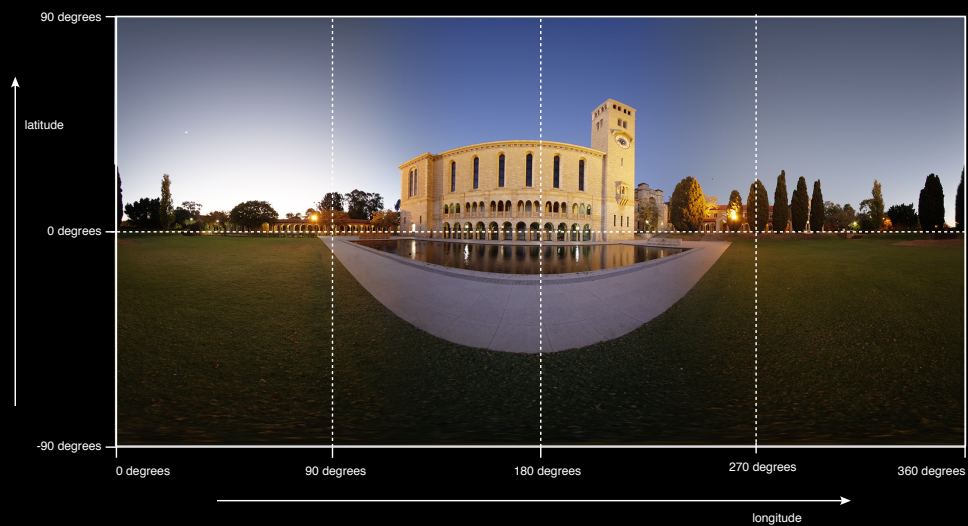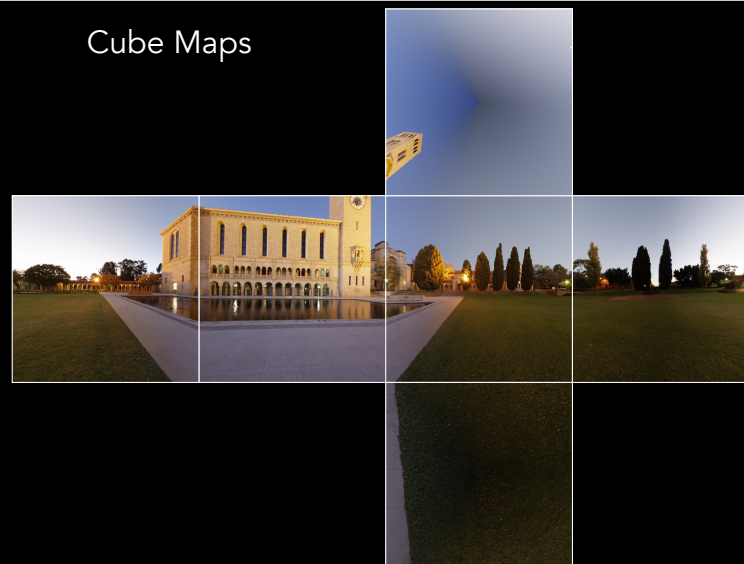Camera position

Object in the scene

Position on cylinder

Projection cylinder

Side view (cross section)

