orbit descr : Kepler $X_{ECF} = R\, X_{ECI}$

$$M_a(t)\, M_c\, M \left(\begin{pmatrix} x \\ y \\ z \end{pmatrix}_{ECF} - \left(R \begin{pmatrix} x_c \\ y_c \\ z_c \end{pmatrix}_{ECI} + \begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} \right) \right)$$

$M_a(t)$ ← M ← nominal attitude

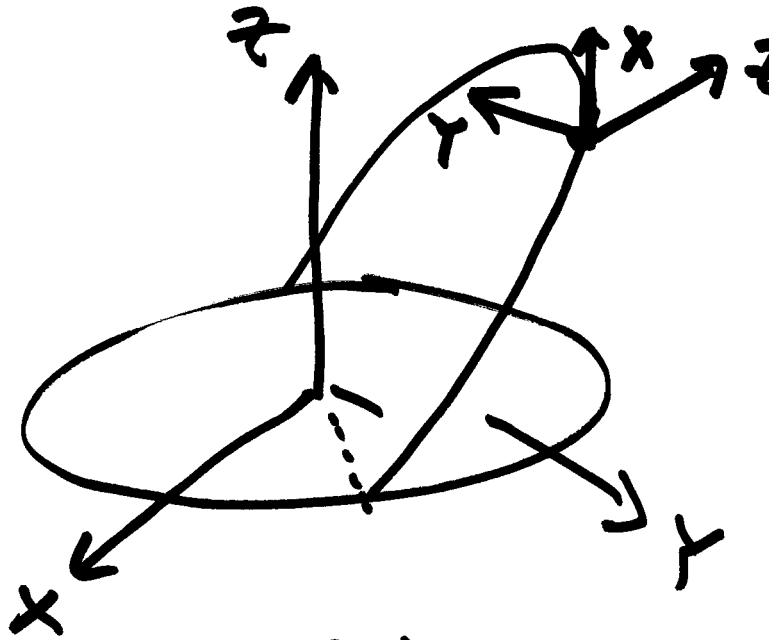
R ← $\begin{pmatrix} x_c \\ y_c \\ z_c \end{pmatrix}_{ECI}$

$\Delta\omega = \underline{d\omega_0} + \underline{d\omega_1} t + \underline{d\omega_2} t^2$

$\Delta\varphi$

$\Delta\kappa$

line # → time → Kepler



$$X_{ECI} = S\, X_{SAT}$$

S: Ω, ω, f

MRS matrix applied to sat system

$$RS\, S^T R^T \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}_{ECF} - RS\left[\begin{pmatrix} x_L \\ y_L \\ z_L \end{pmatrix}_{SAT} + \begin{pmatrix} dx \\ dy \\ dz \end{pmatrix}\right] \qquad \begin{pmatrix} 0 \\ 0 \\ R \end{pmatrix}$$

$$M_q M_c \left[M\, RS\right]\left[S^T R^T \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}_{ECF} - \left(\begin{pmatrix} x_L \\ y_L \\ z_L \end{pmatrix}_{SAT} + \begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} \right) \right]$$

eph_cdf.txt
att_cdf.txt

result = dlmread('eph_cdf.txt')

814 × 13

$x\ y\ z\ \dot{x}\ \dot{y}\ \dot{z}\ \sigma_x^2\ \sigma_{xy}\ \sigma_{xz}\ \sigma_y^2\ \sigma_{yz}\ \sigma_z^2$

$$\begin{bmatrix} \cdot & \vdots & \vdots \\ & \cdot & \\ & & \cdot \end{bmatrix} \qquad \sigma_x, \sigma_y, \sigma_z$$

attitude 814 × 15

$q_i\ q_j\ q_k\ q_s\ \sigma_{q_i}^2\ \sigma_{q_iq_j}\ \sigma_{q_iq_k}\ \sigma_{q_iq_s}\ \cdots$

$$\begin{bmatrix} q_s^2+q_i^2-q_j^2-q_k^2 & 2(q_iq_j-q_sq_k) & 2(q_iq_k+q_sq_j) \\ 2(q_jq_i+q_sq_k) & q_s^2-q_i^2+q_j^2-q_k^2 & 2(q_jq_k-q_sq_i) \\ 2(q_iq_k-q_sq_j) & 2(q_jq_k+q_sq_i) & q_s^2-q_i^2-q_j^2+q_k^2 \end{bmatrix}$$

