The study of measurement methods of twinkling stars

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Abstract

The purposes of this research are (1) study the measurement methods of twinkling stars and (2) study the relationship between the blinking and altitude. In this work, the blinking means the standard deviation of stars' brightness values. The observation data are taken by a DSLR camera with the 8" Schmidt Newtonian telescope at Prommanusorn Phetchaburi School in Thailand. We compare the standard deviation of the brightness from each method and create the graph between the blinking and altitude. In this study, there are three measurement methods. The first one is long exposure shot and slightly move camera. The second one is record video. And the last one is record video with Differential image motion monitor method (DIMM). The results show that the best measurement method is recording the video with the DIMM method. And the blinking inversely proportion to altitude.

Introduction

The first one is long exposure shot and slightly move camera at two second intervals. The second one is record video at the same duration. And the last one is record video with the DIMM method. The DIMM method is seeing measurement. It consists of instrument that used to cover the aperture of the telescope. This instrument has two small holes. It can simulate the seeing conditions. When focal plane is shifted, two virtual spots of the star will be appeared. Their time-averaged motion is proportional to the astronomical seeing.

Method

Part 1: the best measurement and the best precision methods.
1. Taking photos and recording videos with three methods, long exposure shot, record video, and DIMM method.
2. Measuring the brightness of the star from each method. In the DIMM method, measuring the gap between stars were also considered.
3. Calculating the blinking represented by the standard deviation (SD) of the data then comparing them to find the best measurement methods.
4. Calculating the precision represented by the SD of SD then compare them to find the best precision methods.

Part 2: the relationship between the blinking and altitudes.
1. Choosing the clearly visible stars with altitude in range $10° - 80°$.
2. Collecting data 10 times of each star at different times and transcript altitude.
3. Measuring and calculating the blinking of each star.
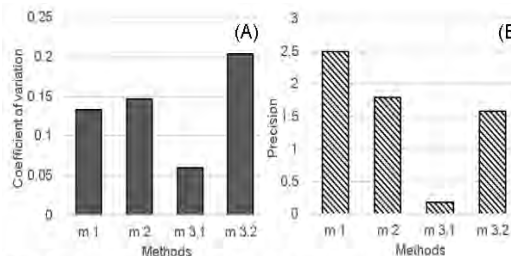4. Finding the relationship by plotting a graph.

Result

Fig 1: (A) coefficient variation of each methods.
(B) precision of each methods

M1: taking photos method. M2: record videos method.
M3.1: DIMM method analyzed the distance between stars.
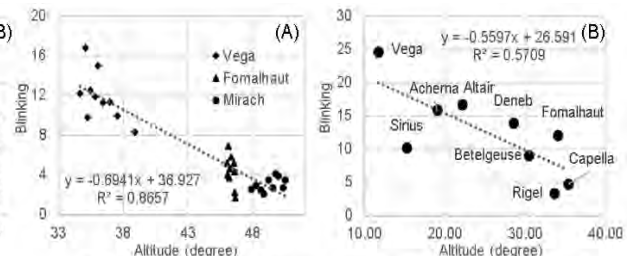M3.2: DIMM method analyzed the brightness.

Fig 2: (A) the graph of blinking and altitudes with 3 stars at the different times.
(B) the graph of blinking which and altitudes with 8 stars at the same times but different altitude.

From the Fig 1, (A) This graph shows obviously methods. The best of obviously is M3.2 (record videos with the DIMM method and analyze the brightness.) (B) This graph shows stability of methods. The best stability is M3.1 (record videos with the DIMM method and analyze measure distance between stars.)

From the Fig 2, (A) This line graph shows trend as this equation y = -0.6941x + 36.927, R^2 = 0.8657. (B)This line graph shows trend as this equation y = -0.5597x + 26.591, R^2 = 0.5709.

Conclusions and Discussion

The best blinking measurement method is the DIMM method. According to the results, the DIMM method can obviously measure the changing in brightness of the twinkling stars. Moreover, this method can also measure precisely comparing with other methods.

The relationship between blinking and altitudes is inversion. When the altitude increases, the blinking will decrease. Because the air mass is larger when the altitude is lower. Thus, these results are relating to air mass.

Acknowledgments

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