Heuristic Redesign of the Hungarian Graph Algorithm for an Automated Asteroid Detection

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This project aims to present a novel method for the asteroid search processes' automatization, since these procedures still commonly rely on humans and manual spotting. The program, featuring a user interface for demonstration and explanation purposes, only needs the provision of an array of CCD sensor images in order to return the positions, speeds, directions and rotation periods of every asteroid within the pictures. The main algorithm may be split in three sections: image pre-processing, object tagging and object tracking. The first process will consist in the conversion of the given images into pixel brightness matrices, as well as the noise removal through Poisson distribution and the image size reduction (by cutting the provided pictures into 500x500 pixel sections). The second section of the program employs two algorithms to locate and tag objects: the sweep line algorithm, which identifies the different bodies, and the hungarian algorithm (never used for similar purposes before), which relates the objects along their various positions in every image. In the end, we will work out the center of every object and we will track it throughout all the pictures, revealing its approximate trajectory and speed. Two additional algorithms are featured in our project: the stack algorithm (which will calculate the arithmetic mean of all the given images, "stacking together" all the pictures, and then seeking moving objects through working out their eccentricities) and the light curve algorithm (which will analyze the shifts in the brightness of every asteroid to calculate their rotation periods). The program has been tested through real and artificial images, proving to be very valuable and able to free scientists from the tedious bare-eye asteroid seeking procedures.

Awards Won:
Third Award of $1,000
NASA: Second Award of $750