$$\left.\begin{array}{l} > \text{diary } \underline{\text{filename}} \\ \quad \vdots \\ > \text{diary off} \end{array}\right\} \text{captures Screen dialogue}$$

$$R = [1\ 2\ ;\ 3\ 4]$$

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

$$\left\{ \begin{array}{l} \text{More} \\ \text{Matlab} \\ \text{hints} \end{array} \right.$$

$$v = [5\ ;\ 6]$$

$$\begin{bmatrix} 5 \\ 6 \end{bmatrix}$$

$p = R * V$

$$\begin{bmatrix} 17 \\ 39 \end{bmatrix}$$

case sensitive

P, p are different variables

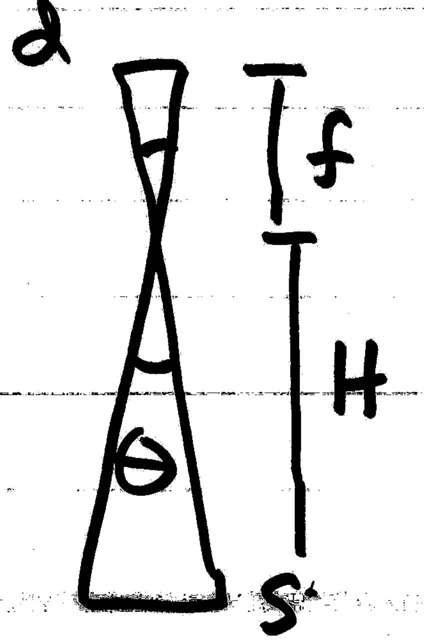
save

load

Resolving Power: If optics are diffraction limited, then

$$\text{resolving power} = \beta_{min} = \frac{1.22\,\lambda}{D} = \frac{0.61\,\lambda}{R_a}$$

D: diameter of Aperture



Scale:

