Satellite Visualizer

Team Members: Curtis Batters, Joseph Corona, Eben Fuentes, Angel Gutierrez Sanjuan, Zhuowen Li, Dennis Martinez, Rosa Saldivar, Sanskar Thapa, Kevin Ortez
Faculty Advisor: Dr. Zilong Ye
Aerospace Corporation Liaisons: Pablo Settecase, Dearo Yam, & Denny Ly
Department of Computer Science
College of Engineering, Computer Science, and Technology
California State University, Los Angeles

Objective

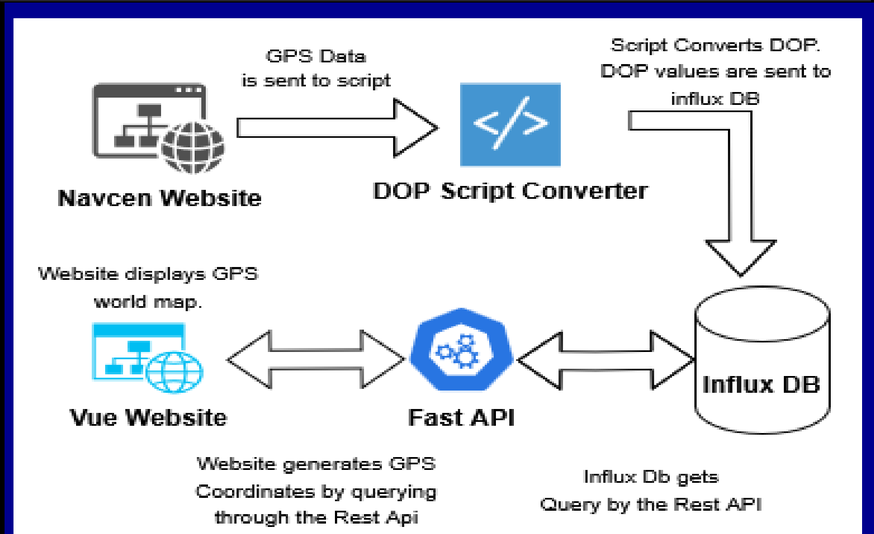
Our goal is to make a web app that visualizes satellite positions over time.
Objectives are the following:

- Modernize existing project to use up-to-date web frameworks
- Visualize satellite data over a map of the Earth over time

Background

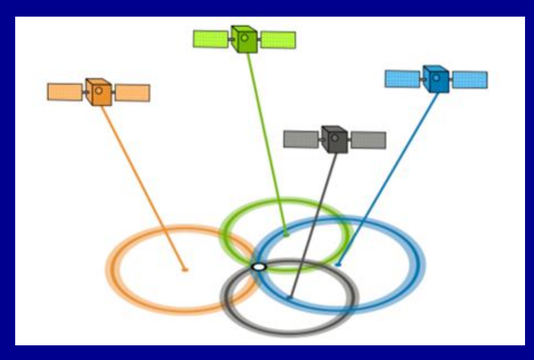
- GPS accuracy is influenced by satellite positioning geometry, measured using DOP (Dilution of Precision).
- DOP is a numerical representation of satellite alignment. The lower the DOP value, the better the positioning accuracy.

