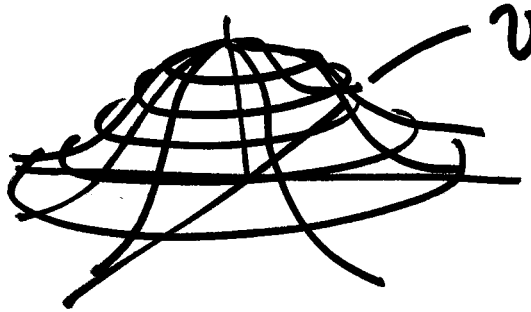
$$f(x) = \frac{1}{(2\pi)^{n/2}\sqrt{|\Sigma|}} \exp\left[-\tfrac{1}{2}(x-\mu_x)^T \Sigma_{xx}^{-1} (x-\mu_x)\right]$$

↑ vector $n,1$

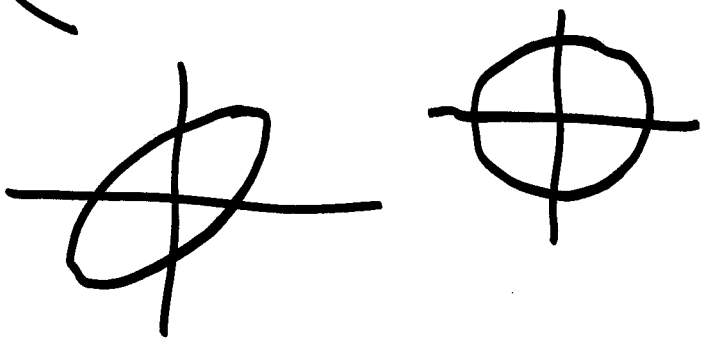
$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$



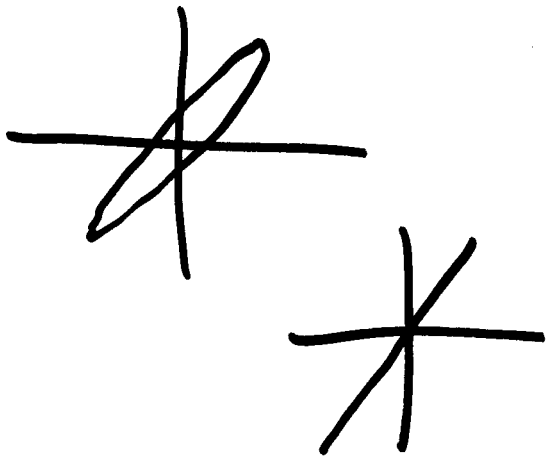
exponent $\sim \chi^2$

Solve for x, y

$\Rightarrow$ <u>eq. of ellipse</u>



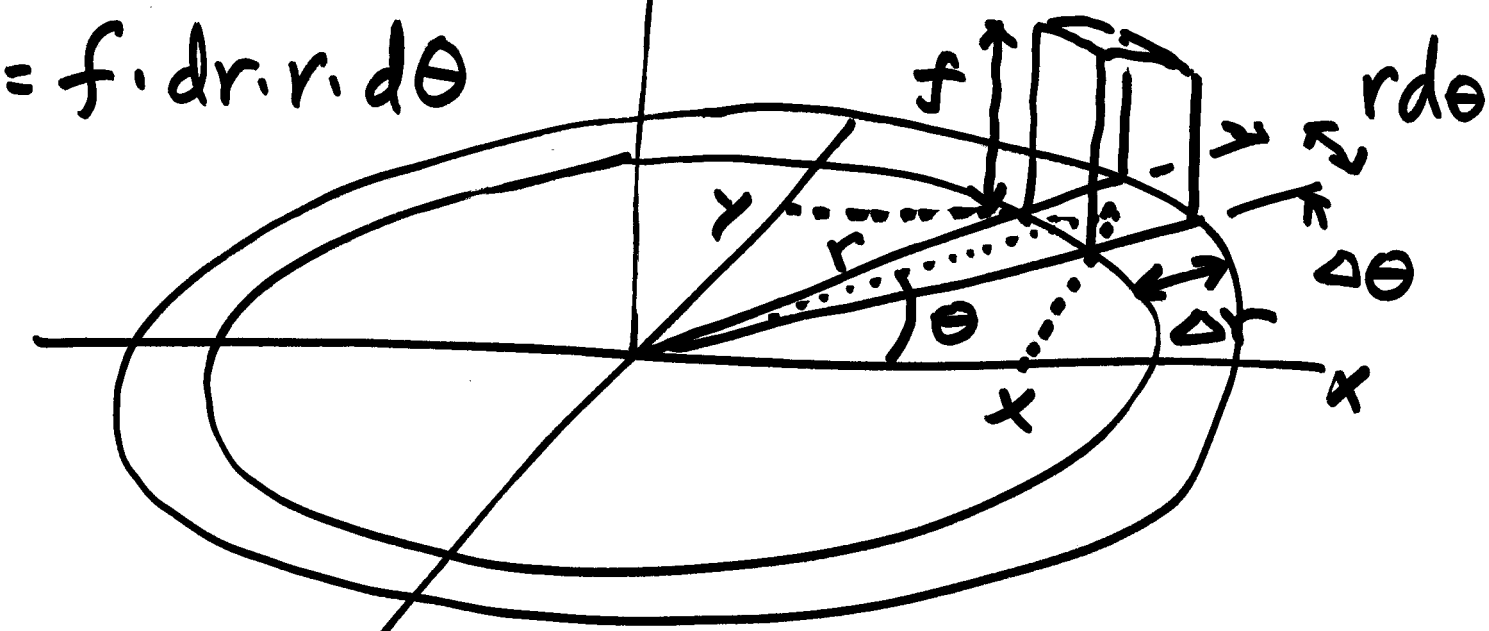
$\Rightarrow$ those regions generated by slicing with horiz. plane