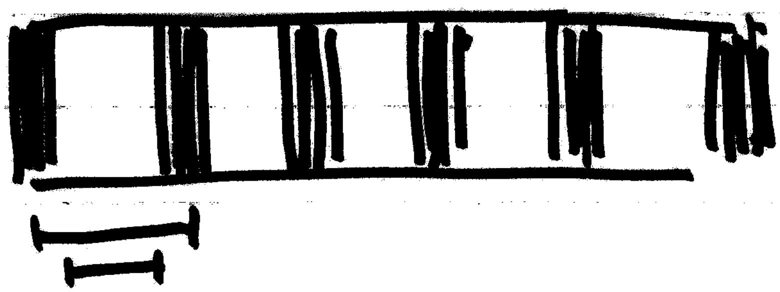
$$\frac{f}{H} = \frac{d}{s}$$

$$\theta \approx \frac{d}{f} = \frac{s}{H}$$

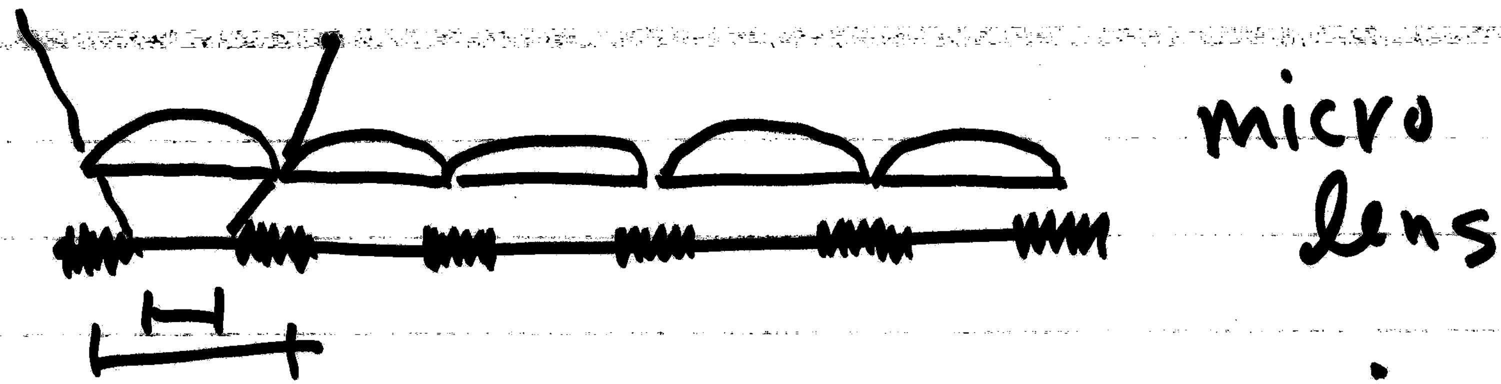
1. if actual angle

$\frac{d}{f} < \beta$, then not resolving GSD

2. if $\frac{d}{f} > \beta$, then you may have to take corrective action



then you are undersampling the signal ⇒ aliasing } fix: defocus the optics



Dynamic Range : $\dfrac{\text{full well capacity (e)}}{\text{noise (e)}}$

$\dfrac{100,000}{31} = \underline{\underline{3225}}$, this requires

4096 levels

A/D (in the analog to digital convertor)

