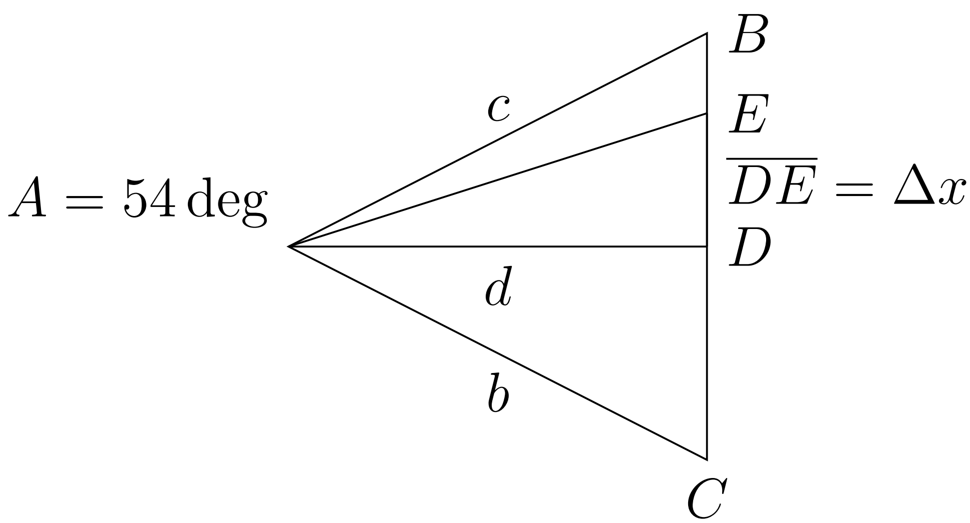
This is a figure looking down on the limelight as if it were a perfect pinhole camera.




Let $\overline{AD} = d$, $A = 54\,\mathrm{deg}$ and $\overline{DE} = \Delta x$. To determine the angle $\angle AED$, we must first evaluate the givens. We know that $\overline{BC}$ is the horizontal resolution $R_h$ of the LimeLight (that is, 320 pixels), so therefore $\overline{BD}$ is half of 320, or 160. Furthermore $\angle BAD$ is half of $\angle AED$, so therefore $\angle BAD = 27\,\mathrm{deg}$. From here, we observe that the

$$\tan(27) = \frac{R_h/2}{d}$$

. Which can be simply rearranged to

$$d = \frac{R_h/2}{\tan(A/2)}. \tag{1}$$

From here, we can apply the same logic to triangle $EAD$ to find that

$$\tan(\angle EAD) = \frac{\Delta x}{d}. \tag{2}$$

We substitute (1) into (2) to find that

$$\tan(\angle EAD) = \Delta x/(\frac{R_h/2}{\tan(A/2)}). \tag{3}$$

We finally take the inverse tangent of both sides to find that

$$\angle EAD = \tan^{-1}(\Delta x / (\frac{R_h/2}{\tan(A/2)})). \tag{4}$$

This angle $\angle EAD$ should be positive for points above the crosshair at $\overline{AD}$, and negative for points below the crosshair. We just have to plugin FOV and resolution of the vertical and horizontal axis of the LimeLight to find the angle delta in X and Y axis:

$$\angle \Delta X_{\Theta} = \tan^{-1}\left(\Delta x / \left(\frac{(320)/2}{\tan((54)/2)}\right)\right). \tag{5}$$

$$\angle \Delta Y_{\Theta} = \tan^{-1}\left(\Delta x / \left(\frac{(240)/2}{\tan((41)/2)}\right)\right). \tag{6}$$

We can use this information to estimate distance from a a target. LimeLight docs use this picture to illustrate such a setup:

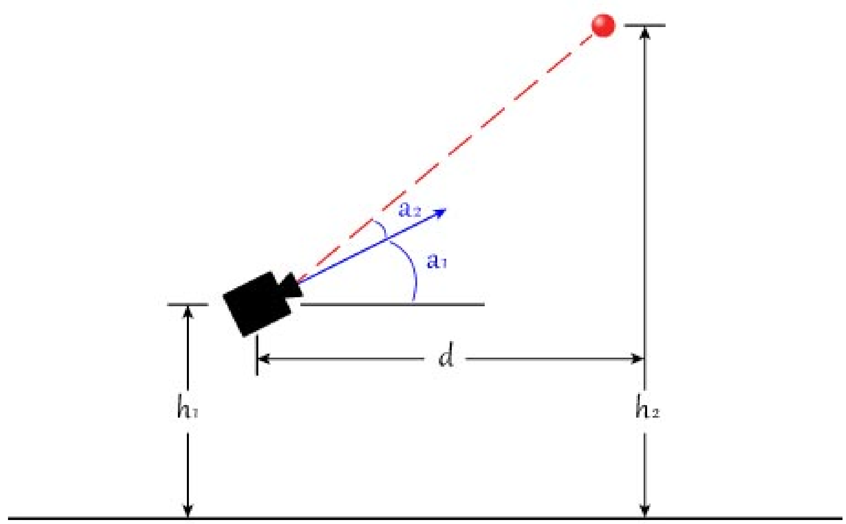



Figure 1: Distance Estimation using a LimeLight.

We will again use tangent to solve for $d$. We know that

$$\tan(a_1 + a_2) = (h_2 - h_1)/(d),$$

So we can simply rearrange and solve for $d$ to find that

$$d = \frac{h_2 - h_1}{\tan(a_1 + a_2)} \tag{7}$$