circular error ?, given $\Sigma_{(x,y)}$

area of base = $dr \cdot r \cdot d\theta$

vol = $f \cdot dr \cdot r \cdot d\theta$



$$\text{volume} = \int_0^R \int_0^{2\pi} f \cdot r \, d\theta \cdot dr$$

$$vol = \sum_{i=0}^{n} \sum_{j=0}^{m} f(x_i, y_i)\, r_i\, \Delta\theta\, \Delta r$$

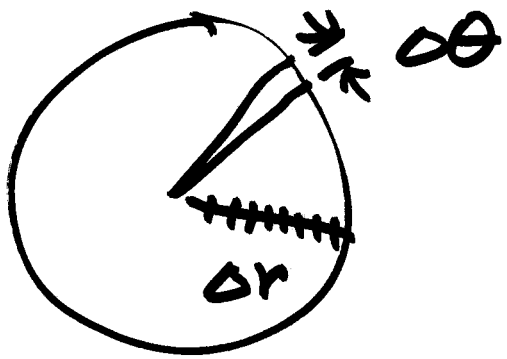
$\Delta\theta = \frac{2\pi}{m}$ $\Delta r = \frac{R}{n}$

$x_i = r_i \cos\theta_j$

$y_i = r_i \sin\theta_j$

$r_i = i \cdot \Delta r$

$\theta_j = j \cdot \Delta\theta$



given volume fraction (probability)

