Sun shadow Location

Haochen Huang1, a

[1]School of North China Electric Power University, BaoDing 071000, China;
[a]634032756@qq.com,

Keywords: Vector dichotomy exhaustive regression analysis

Abstract. This paper studies the changes of different time, place, rod length and shadow length. Use of existing video data, using mathematical vectors, linear programming, dichotomy, multi-stage euqal exhaustive and other methods, according to the laws and geographic relationship to establish true solar time and analytic geometry sun shadow length and the date, time, longitude , the relationship between latitude, describing a given date and geographical coordinates sun shadow length changes with time. Using MATLAB programming tools curves obtained relevant data, to determine its location and date in the shadow of the trajectory of the object through the sun. Followed by the establishment of the corresponding model, verify the availability of the model.

Introduction

In life, how to determine the location and shooting video of date, it is the key to determine the best shooting opportunity, but also an important aspect of video data analysis. Sun shadow positioning technology is through analysis of video sun shadow of objects change, a method of determining the video shooting location and date.

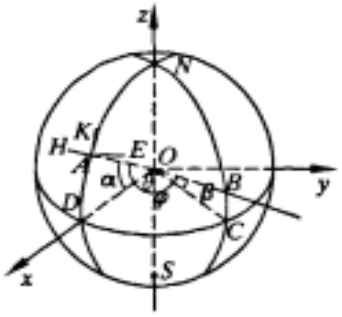

Figure I schematic view of the sun-Earth Coordinate

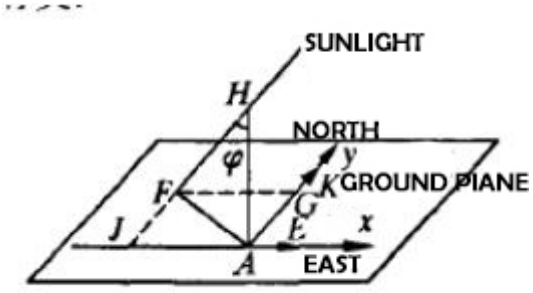

Figure II.Shadow schematic plan view of two sunlit pole

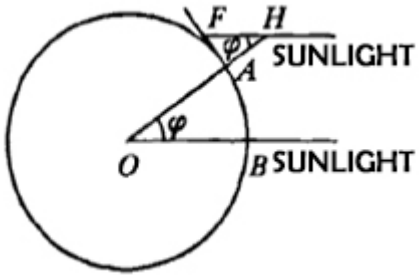

Figure III schematic plan view of the Earth's sun

Derived.

Suppose the region do not move to the Earth as the center and radius for any field of an imaginary sphere, the imaginary celestial sphere is called. All the stars including the sun, including, both in this sphere to rotate about the axis.

Equatorial coordinate system is to extend the latitude and longitude coordinates on the Earth to the celestial sphere, in parallel to the equatorial plane of the Earth's latitude circle on the celestial sphere is called declination circle; in the north and south poles of the Earth by the accuracy circle on the celestial sphere is called when the ring . And when the angle of declination δ in Ω indicates the position of the sun. The so-called hour angle is the angle between the sun when the ring where the ring and through difficulties when constituted, in degrees. Since celestial North Pole, the clockwise direction of the needle is positive, the counterclockwise direction is negative. When the sun's azimuth angle indicates, because the celestial sphere in 24 hours a day, rotating 360 °, so an hour rotation 15 °.

Horizontal coordinate system is the basis of the horizon circle with solar elevation angle h and azimuth A to determine the position of the sun in the sky. The so-called solar elevation angle is the angle between the sun and direct light between the ground plane. Solar azimuth is the angle between the sun direct sunlight on the ground plane of the projection line and the ground plane to the south. Generally south of the point S is 0 °, the west is positive, negative east.

Let the Earth radius R, ∠AOD = α, ∠BOD = β, ∠AOB =, α is the observation ground at A latitude, -90o≤α≤90o; latitude several β position of the sun direct point B, -23o26'≤ β≤23o26 '; θ is the solar direct point A to point B longitude difference, for a day to day A t the time (place, time is 12:00 noon) have θ = (t-12) * 15 / (0 ≤t≤24), where t is the true solar time. As the sun's rays 0B corresponding vector OA and normal vector angle A to level the ground. Figure 3 shows the two places had great circle AB, because HF // BO, so ∠AOB = ∠AHF =, A t the time to sun elevation angle of 90o-φ. Figure A to O as the origin, OD where the straight line x-axis, ON where the straight line is the Z axis coordinate system is established, there are:

