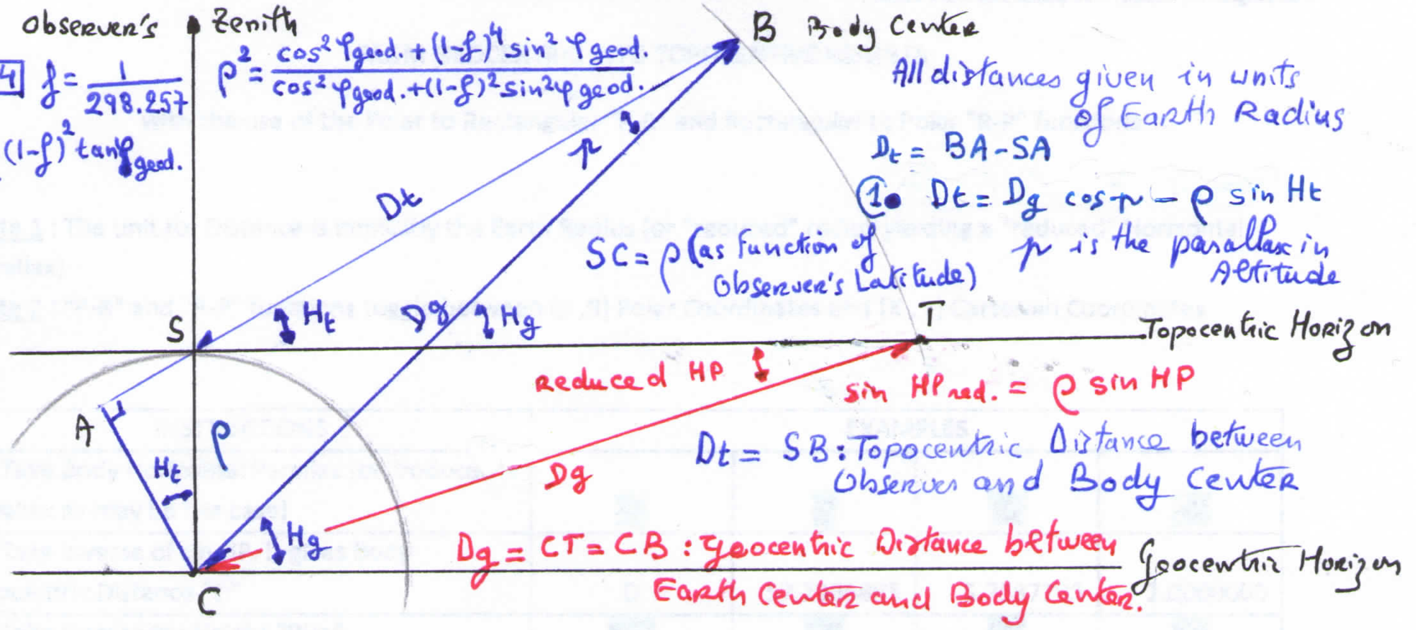
MOON PARALLAX AND AUGMENTED SD FROM AN EARTH ASSUMED TO BE SPHERICAL
IN HORIZONTAL COORDINATES

$\boxed{\text{WGS 84}}$ $f = \dfrac{1}{298.257}$ $\rho^2 = \dfrac{\cos^2\varphi_{geod.} + (1-f)^4 \sin^2\varphi_{geod.}}{\cos^2\varphi_{geod.} + (1-f)^2 \sin^2\varphi_{geod.}}$

$\tan\varphi_{geoc.} = (1-f)^2 \tan\varphi_{geod.}$

All distances given in units of Earth Radius



$D_t = BA - SA$

(1) $D_t = D_g \cos p - \rho \sin H_t$

p is the parallax in Altitude

$SC = \rho$ (as function of Observer's Latitude)

$\sin HP_{red.} = \rho \sin HP$

$D_t = SB$: Topocentric Distance between Observer and Body Center

$D_g = CT = CB$: Geocentric Distance between Earth Center and Body Center.

(2) $\sin HP = \dfrac{\text{Earth Radius}}{CT} = \dfrac{1}{D_g}$ For the MOON (3) $\sin SD_g = \dfrac{1738}{6378.137} \sin HP$

Let Rb be the Body Radius, SD_g : Geocentric SD and SD_t : Topocentric SD

then: $\sin SD_g = \dfrac{Rb}{D_g}$ and $\sin SD_t = \sin SD_{augmented} = \dfrac{Rb}{D_t}$

thus ($Rb=$) (4) $D_t \sin SD_t = D_g \sin SD_g$ (5) $H_g = H_t + p$

(6) $\sin p = \dfrac{CA}{CB} = \dfrac{SC \cos H_t}{CB} = \rho \dfrac{\cos H_t}{CT} = \rho \cos H_t \sin HP$

(7) $\tan H_t = (\sin H_g - \rho \sin HP)/\cos H_g$

If you know Ht, start here →

(1) From H_t, compute $\sin p = \rho \cos H_t \sin HP$

(2) $H_g = H_t + p$

If you know Hg, start here →

(3) Compute $(D_g \cos H_g,\ D_g \sin H_g)$

(4) Compute $\begin{cases} D_t \cos H_t = D_g \cos H_g \\ D_t \sin H_t = D_g \sin H_g - \rho \end{cases}$

(5) Compute $D_t = \sqrt{(D_t \cos H_t)^2 + (D_t \sin H_t)^2}$

Compute $H_t = \operatorname{Atan}\left(\dfrac{D_t \sin H_t}{D_t \cos H_t}\right)$

(6) Compute $\sin SD_t = \dfrac{D_g}{D_t} \sin SD_g$

(7) Compute $SD_t = \text{ARCSIN}(\sin SD_t)$

MOON EXAMPLE with $D_g = 60$, $HP = 0°9549739$, $SD_g = 0°2602129$

(1) $H_t = 53°$, $\rho = 0.985$, $\sin p = 0.0098798$

(2) $H_g = 53° + 0°5660799 = 53°5660799$

(3) $D_g \cos H_g = 35{,}633177$ $D_g \sin H_g = 48.2725405$

(4) $D_t \cos H_t = 35.633177$

$D_t \sin H_t = 47{,}2875405$

(5) $D_t = 59.2104156$

$H_t = 53°0000000$

(Ht value hereabove is a check)

(6) $\sin SD_t = 0.0046021$

(7) $SD_t = SD_{augmented} = 0.2636829$

NOTE (1) If you know Ht, in order to compute SD augmented, you need to "travel" all the way from step (1) through step (7)

* NOTE (2) The algorithm hereabove is almost "perfectly" accurate and quite sufficient for the MOON (better than 0.01"). However, because on an Ellipsoid, the Earth center is generally NOT on the Observer's Vertical Line (NADIR), for utmost accuracy (satellites) computations cannot be carried out in a 2 dimension plan, But in 3 dimension space.

FEB 16, 2011 Antoine M. "Kermit" Couëtte