

The Robot Doctor

Episode 106: Robot Vision

Common Core Standards:

- Pinhole Model and Camera Calibration:
 - Equation of a Line given two points
 - Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Review:

Stereo vision:

- 1) Take a picture – This step produces an image – a 2-dimensional representation of the real-world
- 2) Process the Image – find interesting points such as corners and edges of objects in the image – we'll call these interesting points, features
- 3) Calculate information – Use the features to extract information about the scene in the image such as where objects are, or distance to particular features or which objects are in view.

Line through two points:

$$z - z_c = \frac{f - z_c}{A_x - x_c}(x - x_c)$$

x_c, z_c is the center of the camera – typically one camera will be set at the origin and is 0,0, the other will typically have the x position as the offset between the two cameras.

A_x is the position in mm of the pixel of the feature in the image – find by multiplying the number of pixels from center by the ratio of sensor size to pixel count (i.e. if the sensor is 2000 px wide and 10 mm wide than the ratio would be 200 px per mm).

For the both cameras, if the pixel of the feature in the image is to the left of center, than the value will be negative.

You will have two equations with z and x in them. Solve by substitution, or by systems of equations.

Challenge Questions

A robot with a stereo camera pair mounted 30 cm apart, with 50 mm focal length and a sensor that is 16mm wide with 4000 horizontal pixels.

- 1) If a feature on an object is located at an x-coordinate of 3000 on the left camera and at an x-coordinate of 1000 on the right camera, how far in front of the robot is the object?

- 2) Why does the accuracy of this method become worse as the objects move farther away? It may help to think about what the distance is if the objects are 1 pixel from the center versus 2 pixels from the center

