Indian Institute of Technology Delhi

Lamp Post Measurement

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1 Measuring Height

1.1 Assumptions

- We require the field of view of the camera. Either this can be given in specifications itself or this can be easily calculated by placing an object of known length at a known distance from camera (this gives us the angle subtended) and dividing the angle with the ratio of the length of object in image by image height. Let us denote the field of view of camera by Ω.
- We assume the camera to be kept on the ground and thus field of vision will be reduced by half.
- The object is sufficiently far away that whole of it is visible in the image.

1.2 Basic Equations

$$\tan\theta = \frac{h}{l} \tag{1}$$

$$\tan\theta' = \frac{h}{l-d} \tag{2}$$

$$\frac{p'}{p} = \frac{\theta'}{\theta} \tag{3}$$

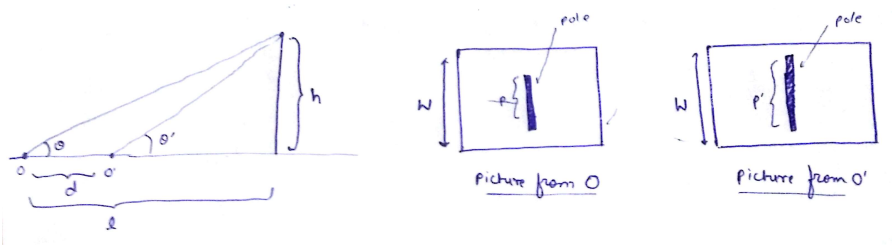

Figure 1: Diagram of situation

$$\frac{p}{W} = \frac{theta}{\Omega/2} \tag{4}$$

From equation 1 and equation 2:

$$h = \frac{d \tan\theta \tan\theta'}{\tan\theta' - \tan\theta} \tag{5}$$

1.3 Procedure

1. Take a picture from unknown distance l of the pole. Let the real height of pole be h (vertically from ground). Let picture height be w and height of pole in picture be p.

2. Move d distance towards the pole and take a picture. Let the new height of pole in picture be p' .

3. Now using equation 4 we can measure angle θ and using equation 3 we can measure angle θ' .

4. Then using equation 5 we measure the vertical height h of pole from ground.

2 Measuring Inclination

1. First measure the actual length of pole using:

$$L = (\text{Length of inclined post in pixel}) * \frac{h}{p}. \tag{6}$$

2. Then calculate the inclination from vertical using : $\theta_a = \cos^{-1}(L/h)$