$\overrightarrow{AE}$ =(0,1,0), $\overrightarrow{AR}$ =(-sinα ,cosα);

A(Rcosα ,0,Rsinα),B(Rcosβ cosθ ,Rcosβ sinθ ,Rsinβ);

cosφ =cos（ $\overrightarrow{OA}$, $\overrightarrow{OB}$ ）=cosα cosβ cosθ +sinα sinβ ;

Figure III, RtΔAHF in,HF=AH/cosφ , set up with the angled, cosδ =cos($\overrightarrow{HF}$, $\overrightarrow{AE}$)=-cosβ sinθ .HF positive projective AJ on AE,AJ=HFcosδ =cosδ /cosφ *h,Let the angle formed by the $\overrightarrow{HF}$ $\overrightarrow{AR}$

cosγ =cos（ $\overrightarrow{HF}$, $\overrightarrow{AR}$ ）=cos（ $\overrightarrow{BO}$, $\overrightarrow{AR}$)=sinα cosβ cosθ -cosα sinβ

Using MATLAB to make the curve as follows:

October 22, 2015 Beijing time 9: 00-15: changes in the sun's shadow length between 00 Tiananmen Square 3-meter-high straight bar graph

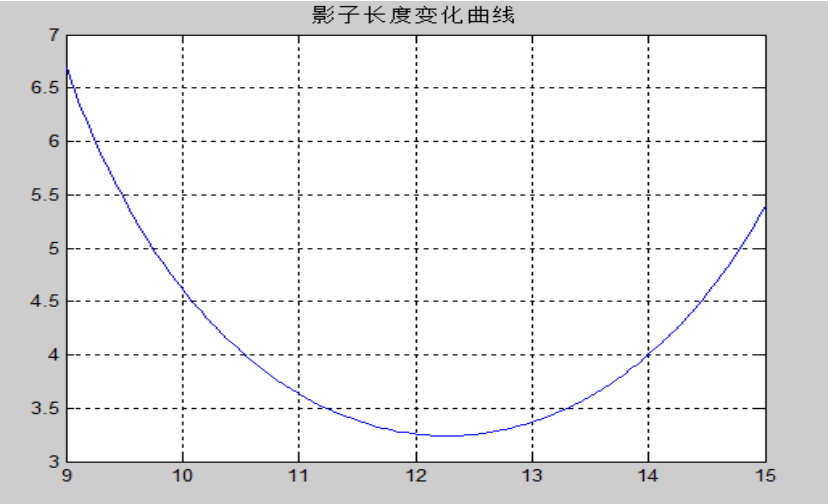

Figure IV

3. Conclusion.

Establish equatorial coordinate system and horizontal coordinate system, according to changes in the equatorial coordinate system when the angle of declination and horizontal coordinate system and changes in elevation and azimuth calculated solar elevation angle and azimuth, the above derivation establish functional relationship by:

$$l = \tanh * b$$

$$\sin h = \sin\alpha \sin\beta - \cos\alpha \cos\beta \cos\theta$$

$$\sin\beta = 0.39795\cos[0.98563(N-173)]$$

$$\theta = [(t-12)*15^{\circ} + \gamma - 120^{\circ}/180^{\circ} * \pi$$

Note: Here t GMT;

N is the number of days, counting from 1 January each year

Effect of various parameters on the video length: (1) t ,, constant shadow graphics constant change, the graphics move around; (2) some other, smaller, the shorter the length of the shortest shadow.

References

[1] 1001-1595 (2008) 01-0005-05 Lee Magnolia, while SURVEYING. Gauss projection represents a complex function of Surveying and Mapping Technology, 2008.

[2] 1006-3080 (2010) 03-0458-06. Zheng Pengfei, Linda Jun, Liu lamb, Wuzhi Ting based technology research shadow trace reverse lighting effect. CHINA UNIVERSITY .2010.

[3] Army. Dichotomy two solstices the sun, as the trajectory resolution. Write count (Education Research) .2012 (43)

[4] 1006-7329 (2008 JO5 a O13O-O5. Xu Feng, Wang Bo, Zhang Hailong. Architectural Sunlight Analysis Improvement of the sun's position in the formula [A] Chongqing Jianzhu University Vol 30, 5 .2008.10.

[5] 1673-7148 (2007) Suppl -0161-04. WANG Guo, rice Hung Tao, Deng Tianhong, Leanne, Li Lanxia calculated solar elevation angle and azimuth variation range sun sunset time year [B]. Meteorology and environmental Science Vol. 30 Suppl .2007.09.

[6] Wang peace. Inquiry shadow trajectory. Middle School Mathematics Monthly .2010 (9)