$$f_a = f_m - \text{mean period of worm} \quad @ \quad f_m \cdot \frac{\pi}{648.10^3} \cdot \frac{d\alpha}{dt}$$

$$\frac{d\alpha}{dt} = \frac{A.\frac{dH}{dt}.\cos\phi.\sin H.\sin\eta}{\sin z.\cos^2 z}$$

$$\tan\eta = \frac{\sin H}{\cos\delta.\tan\phi - \sin\delta.\cos H}$$

$$\cos z = \sin\phi.\sin\delta - \cos\phi.\cos\delta.\cos H$$

*where* $f_m$ = *mean sidereal frequency*

$f_a$ = *apparent sidereal frequency*

$A$ = *constant of refraction*

$\frac{dH}{dt}$ = *mean rate of change of hour angle with time* $= 1.015\sec s/hr$

$\phi$ = *site latitude*

$H$ = *hour angle*

$\eta$ = *parallactic angle*

$z$ = *zenith distance*

$\delta$ = *declination*