System Architecture

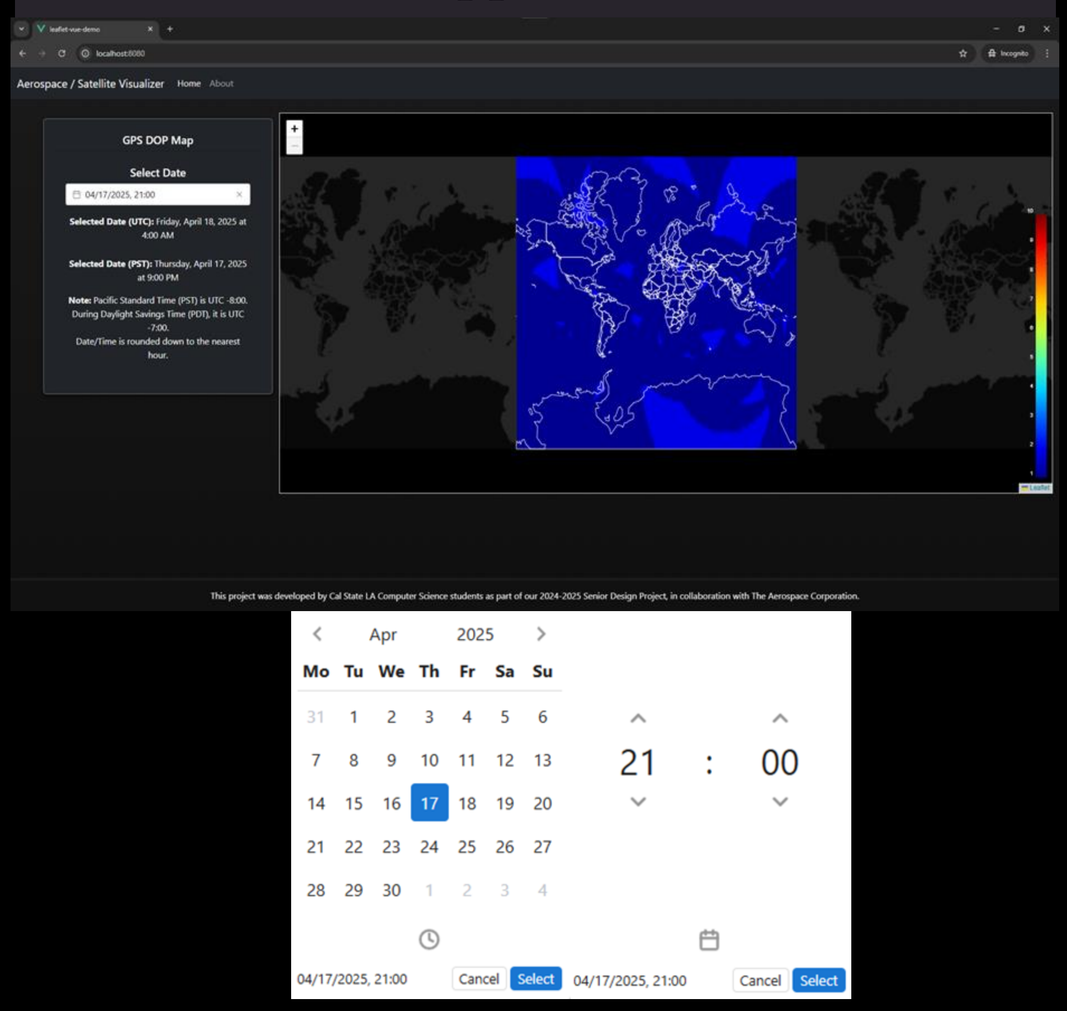


What is DOP?

Dilution of Precision (DOP) reflects how satellite geometry affects GPS accuracy. When satellites are well-positioned and there are enough of them, DOP is low and accuracy improves. When satellite positions are less favorable, DOP increases and accuracy drops. PDOP is a type of DOP that specifically measures 3D position accuracy.



Web Application UI



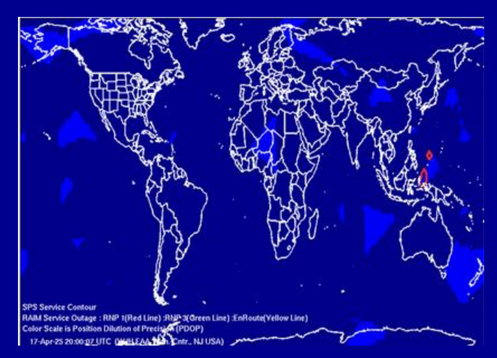
Technologies



Results



Our website's visualization



Official FAA website

The figure on the left represents our result after selecting April 17th, 2025 at 1 PM. The figure on the right corresponds to the exact same date and time as displayed on the Federal Aviation Administration's website, confirming consistency between our findings and official data.

Conclusion

- Developed a responsive user-friendly web application to visualize PDOP data on a 2D world map.
- Enabled user interaction through:
  - Date/time picker for custom timestamp selection
  - Zoom functionality
  - Real-time hover-based PDOP value display
- Streamlined data visualization by replacing CSV-based frontend input with API integration connected to an InfluxDB v1.8 database.
- Integrated web scraping from navcen.gov to retrieve the SEM almanac for each date selected, ensuring accurate satellite data for each query.
- Optimized backend performance by filtering DOP queries by timestamp, reducing map loading time from **~60 seconds** to **~5 seconds.**
- Visualizations were confirmed to be accurate by a GPS subject matter expert at The Aerospace Corporation and FAA website.