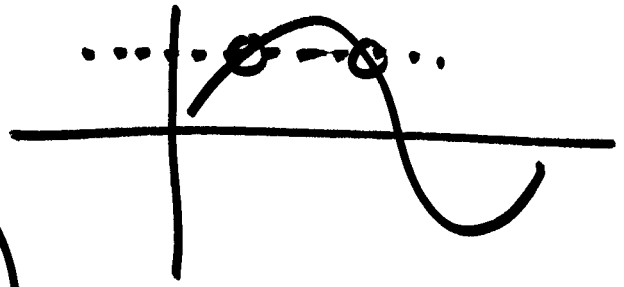
$M \nearrow$

$$\begin{bmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{bmatrix}$$

$$M = M_k M_\phi M_\omega$$

$$\begin{bmatrix} \cos\phi\cos k & \text{———} & \text{———} \\ -\cos\phi\sin k & \text{———} & \text{———} \\ \sin\phi & -\sin\omega\cos\phi & \cos\omega\cos\phi \end{bmatrix}$$

$$\phi = \sin^{-1}(m_{31})$$



$$\omega = \tan^{-1}\left(\frac{-m_{32}/\cos\phi}{m_{33}/\cos\phi}\right)$$

$$\omega = \tan^{-1}\left(\frac{-m_{32}}{m_{33}}\right)$$

$$k = \tan^{-1}\left(\frac{-m_{21}/\cos\phi}{m_{11}/\cos\phi}\right)$$

$$k = \tan^{-1}\left(\frac{-m_{21}}{m_{11}}\right)$$

$$\phi = f_\phi(q_s, q_i, q_j, q_k)$$

$$\omega = f_\omega(q_s, q_i, q_j, q_k)$$

$$K = f_K(q_s, q_i, q_j, q_k)$$

Linear: $Y = AX$

Error Propagation Law $\boxed{\Sigma_{yy} = A \Sigma_{xx} A^T}$

Nonlinear: $Y = F(X) \approx F^0 + J(\delta x)$

$$J: \underset{(m,n)}{\begin{bmatrix} \frac{\partial F_1}{\partial x_1} & \cdots & \frac{\partial F_1}{\partial x_n} \\ \vdots & & \\ \frac{\partial F_m}{\partial x_1} & \cdots & \frac{\partial F_m}{\partial x_n} \end{bmatrix}}$$

$$\boxed{\Sigma_{yy} = J \Sigma_{xx} J^T}$$

$$\frac{d}{dx}(\tan^{-1} u) = \frac{1}{1+u^2} \cdot \frac{du}{dx}$$

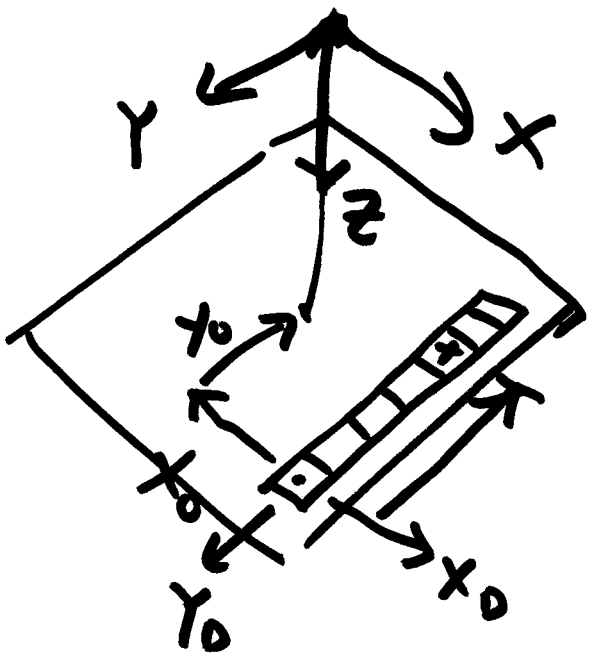
$$\frac{d}{dx}(\sin^{-1} u) = \frac{1}{\sqrt{1-u^2}} \cdot \frac{du}{dx}$$

$$\frac{d}{dx}(\cos^{-1} u) = \frac{-1}{\sqrt{1-u^2}} \frac{du}{dx}$$

$\sigma_\omega, \sigma_\phi, \sigma_k$

$$\sigma_\theta, \quad \theta = \cos^{-1}\left(\frac{\text{tr}M - 1}{2}\right)$$

$$\begin{pmatrix} 0 - x_0 \\ y - y_0 \\ +f \end{pmatrix} = \begin{pmatrix} u \\ v \\ w \end{pmatrix} \lambda$$



$$0 = x_0 + f\frac{u}{w}$$

$$y = y_0 + f\frac{v}{w}$$

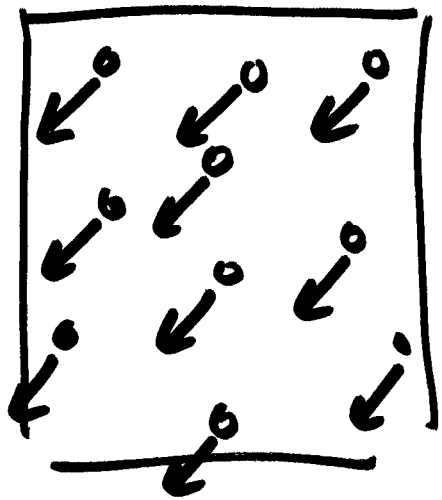
$$l_{comp} = l + x_0 + f\frac{u}{w}$$

$$s_{comp} = -\left(y_0 + f\frac{v}{w}\right)$$

$$\left.\begin{matrix} l - l_{comp} \\ s - s_{comp} \end{matrix}\right\} \quad \begin{matrix} -\left(x_0 + f\frac{u}{w}\right) \\ s + y_0 + f\left(\frac{v}{w}\right) \end{matrix}$$

misclosure calc. : <u>Matlab function</u>

$$(miscl_\ell, miscl_s) = QB(\ell, s, eph, att, \phi, \lambda, h)$$



misclosure:

