Astronomical Image Processing: A Novel Application of Image Proessing Aimed at Asteroid Detection

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Approximately 700,000 asteroids are being tracked, however this may represent only 1% of the total. While a number of professional efforts are searching for near-Earth asteroids, amateur astronomers still play a significant role in asteroid discovery. Professional telescopes are bigger, but amateurs have greater numbers, and there are millions of asteroids to be discovered. This project aims to improve asteroid detection techniques used by amateur astronomers by applying signal processing techniques including image smoothing, sharpening, differencing and time-delayed integration (TDI). Smoothing, sharpening and image stacking (related to TDI) are used in commercial photo editing software like Adobe Photoshop. The software package, Astrometrica, represents the state-of-the-art asteroid detection tool for amateurs. Several series of images of asteroid-rich star fields were obtained using the iTelescope network, and the image files were converted from telescope image format to Microsoft Excel. Known asteroids in these images which are near and beyond the limiting magnitude were selected for analysis. Signal to noise ratio (S/N) was defined and used to measure the degree of improvement. The S/N ratios were determined for the control cases (Astrometrica stacked). The signal processing equations necessary to accomplish various combinations of the smoothing, sharpening, differencing and TDI were applied in Excel format, and the S/N of these processed images was compared to the control cases. Results show these techniques improve the S/N by 84%, increase the limiting magnitude by 0.67, allow a 27% reduction in asteroid size, and increase the number of asteroids a given viewer can detect by 79%.

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