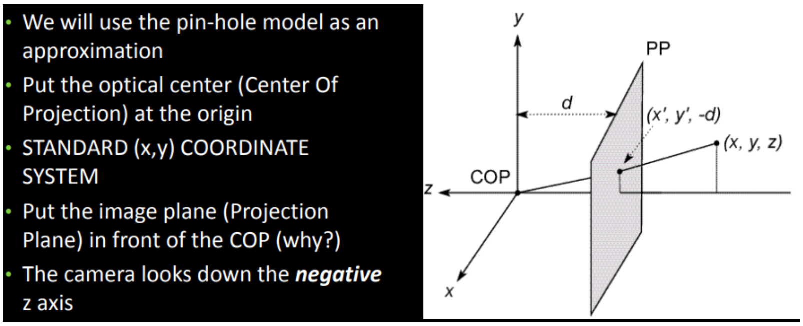
3A-L2 Perspective imaging

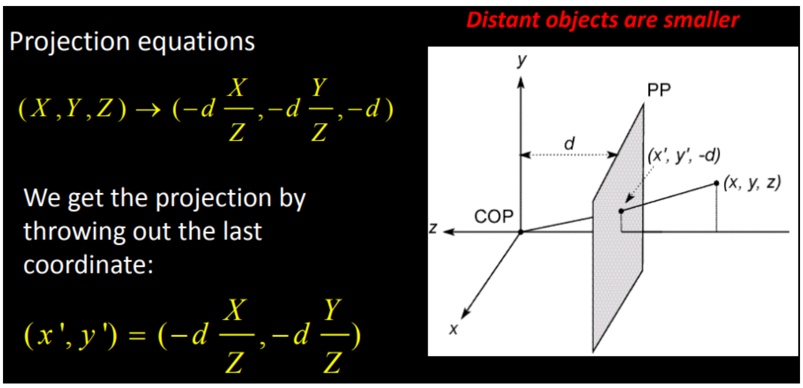
2017/11/24 16:58

1. Intro
    a. math behind geometry and configuration of cameras.
    b. pinhole model
        i. all the rays are in focus
        ii. the reason we're doing that is to try to make our images be more like they were generated from just some really uber pin-hole camera. Since camera is not a perfect pin-hole model.
    c. modeling projection
2. Coordinate System
    a. fundamental to the notion of imaging is projection operation.



    b. put the image plane in front of the coordinate system.
        i. it's mathematically convenient because this way our images don't get inverted
        ii. so it's (x', y', -d)
            1. the distance d from the origin to the image plane

1. Modeling Projection



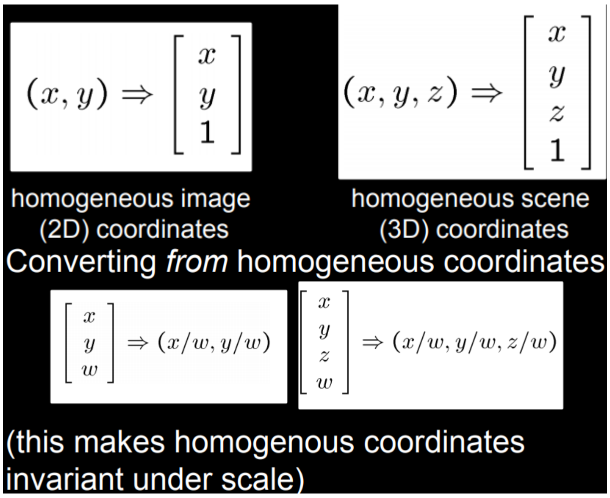
    a. use similar triangles to compute the coordinates
    b. the origin of the image is in the center
    c. Z's effect: the farther the distance, the smaller the image.
    d. When objects are very far away, the real X and real X can be huge. If I move the camera (the origin) those numbers hardly change. Since the thing really matters is the angle

1. Homogeneous Coordinates
    a. The projection operator is not a linear transformation, which

brings inconvenience

b. In order to make it linear, we introduce another coordinate, Homogeneous Coordinates

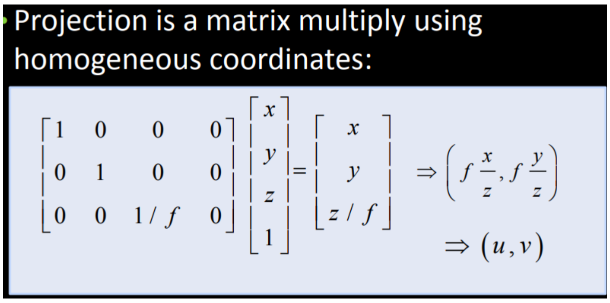
i. 加一维，作为被除因子



5. Perspective Projection

a. multiplication under the HC is linear now. During computation, we keep the additional dim. When we need the image, we convert it back.

b. f is the focal length, the distance from the origin to the image plane. It's the d talked above.



c. How does scaling the projection matrix change the transformation?