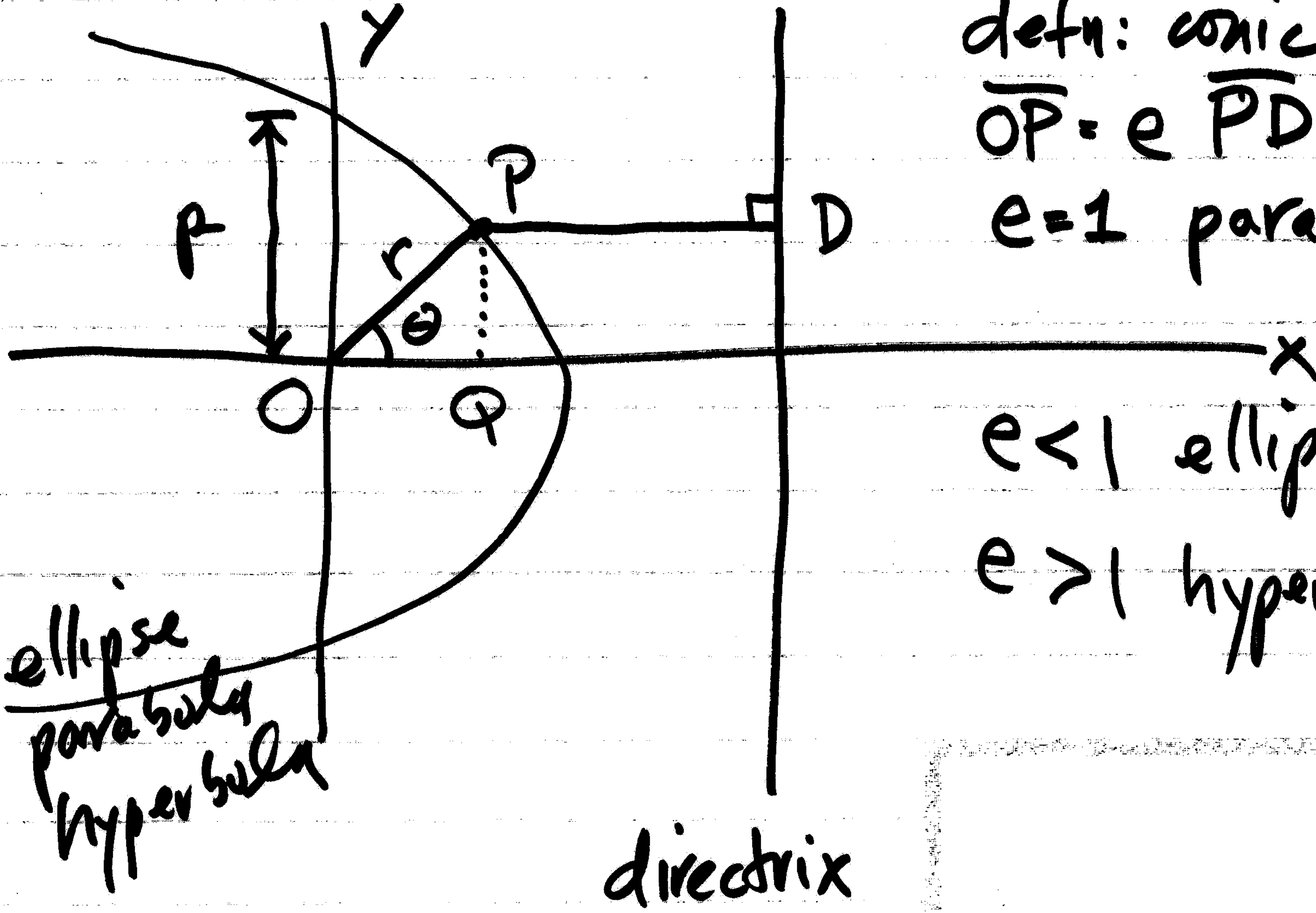
$4096 = 2^{12}$

$\Rightarrow$ 12 bit quantization

DR: in decibels dB

$$DR(dB) = 20 \cdot \log_{10}\left(\frac{100{,}000}{3}\right)$$

$$\underline{\underline{70}}$$



defn: conic

$\overline{OP} = e\,\overline{PD}$

$e = 1$ parabola

$e < 1$ ellipse

$e > 1$ hyperbola

$$r = e(\overline{OD} - \overline{OQ})$$

$$r = e(\overline{OD} - r\cos\theta)$$

$$r = \underbrace{e\,\overline{OD}}_{\substack{\text{fixed} \\ \text{constant } p}} - e r \cos\theta$$

