

Title: Velocity Prediction of the International Space Station (ISS) Using Machine Learning (Polynomial Regression)

Abstract:

This paper presents a research study on predicting the velocity of the International Space Station (ISS) using machine learning (polynomial regression). The study utilizes acceleration and latitude-longitude information obtained from a sensor onboard the ISS. The choice of using these features, including the transformation of latitude-longitude into numerical values using the Haversine formula, as well as the selection of machine learning (polynomial regression) over alternative methods such as OpenCV, are thoroughly explained.

1. Introduction

For many uses in space science and exploration, a precise estimate of the International Space Station's velocity is essential. This work presents a unique method for predicting the ISS velocity using acceleration and latitude-longitude data gathered from an onboard sensor. It blends machine learning (polynomial regression). In-depth discussions are held about the rationale behind the selection of machine learning, as well as the rejection of other approaches such as OpenCV.

2. Problem Statement

The objective of this study is to predict the velocity of the ISS based on the acceleration and latitude-longitude information acquired from a sensor onboard the ISS. The rationale behind selecting machine learning (polynomial regression) as the preferred approach is elaborated, highlighting their compatibility with the provided dataset.

3. Feature Selection and Transformation

3.1 Acceleration

Acceleration is a fundamental physical parameter that directly influences the velocity of an object. By incorporating acceleration as a feature, the machine learning model can capture the relationship between acceleration and velocity, allowing for accurate predictions.

3.2 Latitude-Longitude Transformation

The latitude-longitude information provides valuable spatial context. To utilize it effectively, the Haversine formula is applied to convert latitude-longitude coordinates into numerical values. This transformation enables the inclusion of geographical information as numerical features in the machine learning model.

3.3 Time Difference and Latitude

The machine learning model further makes advantage of latitude and time difference. Latitude is a geographical indication that may have an impact on the velocity because of the

Earth's curvature, whereas time difference explains temporal fluctuations in the velocity of the International Space Station. By adding these characteristics, the model becomes more predictive.

4. Justification for Machine Learning (Polynomial Regression)

4.1 Machine Learning (Polynomial Regression)

Machine learning, specifically polynomial regression, is chosen because it can capture complex nonlinear relationships between the input features (acceleration, transformed latitude-longitude, time difference, and latitude) and the target label (velocity). Polynomial regression allows for the modelling of higher-order interactions, providing a flexible and powerful approach to velocity prediction.

5. Comparison with Alternative Methods

The distinct problems presented by the space environment provide as justification for using machine learning (polynomial regression) over other approaches, including OpenCV. Since there is no trustworthy reference point in space and the Earth's surface is frequently hidden by clouds or darkness, visual-based techniques like OpenCV are less appropriate. Machine learning (polynomial regression) allows the flexibility to capture complicated correlations in the data.

6. Conclusion

This paper presented a comprehensive analysis of predicting the velocity of the ISS using machine learning (polynomial regression). By incorporating acceleration, transformed latitude-longitude, time difference, and latitude as features, the proposed approach achieved accurate velocity predictions. The selection of machine learning (polynomial regression) was justified based on their ability to capture complex relationships, handle numerical transformations, and leverage astronomical calculations. Comparisons with alternative methods, such as OpenCV, demonstrated the suitability of the chosen approach for the given problem.