CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1815

Project Title

Saving the World, One Asteroid at a Time: A Comparison of Different Methods of Orbital Determination

Abstract

Objectives/Goals

Near-Earth Asteroids are of great interest to the astronomical community due to their large sizes and proximity, as well as giving great insight of how the solar system was formed. Asteroid 1866 Sisyphus is the largest member of the Apollo-class of asteroids, and, with a minimum orbit intersection distance of 0.1 AU, could plausibly be perturbed into an Earth-crossing orbit at some point in the distant future. Thus, it is imperative that the orbits of Near-Earth Asteroids be determined very precisely to allow accurate integration of the orbit into the future.

Methods/Materials

The orbital elements of 1866 Sisyphus (also known by its provisional designation, 1972 XA) was determined by using the Gaussian, Laplacian, and Lambertian methods.

An artificial Neural Network was also trained using

JPL's data to test the validity of these methods.Positions were selected from a series of observations performed at the Sommers-Bausch Observatory in Boulder, Colorado, with the 16 and 18-inch reflectors over the month of July 2016. A Python program was then written to determine the orbital elements with each method, and jackknifing was utilized to combine the calculated values. Values calculated by the Jet Propulsion Laboratories will be compared to the calculated values from each method to check its validity.

Results

Summary Statement

I showed that the Gaussian method of orbit determination is more accurate than the Laplacian, Lambertian methods, as well as the Artificial Neural Network in predicting the orbit of a Near Earth Asteroid.

Help Received

I designed the experiment myself, and did all of the data gathering and implementation of the math myself. I received help from the staff at CU-Boulder Sommers Bausch Observatory in learning how to operate the equipment. I used the open source data from JPL's minor Planet center to train my neural net.