50%, 90%, 99%

0.5 0.9 0.99

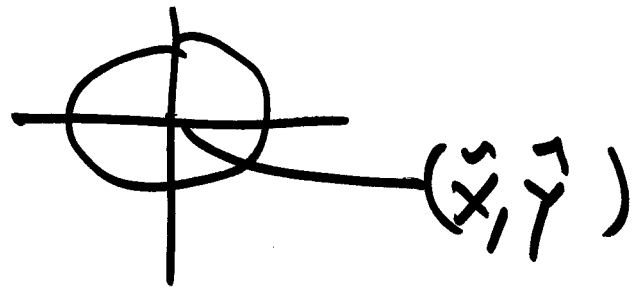
integrate until reach denied value

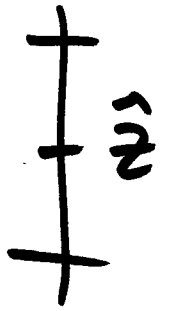
R defines P% circular error

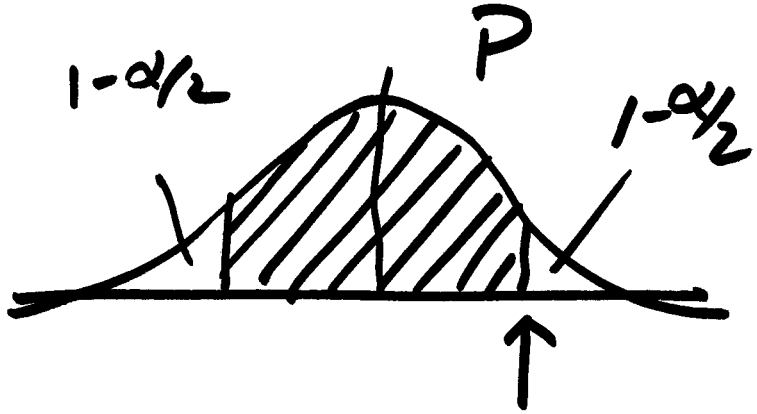
---

given R, integrate until reach R

$\Rightarrow$ P

$\Sigma_{\begin{pmatrix} x \\ y \end{pmatrix}}$ → 

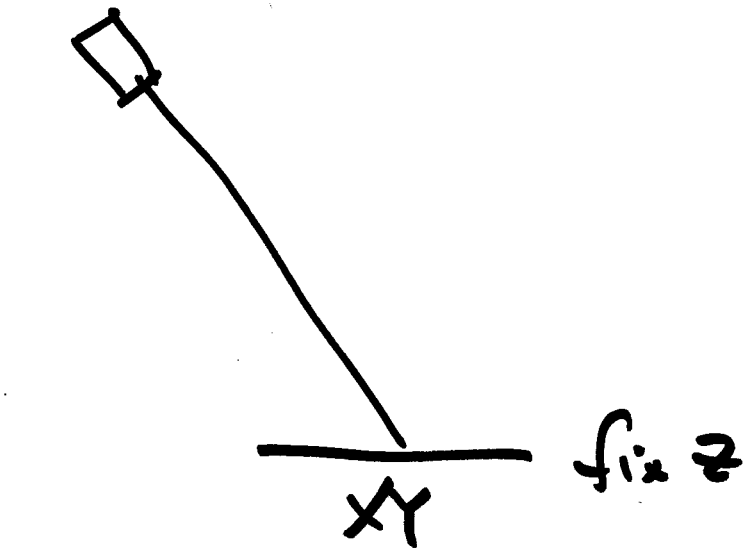
$\Sigma_{\begin{pmatrix} x \\ y \\ z \end{pmatrix}}$ 



LE linear error (z)

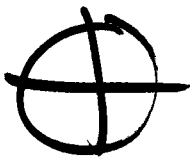
$$\hat{z} \pm z_p \cdot \sigma_z$$

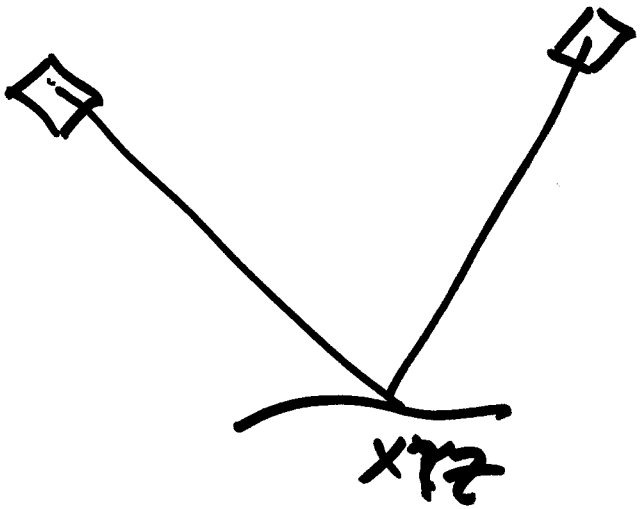
- $\hat{z}$ ↑ estimate
- z_p ↑ std. normal, $1-\alpha/2$
- σ_z ↖ std. dev.



2 EQ
2 UNK

$$\begin{pmatrix} \sigma_x^2 & \sigma_{xy} \\ \sigma_{xy} & \sigma_y^2 \end{pmatrix} \rightarrow$$





4 EQ
3 UNK } LS

$$\Sigma = \left[\begin{array}{cc:c} \sigma_x^2 & \sigma_{xy} & \sigma_{xz} \\ & \sigma_y^2 & \sigma_{yz} \\ \hdashline & & \sigma_z^2 \end{array}\right]$$

