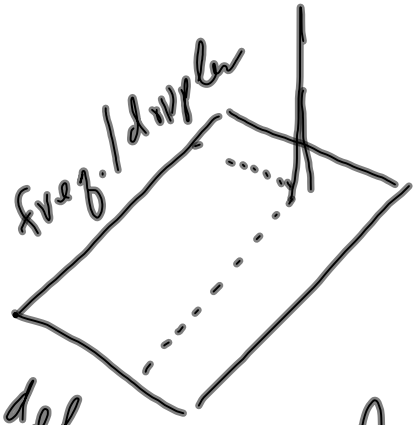
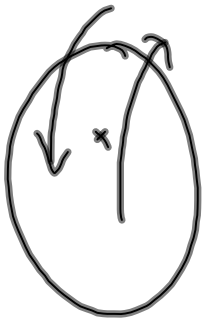
32-1

$$r_{kk}(m=0) = \sum_{l=0}^{1022} c^k(l)\, c^k(l+m) = 1023$$





Acquisition

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32-2

sub frame

HOW : TOW : time of transmission of next sub frame

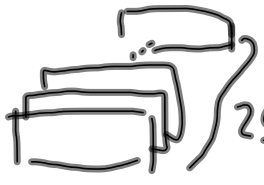
frame/page

clock errors status/health

EPH EPH 4-1 5-1

4n i 5-2 i

30s min. time for nav. solution



broadcast ephemeris

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2 body problem

Ω: Right Ascension of asc. node

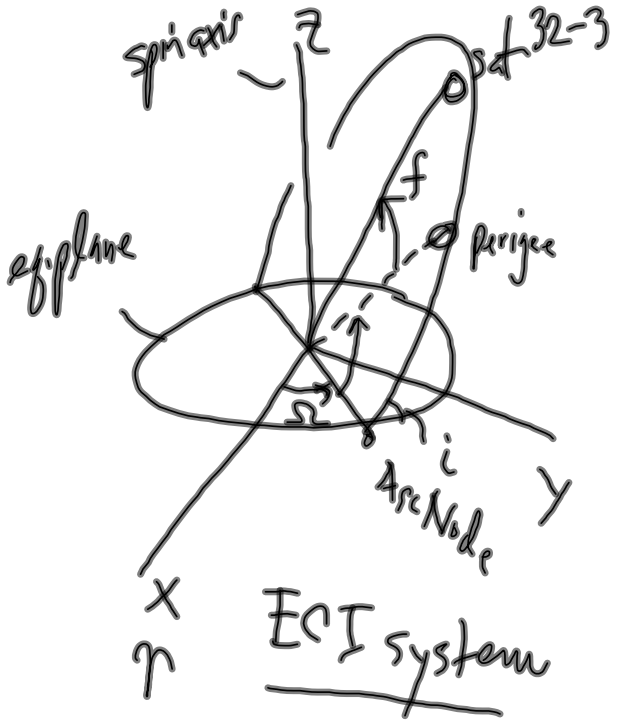
i: inclination

ω: argument of perigee

f: true anomaly

a: semi major axis

e: eccentricity



ECI system

GPS: ECF, Ω longitude of asc. node

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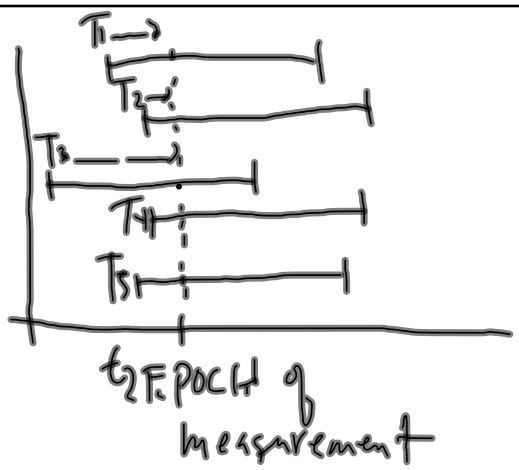

