The Study of Distance between the Earth and Moon with an occultation of Mars by the Moon by Lunar Parallax Method

Miss Ploysai arkkarapongchanaporn (Grade 11)
[Demonstration school of Phuket Rajabhat University, Phuket, Thailand]

Abstract

The study aimed to measure the distance from the Earth to the Moon from the phenomenon. In addition, this study identifies trends of deviation. Data were collected by imaging the Moon and Mars in different regions on April 17th, 2021, using 10-inch Dobsonian reflectors connected to a DSLR camera. The result shows that the distance from Earth to the Moon, calculated using the Lunar Parallax method, was correlated with the distance, and the discrepancy results were affected by the distances.

Introduction

The distance from the Earth to the Moon can be measured using the parallax method, so this study is observed by the change in position of an object relative to its background from a different perspective. In this research, the researcher studied the distance from the Earth to the Moon from the occultation of Mars by the Moon that occurred on April 17, 2020, by using the Lunar Parallax method.

Methodology of research

1. Data Collection

1.1 Study the phenomenon of the moon obscuring Mars (Occultation of Mars by the Moon) on April 17, 2020, from 8:00 PM to 8:45 PM on the Stellarium program.

1.2 The moon and Mars' pictures were carried out by using the 10-inch dobsonian reflector telescope and DSLR cameras from 8 positions of observation, from 7:30 p.m. until the moon eclipsed.

2. Data analysis

2.1 Measure the distance between locations by using Google Maps and taking pictures of each location. Overlay and measure the apparent magnitude of the moon and its parallax on the Geometer's Sketchpad program. (figure 1)

2.2 The distance from the Earth to the Moon is calculated

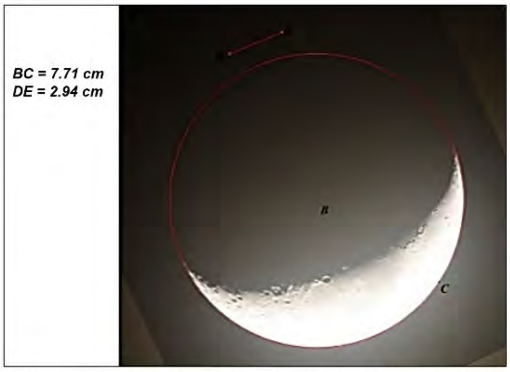

Figure 1. Angle measurements in Geometer's Sketchpad (GSP) program.

$$\boldsymbol{Moon\ Distance\ (D)} = \left(\frac{\boldsymbol{distance\ A\ \text{and}\ B}}{\tan(p)}\right) \qquad (1)$$

D = Moon Distance (km)
P = Parallax Angle(◦)

Result and Discussion

1. Table 1: Distance from Earth to Moon photos at the same time.

Cities	Distance between cities (km)	Moon Distance Std. (km)	Parallax angle (°)	Moon Distance (km)	Error (%)
A and B	1,227.27	397,794.62	0.15	461,748.12	16.08
D and C	113.35	399,033.02	0.01	539,919.71	35.31
D and E	691.14	400,373.82	0.09	443,446.94	10.76
D and D	536.56	398,936.77	0.08	415,063.72	4.04
D and G	744.59	399,162.72	0.08	541,761.41	35.72
D and B	695.15	397,696.62	0.09	444,673.07	11.81
C and E	614.60	399,183.58	0.09	414,800.09	3.91
C and F	582.53	398,881.16	0.08	402,942.68	1.02
C and B	668.36	398,885.41	0.08	500,411.79	25.45
E and F	1,192.62	398,999.06	0.17	405,801.33	1.70
E and G	56.22	399,243.75	0.02	154,362.43	61.34
E and B	336.03	398,973.06	0.04	475,742.27	19.24
E and H	1,011.42	399,309.30	0.16	375,606.75	5.94
F and G	1,248.48	399,415.88	0.17	417,390.14	4.50
Average		**399,009.73**		**429,820.43**	**7.72**

Conclusions

A study of the distance between Earth and the moon with an occultation of Mars by the Moon by Lunar Parallax Method found that the simultaneous photographs got the average distance from Earth to the Moon is 421,760.35 km, with an error of 5.71% the data show in Table 1. When considering the Earth-to-Moon distance trend by the Lunar Parallax method, there is an error in calculating the Earth-Moon distance by the Lunar method. The error is correlated with the distance with larger observer distance giving more accurate measurements.

Acknowledgments: I would like to thanks Mr. Nattapong Songumpai, Khomson Thuree, Astronomy Information Officer, National Astronomical Research Institute of Thailand (Public Organization) and my family for their encouragement

References: Romanized Title [Astronomical Phrnonena]. Chang Mai: National Astronomical Research Institute of Thailand (Public Organization) and Matipon Tangmatitham. (2020)