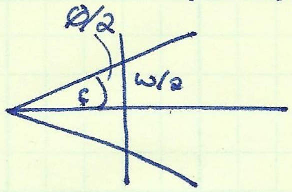
Computer Vision | HW_1 | Christian Prather

1a)

$f = 17mm$



$\tan(\theta/2) = (w/2)/f$

$\Rightarrow \theta = 2\tan^{-1}((w/2)/f)$

$[1.5mm \times 1.5mm]$ = size $\quad \tan(\theta/2) = \left(\frac{1.5}{2}\right)/17$

$\cancel{\tan(\theta/2) = 12.75}$

$\cancel{\frac{\theta}{2} = \tan^{-1}(12.75) = 85.5153^\circ}$

$\boxed{\cancel{FOV = 171.03 \times 171.03}}$

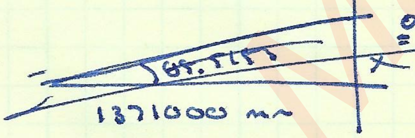
$\boxed{FOV = 5.0522^\circ \times 5.0525}$ $\quad \cancel{\theta = 171.030788}$

$\theta = 5.0522^\circ$

1b) Distance From Brown Hall to STM ≈ 1371 meters = Z
$\Rightarrow$ 1371000 mm

Cone width = $\frac{1.5mm}{(\sqrt{887000})2}$ = 0.00129 mm

min mase = (0.00258 mm)2 ← for space between
= .00516 mm



$\cancel{\tan(85.5153) = \frac{(X/2)}{1371000}}$

$\cancel{\frac{X}{2} = 0.00129}$

$\cancel{x}$ $x = fX/Z \quad \frac{x}{f} = \frac{X}{Z} \quad X = Z\left(\frac{x}{f}\right)$

$X = (1371000)\left(\frac{.00516}{17}\right) = 416.138mm = \boxed{.416m}$

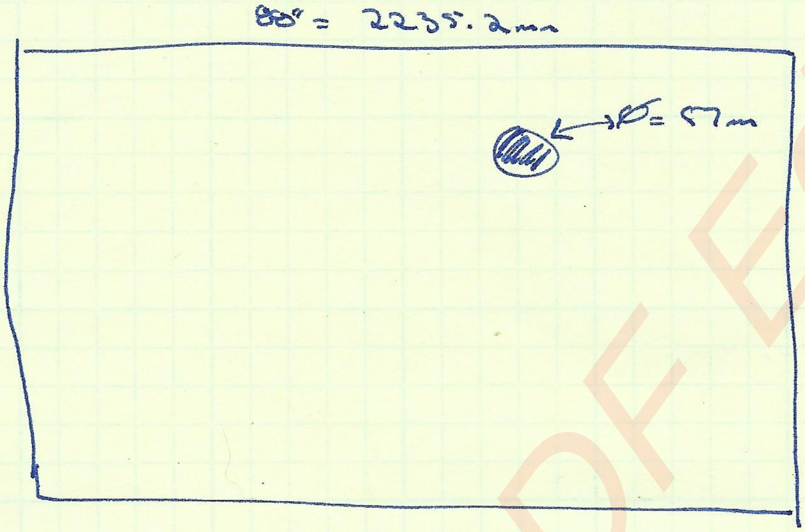
Average height = 1.706 meters so yes you should be able to see a person from the END of South Table Mountain

2)

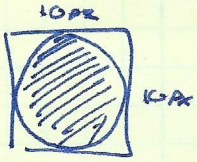
FOV = ?

img(x,y) = ?

44" = 1117.6mm



$\frac{57}{2} = 28.5$



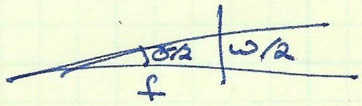
FOV needed to see 88"

$\tan(\theta/2) = ((w/2)/f)$ $\tan(\theta/2) = \left[\frac{(2235.2/2)}{2000}\right]$

$\tan(\theta/2) = 0.5588$

$\frac{\theta}{2} = 29.1964$

$\boxed{\theta = 58.3929^\circ}$ $\boxed{\text{min Lens to cover } 58.3929 = 60^\circ}$



