DSLR Camera Photometry and Star Tracking

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Photometry is an area of astronomy that involves measuring the magnitude of stars and other celestial objects. Traditional photometry observations require thousands of dollars of equipment and complex proprietary software, making it widely unpopular and inaccessible to amateur astronomers. The goal of this project was to determine the efficacy of inexpensive, consumer Digital Single Lens Reflex (DSLR) cameras and lenses by optimizing the process of photometry to produce the most accurate results possible with affordable and accessible hardware and software. This optimization analyzed a variety of factors, including camera sensitivity, location in the frame, focus level, exposure length, overall exposure time, and processing type. The Pleiades star cluster was analyzed for this project, chosen for its optimal positioning in the sky during testing, similar star magnitudes, and recognizability. A prototype equatorial star tracking mount was also designed and tested to examine the impact of star tracking vs manual tracking on the accuracy of photometry results. After taking a wide variety of images, the most influential factors were camera sensitivity (ISO), processing type, and exposure time. Other factors, such as star roundness, distance from the center of the frame, and overall exposure length were less influential, only causing errors at extreme values. In optimal conditions without a tracking mount, this system was able to achieve an average of close to .01 magnitude error repeatably, an acceptable error for measuring many variable stars, and showing that inexpensive consumer equipment is capable of high-accuracy photometry.

Awards Won:
Central Intelligence Agency: Second Award: $300