RE-ESTIMATION OF SOLAR CORONA COEFFICIENTS (A,B,C) BY USING MGS & MEX SPACECRAFT DATAS

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Abstract

The Sun is one of the most studied star in the universe. It has many puzzling features and one of them is solar corona. The solar corona are the result of high density and strongly turbulent ionized gases (Plasma) being ejected from the Sun. During superior solar conjunction, the line of sight between the Earth and a spacecraft passes near the sun. When radio frequency waves pass through these regions, the signals suffer severe degradation or perturbed by the solar corona.

The purpose of this study is to reduce the effect of solar corona on the range data when the signal raypath passes through the solar corona and then to estimate new solar corona coefficients. The model (Eq. 1) used for estimation of solar corona effect (during round-trip of propagation time) has been taken from Anderson (2002) or Moyer (2000).

$$\Delta sc\rho$$
$$= \pm \left[A\left(\frac{R_s}{p}\right) F + B\left(\frac{R_s}{p}\right)^{1.7} e^{-\left[\frac{\phi}{\phi_0}\right]^2} \right.$$
$$\left. + C\left(\frac{R_s}{p}\right)^5 \right] \left(\frac{2296 \times 10^6 \, Hz}{f}\right)^2 \quad m$$

where

A, B, C = solar corona coefficients
R_s = radius of Sun = 696,000 Km
ϕ_0 = reference latitude = 10^0
f = up-leg or down-leg carrier frequency, Hz

The fig. 1 is showing range residuals including solar corona effect during entire life span of MGS spacecraft with constant or initial values of solar corona coefficients i.e. A=6 Km, B=20 Km & C=600 Km.

Re-estimation of coefficients can be simulate by first finding the partial derivates of round-trip light time with respect to solar corona coefficients A,B,C and then by using lest-squares technique to fit these parameters. Fitting processes will be done separately for each corona period due to difference in density and turbulence of ionized gases (Plasma).
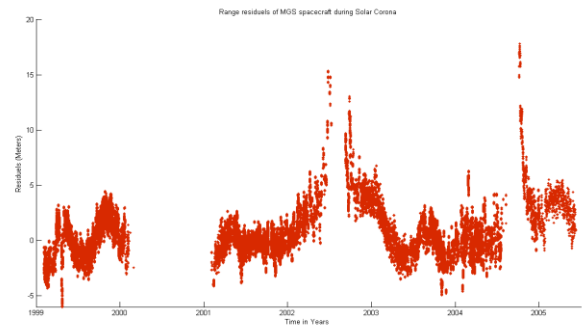
Figure

Fig. 1 : Range-residuals of MGS spacecraft including solar-corona period.

References

[1] Moyer, T.D., 2000. Formulation for observed and computed values of Deep Space Network data types for navigation, Monograph 2, Deep Space Communications and Navigation Series.