EECS101 Discussion 8

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Optical Flow

- The key is to find out u(x,y,t) and v(x,y,t) where u and v are the velocity of the object in the x and y direction respectively
  - Draw some instances of E(x,y,t) at different t. Can you figure out u and v?

Optical Flow

- $Example$: $E(x, y, t) = \cos(y - bt) + C$
  - $When\ t = t_0, E(x, y, t_0) = \cos(y - bt_0) + C$
  - $When\ t = t_1, E(x, y, t_1) = \cos(y - bt_1) + C$
  - $v(x, y, t) = b,\ u(x, y, t) = 0$

- $Optical\ flow\ constraint\ equation$

$$E_x u + E_y v + E_t = 0$$

https://www.youtube.com/watch?v=oPNS5FmotcU

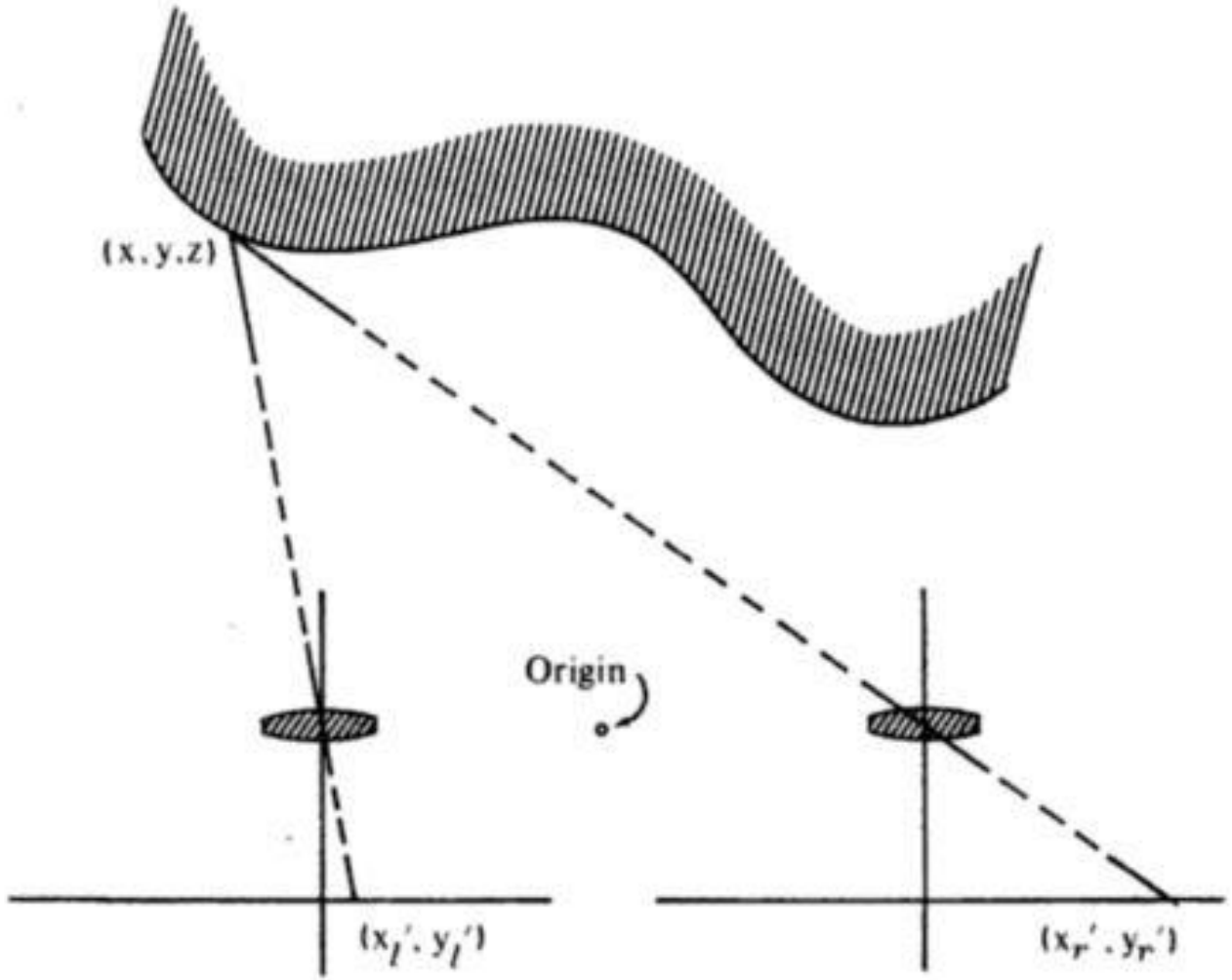

Figure 13-1. Simple camera geometry for stereo photography. The optical axes are parallel to one another and perpendicular to the baseline connecting the two cameras.

Stereo Photography

- Application of disparity equations
  - $x = \frac{b(x_l' + x_r')}{2(x_l' - x_r')}$
  - $y = \frac{b(y_l' + y_r')}{2(x_l' - x_r')}$
  - $z = \frac{bf}{x_l' - x_r'}$

  - Where (x,y,z) is the world coordinate of the point and (x_l', y_l'), (x_r', y_r') are the image coordinates of the point in the left and right images respectively
  - Note coordinate orders should be consistent in the left and right images. If not, switch the points.

Surface Normal

- The plane normal can be found out by the **cross product** of any two vectors determined by the three points
  - $A = (a_1, a_2, a_3)$
  - $B = (b_1, b_2, b_3)$
  - $A \times B = (a_2b_3 - a_3b_2,\ a_3b_1 - a_1b_3,\ a_1b_2 - a_2b_1)$
- The normal is related to (p, q) by
  - $N = (-p, -q, 1)$

Bayes' theorem

- Application of Bayes' theorem, which relates posterior probability to prior and likelihood function, given by
  - $p(c|x) = \frac{p(x,c)}{p(x)} = \frac{p(c)p(x|c)}{\sum_i p(c_i)p(x|c_i)}$
  - Where c is the parameter (i.e., the class, tail or head) and x is the observation (brightness)
  - $p(c)$ is the a priori (or prior) probability
  - $p(c|x)$ is the posterior probability
  - $p(x|c)$ is the probability density function, or likelihood
  - $p(x)$ is the normalization term

Bayes' theorem

- $p(c)$ priori: the frequency of class c
- $p(x|c)$ likelihood: given class c, the frequency of x observed

- $p(c|x)$ posterior: x observed, the probability x belongs to class c.

- $p(c|x) \propto p(c)p(x|c)$
- Pick the max $p(c|x)$ to obtain the category of x

Criterial

- Homework #8 due is on March 17th
- 7 points for each sub question
- 2 points for free!