e: eccentricity

p: semi-latus rectum

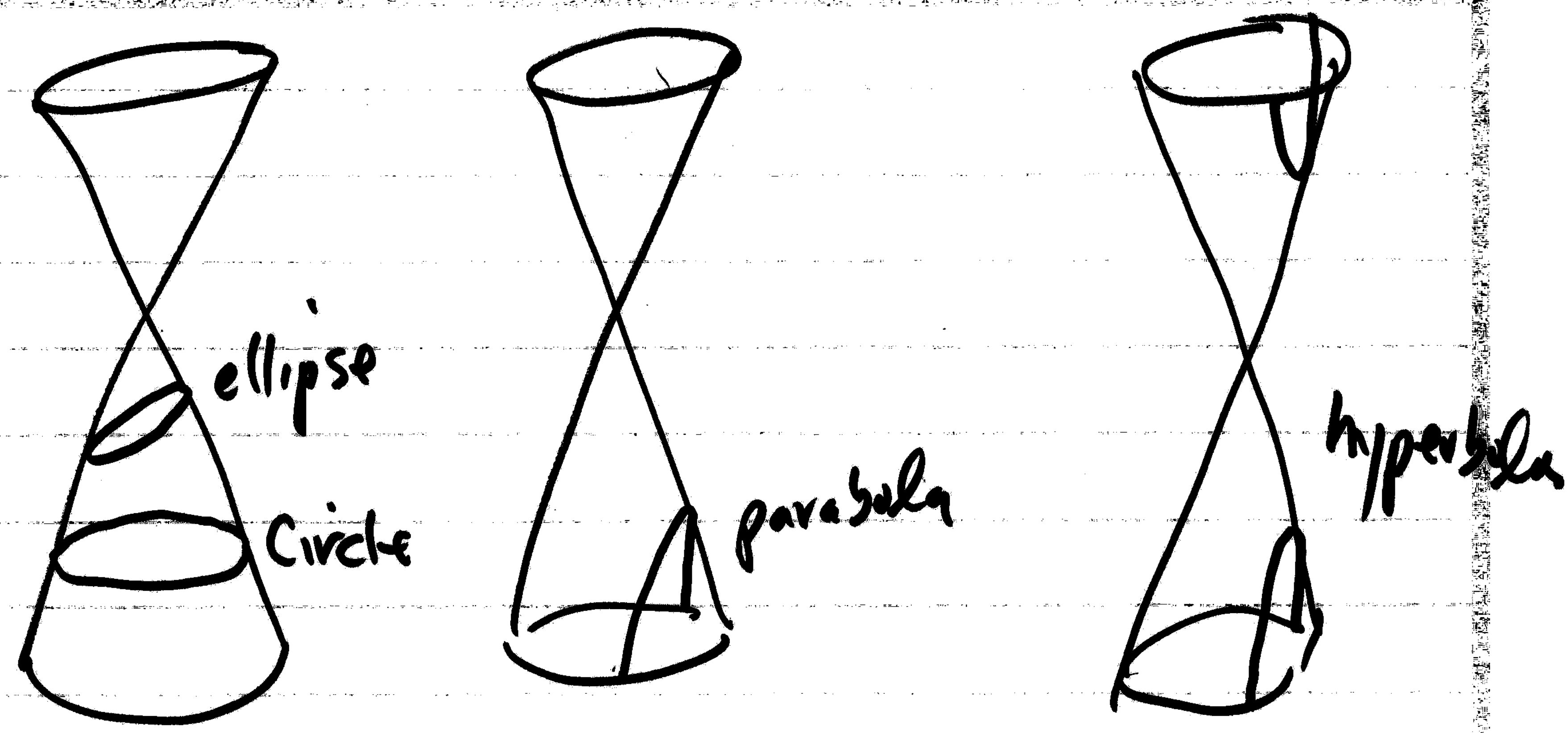
$$r = p - e r \cos\theta$$

$$r + e r \cos\theta = p$$

$$r(1 + e\cos\theta) = p$$

$$\boxed{r = \frac{p}{1 + e\cos\theta}}$$

equation of conic in polar coordinates

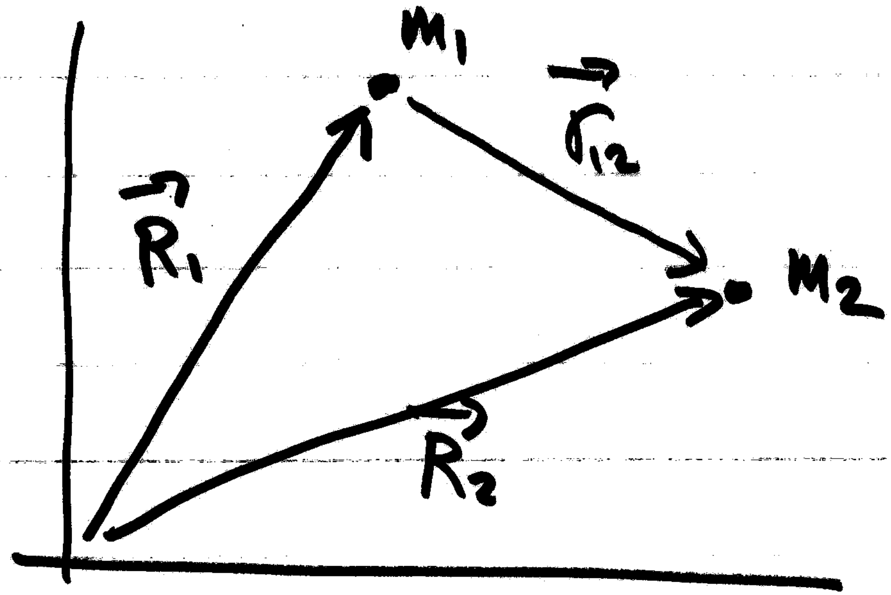

ellipse
Circle
parabola
hyperbola

obscure identities

$$\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{a} \cdot \vec{b})c \quad (2)$$

$$(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d}) = (\vec{a} \cdot \vec{c})(\vec{b} \cdot \vec{d}) - (\vec{a} \cdot \vec{d})(\vec{b} \cdot \vec{c}) \quad (3)$$

Newton's 2nd law



inertial ref. frame

$$\vec{F} = m\vec{a} = \frac{d}{dt}(m\vec{v})$$ Newton

Gravitation

$$\vec{F} = \frac{G m_1 m_2}{r^2}\left(\frac{\vec{r}}{r}\right)$$

$$\dot{\square} = \frac{d}{dt}\square$$

$$\ddot{\square} = \frac{d^2}{d^2t}\square$$

for 2-body problem

$$\vec{F}_1 = \frac{G m_1 m_2}{r_{12}^3}\vec{r}_{12} = m_1\left(\frac{G m_2}{r_{12}^3}\vec{r}_{12}\right) = m_1\ddot{\vec{R}}_1$$

$$\vec{F}_2 = \frac{G m_1 m_2}{r_{12}^3}\vec{r}_{21} = m_2\left(\frac{G m_1}{r_{12}^3}\vec{r}_{21}\right) = m_2\ddot{\vec{R}}_2$$