Estimate: find or refine parameter values to reduce or eliminate misclosure

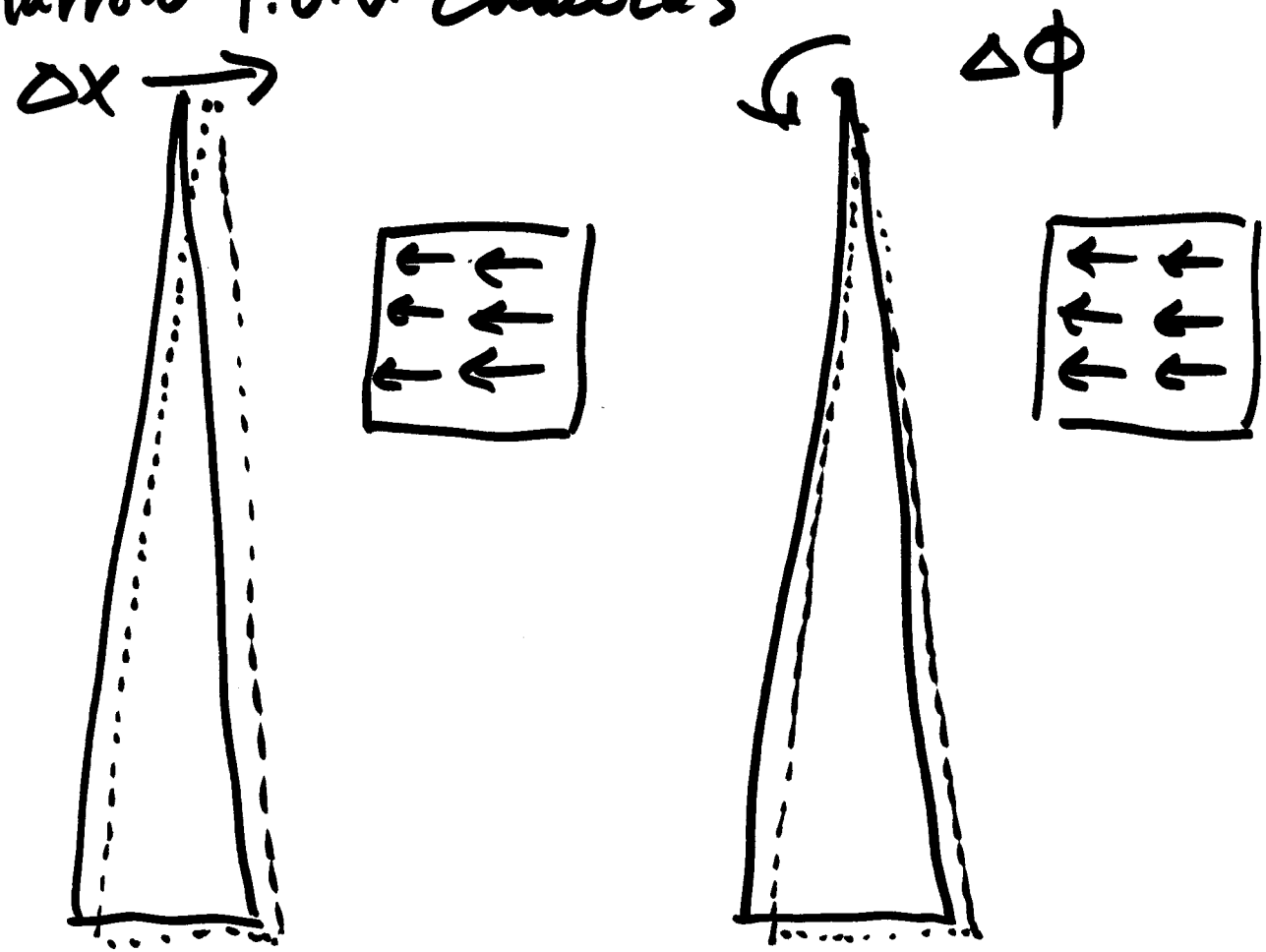
What if 2 parameters both eliminate the misclosure?

any combination of 2 parameters would also eliminate misclosure

LS: cannot decide

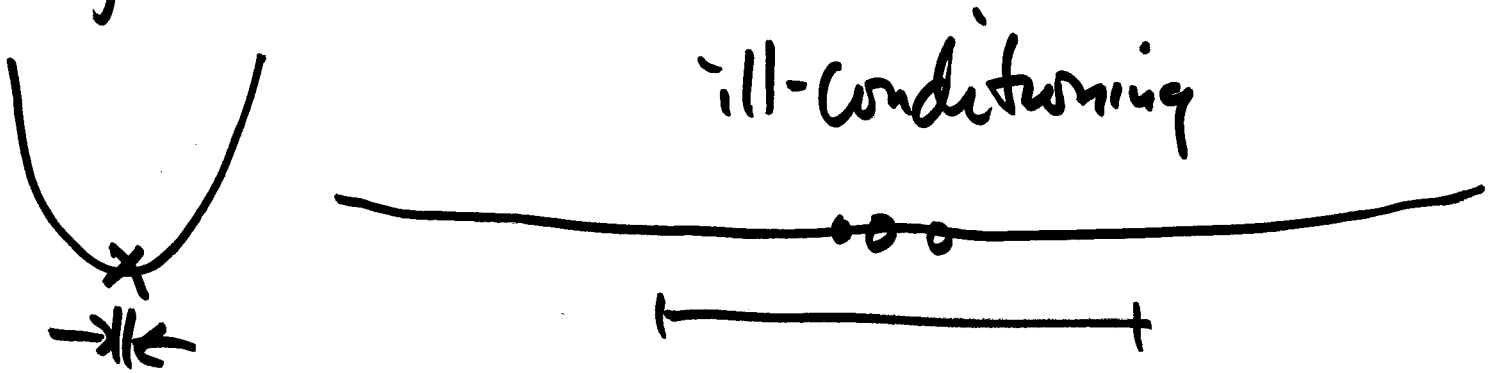
⇒ singularity

Narrow F.O.V. cameras



Δy, Δω

Objective function



singular

condition number