CESAR Science Case – Calculation guide

Calculate the heliographic coordinates of a sunspot

$$R_m = \sqrt{X^2 + Y^2}$$

$$P_m = arc\ tg\left({}^{X}\!/_{Y}\right)$$

$$\rho = arc\ sin\ (R_m/R) - \alpha/2(R_m/R)$$

$$sen(B) = sen(B_0)\ cos(\rho) + cos(B_0)\ sen(\rho)\ cos(P - P_m)$$

$$sen(L - L_0) = sen(P - P_m) sen(\rho) cos\ (B)$$

Where X and Y are the coordinates of a sunspot measured in pixels on the image and L, B the heliographic longitude and latitude.

Use the value of 0.5244˚ for summer, 0.5422˚ for winter and 0.5333 for autumn/spring in the North hemisphere.

L_0, B_0, and P have to be taken from the Ephemeris.

Calculate the rotation period of the Sun

$$S = 360^{\circ} \frac{\Delta t}{\Delta L}$$

$$P = (S * 365{,}25)/(S + 365.25)$$

Where $\frac{\Delta t}{\Delta L}$ could be calculated with: the next formula or just dividing the time between two images by the number of degrees that a sunspot has been moving.

$$\frac{\Delta L}{\Delta t} = \frac{cos^{-1}\left(\frac{x_3 - \varphi}{\varphi}\right) - cos^{-1}\left(\frac{\varphi - (x_2 - x_1)}{\varphi}\right)}{(t_2 - t_1)}$$

Wolf number

$$W = k(10g + s)$$