$$\ddot{\vec{R}}_2 - \ddot{\vec{R}}_1 = \underbrace{\frac{Gm_1}{r_{12}^3}\vec{r}_{21}} - \frac{Gm_2}{r_{12}^3}\vec{r}_{12}$$

$$\ddot{\vec{r}}_{12} = -\frac{Gm_1}{r_{12}^3}\vec{r}_{12} - \frac{Gm_2}{r_{12}^3}\vec{r}_{12}$$

$$\ddot{\vec{r}}_{12} = -\frac{G(m_1+m_2)}{r_{12}^3}\vec{r}_{12}$$

$m_1 \gg m_2$ for earth satellite

$G(m_1+m_2) \approx Gm_1 = \mu$

$$\boxed{\ddot{\vec{r}} = -\mu/r^3\,\vec{r}} \quad \text{2 body equation of relative motion} \quad (12)$$

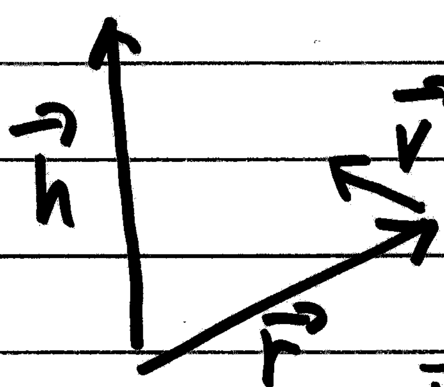
$M_{earth} = 5.974 \times 10^{24}$ kg

$G = 6.67259 \times 10^{-11}\ m^3\,kg^{-1}\,s^{-2}$

product $\underline{GM} = \mu$

$\mu = 398600.4405\ km^3\,s^{-2}$

$\mu = 3.986004405 \times 10^{14}\ m^3\,s^{-2}$



$$\vec{h} = \vec{r} \times \vec{v}$$

$$\underline{\vec{h} = \vec{r} \times \dot{\vec{r}}}$$

$\vec{h}$: angular momentum vector

$$\frac{d}{dt}\vec{h} = \underbrace{\dot{\vec{r}} \times \dot{\vec{r}}}_{\phi} + \vec{r} \times \ddot{\vec{r}}$$

$$\dot{\vec{h}} = 0 - \frac{\mu}{r^3} \underbrace{\vec{r} \times \vec{r}}_{\phi}$$

$\dot{\vec{h}} = 0$, since time derivative 0

$\vec{h}$ **is constant**

relative motion occurs in a plane w/ $\vec{h}$ normal

$$\frac{d}{dt}\left(\frac{\vec r}{r}\right) = \frac{r\dot{\vec r} - \dot r \vec r}{r^2}$$

$$\frac{d}{dt}(\vec r \cdot \vec r) = \frac{d}{dt}(r^2)$$

$$\downarrow \qquad\qquad \downarrow$$

$$2\dot{\vec r}\cdot\vec r = 2r\dot r$$

$$\dot{\vec r}\cdot\vec r = r\dot r$$

$$\dot r = \frac{\dot{\vec r}\cdot\vec r}{r}$$

$$\underline{\frac{d}{dt}\left(\frac{\vec r}{r}\right) = \frac{1}{r^3}\left(r^2\dot{\vec r} - (\dot{\vec r}\cdot\vec r)\vec r\right)}$$

$$\frac{d}{dt}(\dot{\vec r}\times\vec h)$$

$$\downarrow$$

next show that this expression will be almost equal to the one at the left — only scale factor difference

$$\frac{d}{dt}\left(\dot{\vec{r}} \times \vec{h}\right) = \ddot{\vec{r}} \times \vec{h} + \dot{\vec{r}} \times \underbrace{\dot{\vec{h}}}_{0}$$

$$= \ddot{\vec{r}} \times \underbrace{\vec{h}}$$

$$= \underbrace{\ddot{\vec{r}}} \times \left(\vec{r} \times \dot{\vec{r}}\right)$$

$$= -\frac{\mu}{r^3}\vec{r} \times \left(\vec{r} \times \dot{\vec{r}}\right)$$

vector identity #2

$$= -\frac{\mu}{r^3}\left(\left(\vec{r} \cdot \dot{\vec{r}}\right)\vec{r} - r^2\dot{\vec{r}}\right)$$