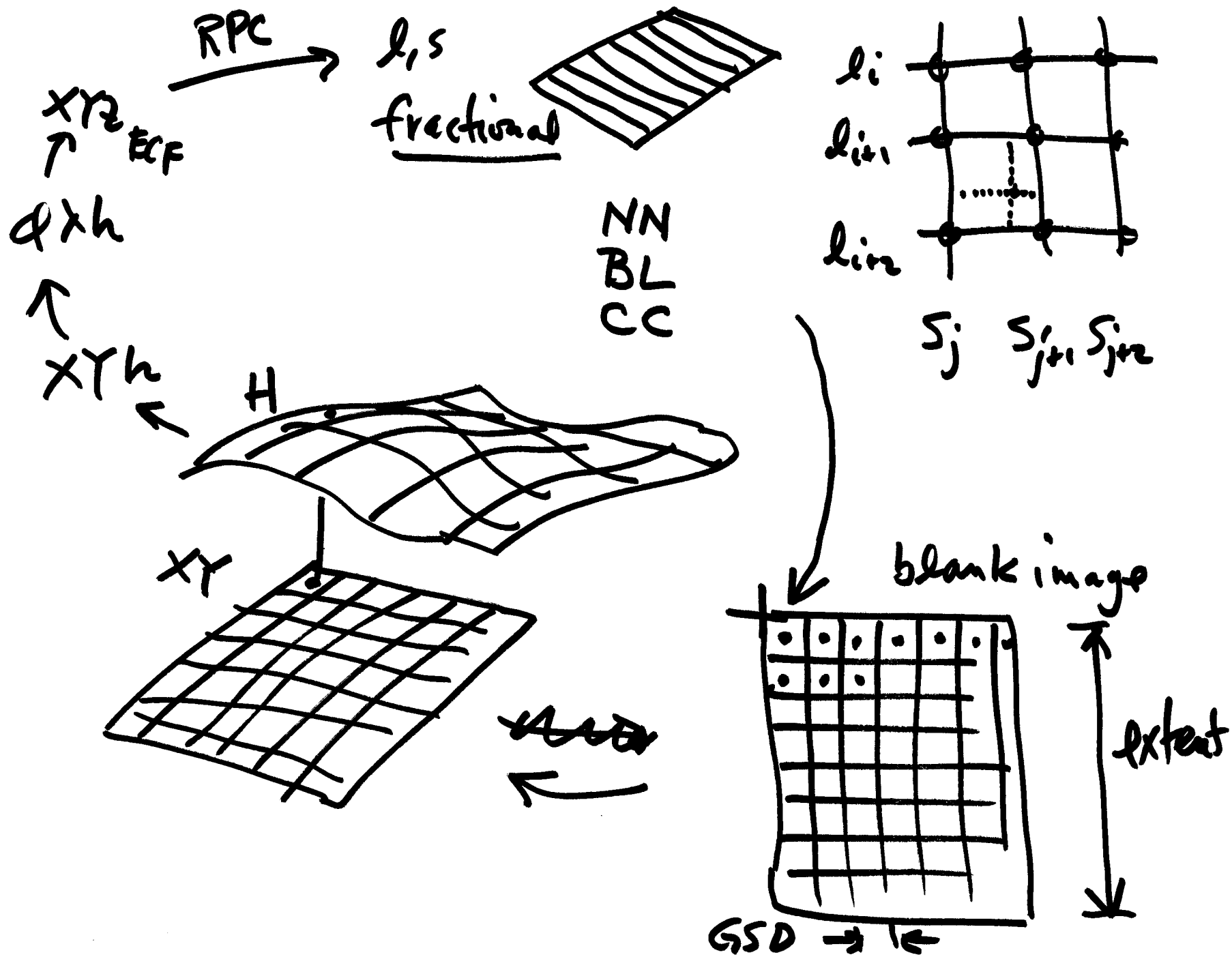
observed − computed

$$M_a M_c M \left(\begin{pmatrix} x \\ y \\ z \end{pmatrix}_{Ecf} - \left(\begin{pmatrix} x_c \\ y_c \\ z \end{pmatrix}_{Ecf} + \begin{pmatrix} dx \\ dy \\ dz \end{pmatrix} \right) \right)$$

$$dx = \underline{dx_0} + \underline{dx_1} t + \underline{dx_2} t^2 \qquad \left.\begin{matrix} dx_0 \\ dx_1 \\ dx_2 \end{matrix}\right\} = 0$$

$$t : t_e - t_{le}$$

$$d\omega = \underline{d\omega_0} + \underline{d\omega_1} t + \underline{d\omega_2} t^2$$


RPC
l, s
fractional
XYZ ECF
φλh
XYh
H
XY
NN
BL
CC
li
li+1
lin
sj sj+1 sjn
blank image
extent
GSD