$\tan(\theta/2) = [(w/2)/f]$

$f\tan(\theta/2) = w/2$ $2f\tan(\theta/2) = w$

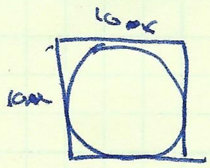
$\cancel{2\tan(\theta/2) = w/f}$ $2(2000)\tan(30) = w$

$w = 2309.401\text{ mm}$

1cm = 10mm 1px = 10mm

so min resolution is $\frac{2309.401}{10} = 230.94\text{px}$

→



$$(57\,mm)\left(\frac{x}{2309.401}\right) = .02468x$$

Given pixel density, ball will take up (.02468)(x) pixels in frame

This must be greater than 100

$$r = \frac{.02468}{2} = .01234$$

$$A = \pi r^2 = 100 \qquad 100 = \pi\left[.01234x\right]^2$$

$$\cancel{100^2 = .03876x^2}$$

$$\cancel{x^2 = \frac{100}{.03876} = 2579.4966}$$

$$\cancel{x =}$$

$$100 = .0004783x^2 \qquad \frac{100}{.0004783} = x^2 = 209035.3437$$

$x = 457.203$ px so min resolution = $\boxed{512 \times 512}$

3)

Utilized the methods from Lab 2, I first constructed a ${}^{M}_{C}H$ matrix to convert Camera points to Mount frame, then I converted Mount frame to Vehicle using a ${}^{V}_{M}H$. Finally I used a ${}^{W}_{V}H$ to get my points in world frame. When multiplied together this gave me a ${}^{W}_{C}H$ which lets me convert camera frames to world points. I need World to Camera however so I took the inverse. This let me utilize built intrinsic and extrinsic matrices to multiply a Point (in world frame) matrix by to get points in camera space.

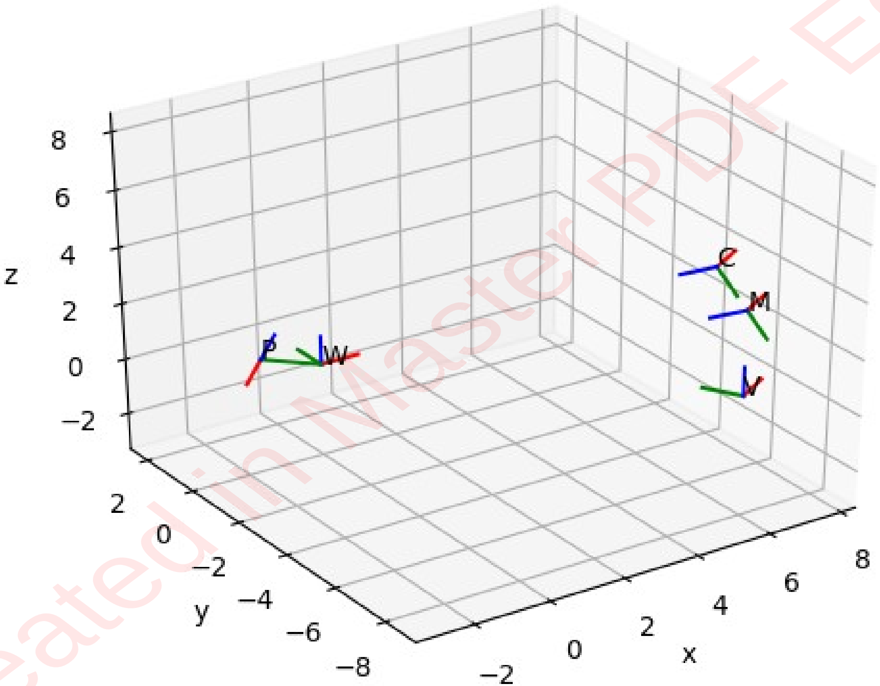
$(-1,-1,0) \rightarrow (170, 251)$

$(1,-1,0) \rightarrow (267, 284)$

$(1,1,0) \rightarrow (329, 230)$

$(-1,1,0) \rightarrow (240, 205)$

$(0,0,3) \rightarrow (241, 69)$


z
8
6
4
2
0
−2
y
2
0
−2
−4
−6
−8
x
−2
0
2
4
6
8
P
W
C
M
V