Earth-Sun-Moon System

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Introduction

The motions of the Moon about the Earth and the Earth about the sun have historically been enlightening on the topic of timekeeping, but their motions are also indicative of the relevant geometries. To develop an intuition of these motions, I will systematically observe them for a month, and use my observations to predict and model their motions.

Procedure

Using the procedure outlined in the previous experiment, I will measure the motion of the star Deneb, and each observation will be made at 19:00MST. To quantify the illumination of the moon, I will photograph it at various stages in its orbit of the Earth, convert the image to greyscale, find a 'threshhold brightness', and iterate over the image to find the amount of illuminated pixels, and then divide that number by the number of pixels the moon occupies. The code, images, and markdown will be included at the end of the report.

Deneb Data

Date	Altitude (Deg)	Azimuth (Deg)
$9/30(21:00MST)$	7 ± 1	80 ± 1
$9/30(22:00MST)$	318 ± 1	75 ± 1
10/1	3 ± 1	79 ± 1
10/6	345 ± 1	79 ± 1
10/22	310 ± 1	80 ± 1

Table 1: Observations of motion of Deneb over 1 month at 21:00MST

Questions

1. 15^o per hour makes sense because they should move 360^o per day.

2. I would expect the stars to shift 1^o per day, but the 23 days of this trial, Deneb has moved $(360 - 310 - 7)^o$, which is about 2.4^o per day

3.

4. See included section on Lunar observations.

5. Jan 31, 1999 and Jan 21, 2000 (Stars and Planets) is 11 months and 21 days, so divding

that number by 12 (the expected number of cycles) yields a synodic lunar period of 29.63 days. Wikipedia says the long term average is 29.5305 days. My 'calculated' synodic period was 29.79 days because it fit my data best. Lunar synodic periods vary from the long term average because the distance between the Earth and moon isn't constant, and because the Earth orbits the sun at different speeds throughout the year.