# Predicting Near-Earth Object (NEO) Trajectories

Abstract

Predicting the trajectories of Near-Earth Objects (NEOs) is a critical task in space science and planetary defense, as accurate forecasts of their paths help mitigate potential collision risks with Earth. NEOs, which include asteroids and comets that come close to our planet, require precise trajectory predictions to assess their impact probabilities and support space agencies in their monitoring and response strategies. This paper presents the development of a Django-based application designed to predict the trajectories of NEOs using advanced machine learning techniques and orbital data. The application aims to enhance NEO tracking capabilities and provide crucial information for impact assessment and collision risk management.

The proposed Django application leverages machine learning models to forecast the trajectories of NEOs based on their orbital parameters. The application is equipped with robust data handling and preprocessing modules to manage and prepare the orbital data for predictive modeling. These modules ensure that the data is cleaned, normalized, and formatted appropriately for accurate trajectory predictions. The preprocessing steps are essential for transforming raw orbital data into a structured format that can be effectively utilized by machine learning algorithms.

The core of the application consists of regression models trained to predict NEO trajectories. By employing advanced machine learning techniques, the application can forecast the future positions of NEOs with high accuracy. The models are designed to handle the complex dynamics of NEO orbits and account for various factors that influence their trajectories. This predictive capability is crucial for assessing potential impact risks and planning observational and mitigation strategies.

Visualization plays a significant role in the application, as it allows users to interpret the predicted NEO trajectories and evaluate the associated collision risks. The application includes a visualization module that generates detailed trajectory plots and impact probability maps. These visualizations provide a clear and intuitive representation of the NEO paths, enabling users to assess potential collision scenarios and prioritize follow-up actions. The interactive visualizations support decision-making processes for space agencies and help communicate risk information effectively.

The application is designed with scalability and adaptability in mind, allowing it to incorporate new data sources and machine learning models as they become available. Its modular architecture ensures that it can evolve with advancements in space science and technology, providing a flexible platform for ongoing improvements. Additionally, the application integrates security measures to protect sensitive orbital data and maintain the integrity of the predictive models.

In conclusion, this paper details the development of a Django-based application for predicting NEO trajectories using machine learning models. The application integrates data handling, preprocessing, regression modeling, and visualization components to provide a comprehensive tool for NEO tracking and collision risk assessment. By offering accurate trajectory forecasts and visualizing potential impact scenarios, the application supports space agencies in their efforts to monitor and mitigate the risks associated with near-Earth objects. Its scalable and secure design ensures its continued relevance and effectiveness in the field of planetary defense and space research.