32-4

t_1: transmit time

t_2: receive time

$\delta t = t_2 - t_1$ apparent travel time ~ 65 ms

Pseudo Range $PR = c \cdot \delta t$ $c: 3 \times 10^8$ m/s

RINEX: receiver independent exchange format

unknowns: x, y, z rec. + 1 clock bias (per epoch)

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32-5

$x \quad y \quad z \quad dt_1 \quad dt_2 \quad dt_3$

B

$$PR_{CORR} = PR_{RAW} + c \cdot dt_s$$

$$PR_{CORR} = \left[(X_R - X_S)^2 + (Y_R - Y_S)^2 + (Z_R - Z_S)\right]^{1/2} + c \cdot dt_R$$

$$F = PR_{CORR} - \left[(X_R - X_S)^2 + (Y_R - Y_S)^2 + (Z_R - Z_S)^2\right]^{1/2} - c \cdot dt_R$$

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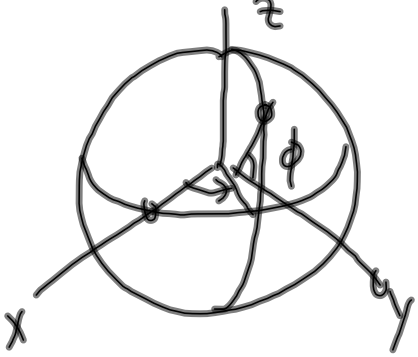
32-6

Recommend: units km, msec

formats of data files: RINEX [stat. pos. .. / observations ..]

to exclude observations too close to horizon:



λ longitude
φ latitude
h ellipsoid

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} \Leftrightarrow \begin{pmatrix} \varphi \\ \lambda \\ h \end{pmatrix}$$

local cartesian $- (e, n, u)$

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32-7

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{bmatrix} (N+h)\cos\varphi\cos\lambda \\ (N+h)\cos\varphi\sin\lambda \\ ((1-e^2)N+h)\sin\varphi \end{bmatrix}$$

N: radius of curvature in prime vert

$$N = a/(1-e^2\sin^2\varphi)^{1/2}$$

other directions: iterate

- approx φ, get N
- $h = \dfrac{(X^2+Y^2)^{1/2}}{\cos\varphi} - N$
- $\varphi = \tan^{-1}\left[\dfrac{Z}{(X^2+Y^2)^{1/2}}\left(1-e^2\left(\dfrac{N}{N+h}\right)\right)^{-1}\right]$
- $\lambda = \tan^{-1}(Y/X)$ * use 2 argument version

repeat until no change

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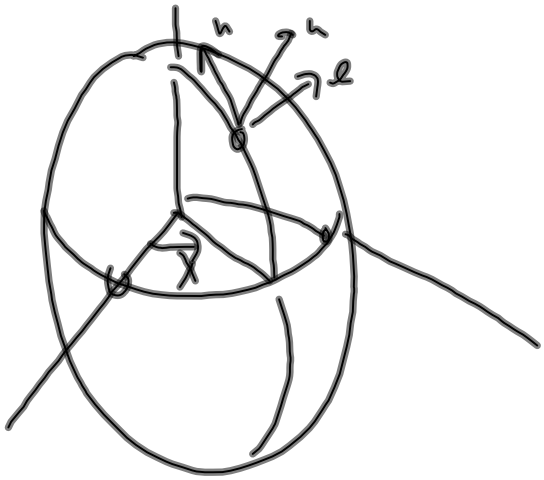
32-8

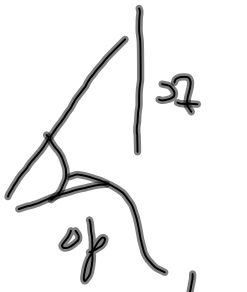


$$(N+h)\cos\varphi\cos\lambda$$
$$(N+h)\cos\varphi\sin\lambda$$
$$((1-e^2)N+h)\sin\varphi$$

$$\begin{pmatrix} e \\ n \\ u \end{pmatrix} = M_X(90^\circ-\phi)\,M_Z(\lambda+90^\circ)\left[\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} - \begin{pmatrix} X_0 \\ Y_0 \\ Z_0 \end{pmatrix}\right]$$

$=$

ref. point



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