Object in the scene

Position on cylinder

Camera position

Projection cylinder

Top view
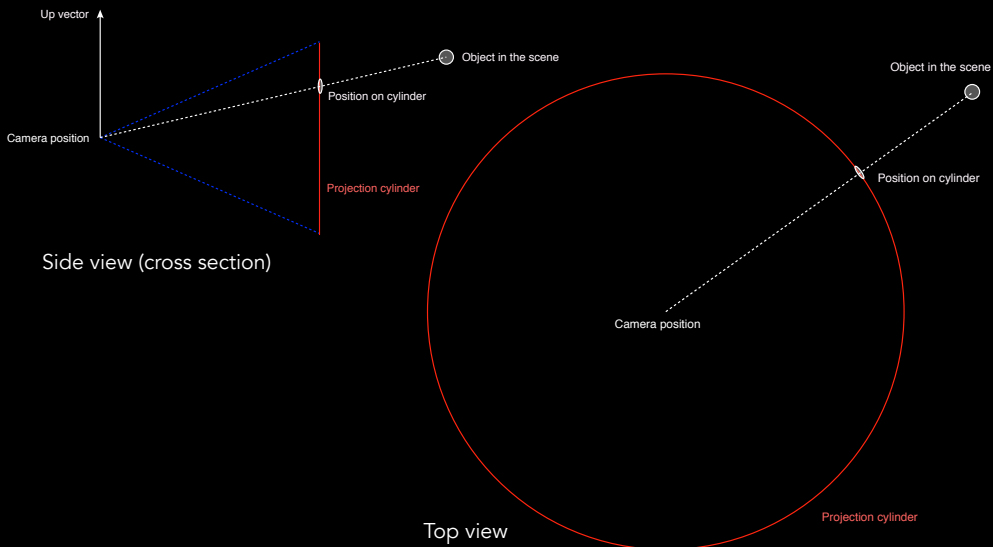
90 degrees vertically

120 degrees vertically

Equirectangular Projections

360x180 degrees

90 degrees

latitude

0 degrees

-90 degrees

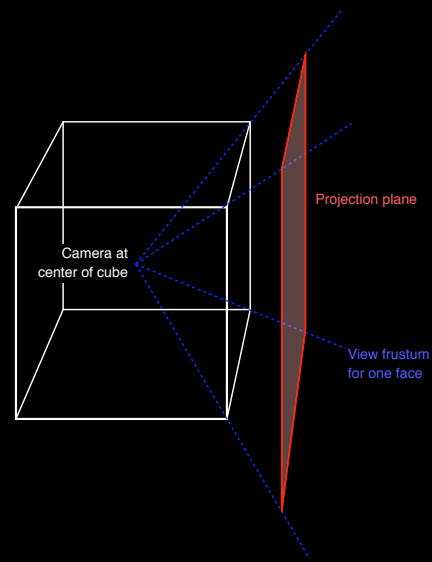0 degrees   90 degrees   180 degrees   270 degrees   360 degrees

longitude

Cube Maps

Slide 1

- Cube maps are 6 square view frustums through the vertices of each cube face.

- Each view frustum is 90 degrees horizontally and vertically.

Projection plane

Camera at center of cube

View frustum for one face

Slide 2

Fisheye

180 degrees horizontally and vertically

(Actually 180 degrees through any axis passing through the center)

Slide 3

- Lines of longitude extend radially from the north pole.

- Lines of latitude (3D) create equal radius lines in the fisheye (2D).

- Put another way, there is a linear relationship between the distance from the centre of the fisheye to the age of the corresponding 3D vector.

Slide 4
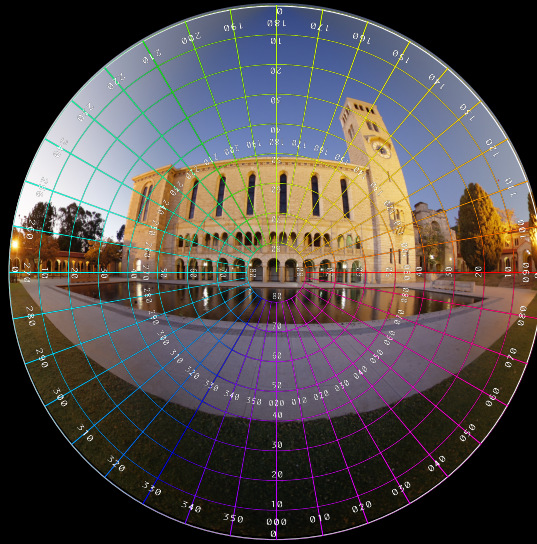
- A fisheye is not limited to 180 degrees although that is the most common type of dome shape: a hemisphere.
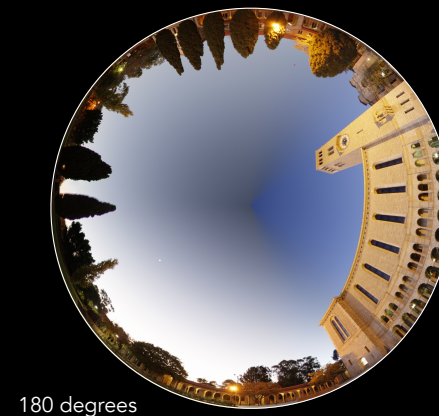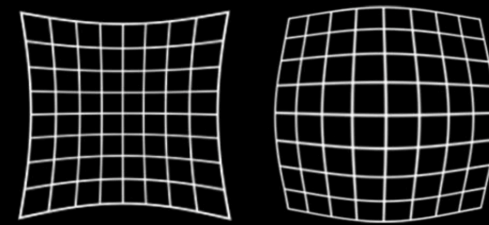

