New Population of Asteroids Discovered! Rapidly Finding and Tracking Faint Near-Earth Asteroids Using an Accurate Deep Learning Based Process

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In 2013, an 18 meter sized asteroid exploded over the city of Chelyabinsk in Russia, injuring ~1100 people– it went undetected! Small asteroids are often missed due to their faintness. In fact, over 98% of 250,000 predicted NEOs smaller than 50 meters remain undiscovered. Current detection methods generate thousands of false detections nightly, necessitating tedious manual inspection. The purpose of this research is to create an automated deep learning enhanced process to accurately discover small, faint, near-Earth asteroids. Because of its ability to pick up faint thermal signals, archival image data in a single band from the Wide-Field Infrared Survey Explorer (WISE) was used. I developed and trained a Convolutional Neural Network (CNN) in 30 minutes on a CPU with synthetic dim asteroid images I uniquely generated from 2D Gaussian function distributions. The CNN training set consisted of ~200k "Non Asteroid" and "Asteroid" images with synthetic dim asteroids implanted into WISE frames. It achieved a final accuracy over 90% on known dim asteroids. I then deployed the CNN on images over 16 square degrees of sky for 5.8 days of data. The positive predictions were inputted into a movement linkage algorithm, and consistent angular velocity links were selected. Seven dim asteroid candidates were discovered. Cross-checks with known asteroid databases verified my findings. Aperture photometry was used to calculate the magnitude of each asteroid. My discovered asteroids are dimmer and faster than known asteroids found by NASA, possibly indicating a new population. My process yields few false positives, outperforming current discovery methods. This research improves our ability to detect elusive near-Earth asteroids, crucial for protecting Earth from future collisions.

Awards Won:
Third Award of $1,000