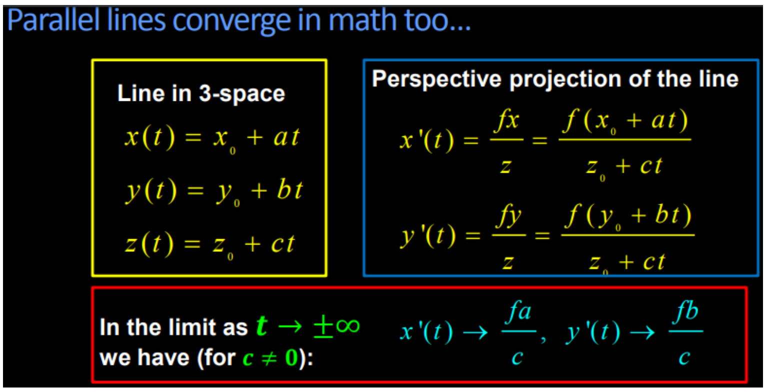
i. invariant

1. Geometric Properties of Projection

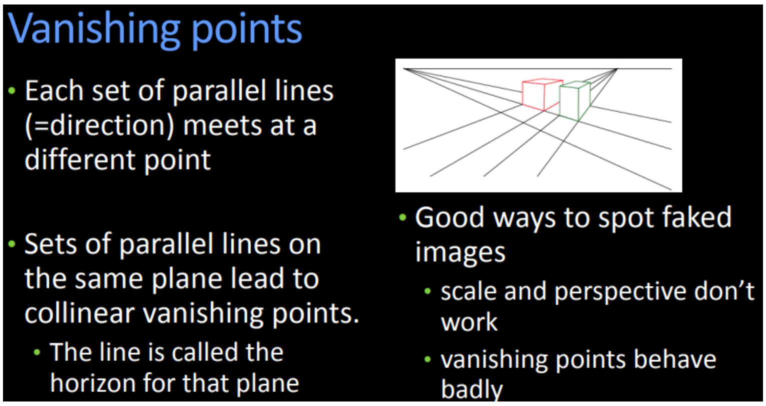
a. points to points, so lines to lines

2. Parallel Lines

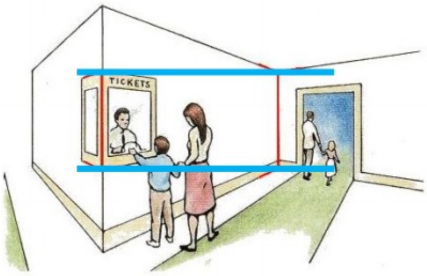
a. All the lines except those parallel with the image plane converges at certain point



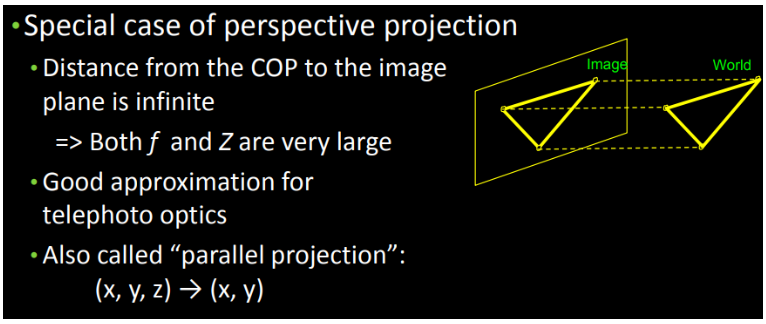
8. Vanishing Points



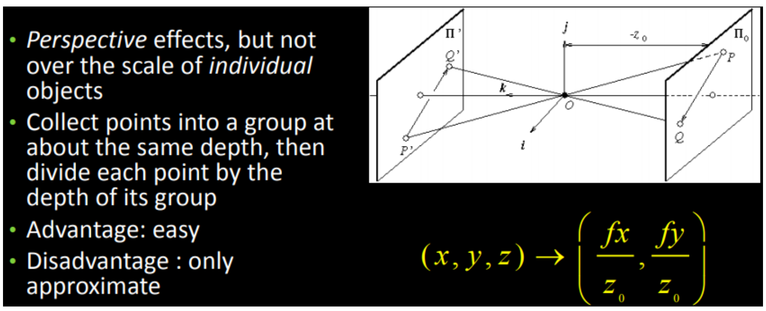
9. Human Vision
    a. We're very sensitive to this structure of parallel lines and what they convey to us. your brain automatically wants to undo that projection transformation



10. Other Models
    a. Orthographic or parallel projection



        i. a special case of perspective projection. where the distance from the center of projection to the image plane is infinite and my object is infinite, [z & x is infinite]
    a. Weak perspective



        i. a special case of perspective projection, where each group of objects has its own scale factor

	3-d point	2-d image position
(1) Perspective:	$(x, y, z) \to$	$\left(\frac{fx}{z}, \frac{fy}{z}\right)$
(2) Weak perspective:	$(x, y, z) \to$	$\left(\frac{fx}{z_0}, \frac{fy}{z_0}\right)$
(3) Orthographic:	$(x, y, z) \to$	(x, y)