180 degrees
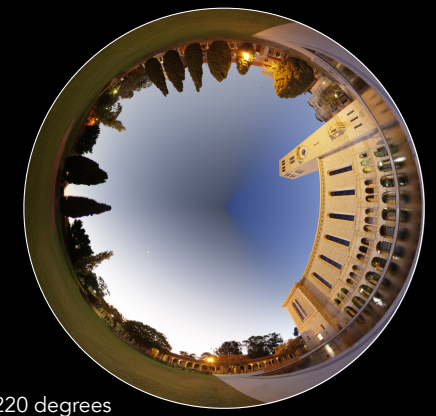
220 degrees

"Distortion"

- One is tempted to refer to the curved nature of what we expect to be straight lines as a "distortion".

- Same applies to the spreading of objects towards the poles in an equirectangular projection.
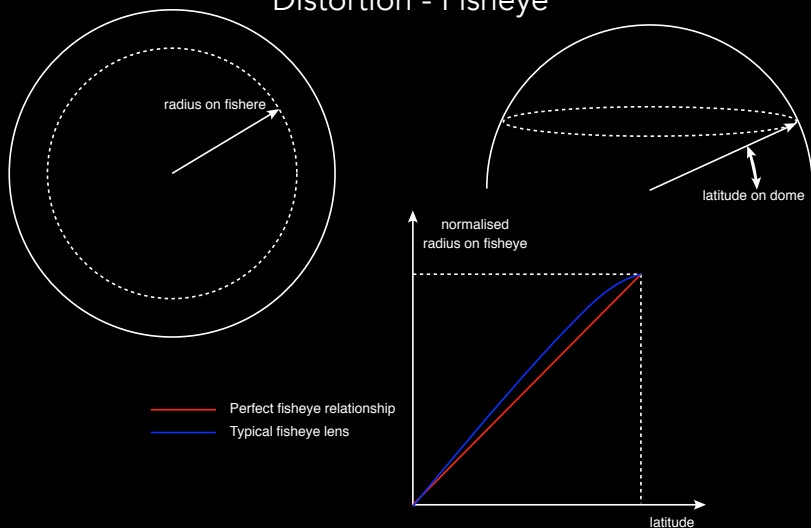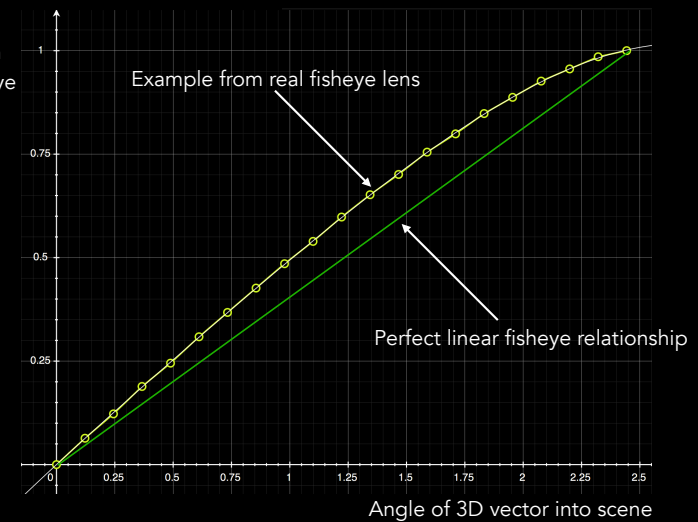

Distortion - Perspective

- Real lenses are not perfect pinhole cameras.

- The result is what is often called pincushion or barrel distortion.

- This is a form of distortion and given the right mathematical formulation can be corrected for.

Distortion - Fisheye

radius on fishere

latitude on dome

normalised radius on fisheye

— Perfect fisheye relationship
— Typical fisheye lens

latitude

Normalised distance from center of fisheye image

Example from real fisheye lens

Perfect linear fisheye relationship

Angle of 3D vector into scene

Distortion Correction

Fisheye off camera

Perfect fisheye relationship

End of part 1