

INTRODUCTION

About Allison Transmission (NYSE:ALSN):

- Largest global manufacturer of automatic transmissions for medium- and heavy-duty commercial vehicles.
- Leading designer and manufacturer of vehicle propulsion solutions.
- Leader in electrified propulsion systems.
- >3400 employees, market presence in 150+ countries.

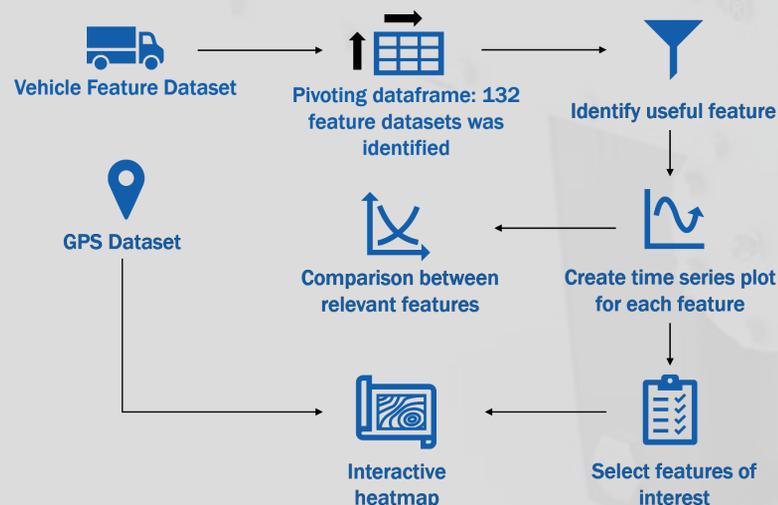
Objectives:

- Identify and create various spatiotemporal metrics to analyze parameters for vehicle delivery routes such as time spent at delivery stops, average distance between delivery stops, and fuel consumption.
- Characterize and compare delivery routes.
- Identify anomalies and quantify trade-offs between time and fuel.

MOTIVATION

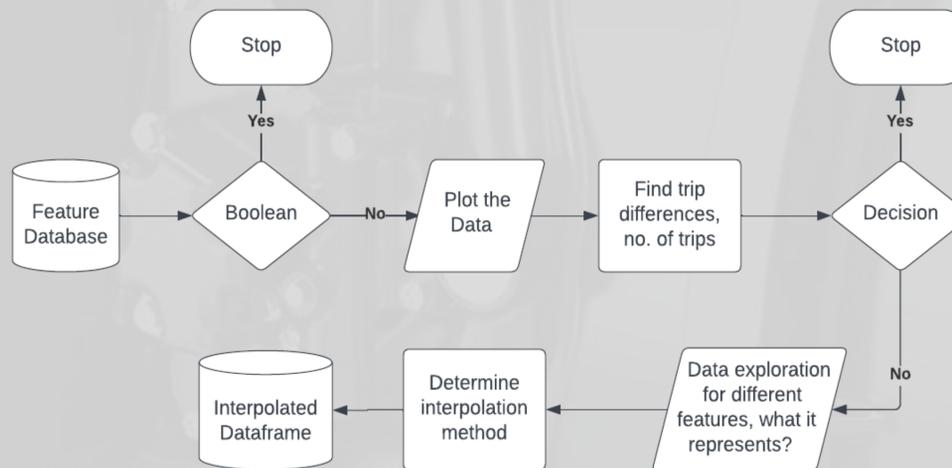
- Improve delivery efficiency:
 - Better on-time delivery rates.
 - Improve flexibility of delivery time windows.
 - Lower fuel consumption.
 - Lower vehicle maintenance cost.
- Understanding the real-world dynamics of the delivery trucks.
- Quantifying trade-offs between time and energy.
- Characterizing various delivery routes.
- Needing more efficient transmission systems.

DATA EXPLORATION



DATA IDENTIFICATION AND INTERPOLATION

- Why interpolate?
 - Not all features have consistent timestamps.
 - Truck dataset's time resolution is not frequent enough to match to the GPS dataset.
 - By interpolating datasets, **timestamps can be merged for further analysis.**
- What are the difficulties?
 - Different data types among features.
 - **Categorical** (Boolean).
 - **Continuous** (Integer, Float, Double).
- When to interpolate?
 - Interpolation flowchart:



DATA CLEANING

- During the data exploration process, we found discrepancies in some of the feature datasets.
- To better understand and address the rationale behind those discrepancies, we consulted with the mentors at Allison Transmission.
- The table below shows examples of discrepancies that we have identified and our proposed solution.

Discrepancy	Reasoning and Steps
Fuel level had some abnormal increments while the truck was in operation.	Cause: During Acceleration, fuel fluctuates inside the tank, resulting in a sensor misreading. Solution: Match with GPS data and use interpolation to smooth out.
Fuel consumption rate is relatively fast during some periods of time.	Cause: The truck was identified travelling on an Interstate highway. Solution: Correlate with GPS data.

SAMPLE DATA PLOTS

Figure 1: Time Series Plot of Fuel Level and Fuel Consumption Rate Based on Vehicle Telematics Data.

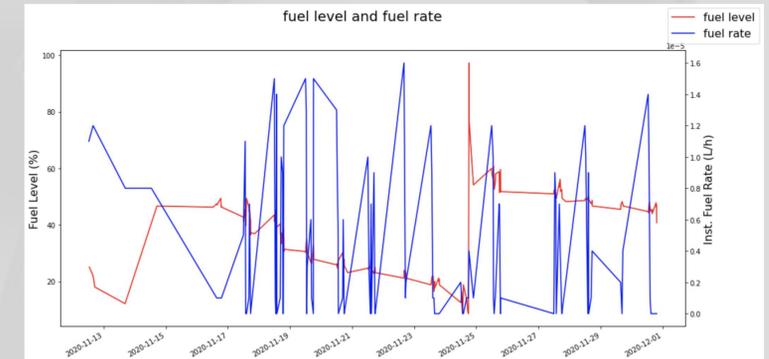
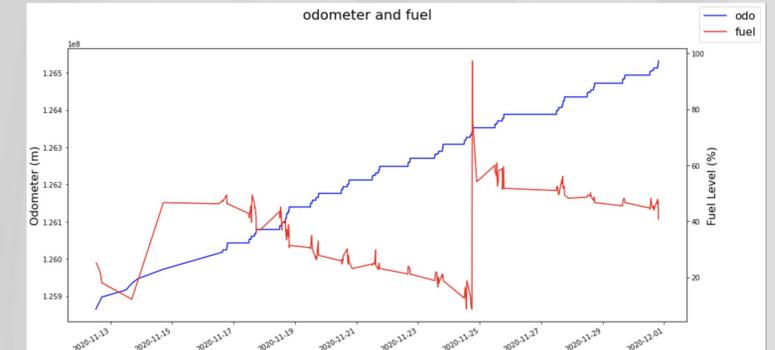


Figure 2: Time Series plot of Odometer and Fuel Level Based on Vehicle Telematics Data.



Figures 3 and 4: Interactive GPS Heatmap Based On GPS Dataset.



FUTURE GOALS

- Define **Key Performance Indicators** – which, in turn, will drive business value for Allison Transmission.
- Develop predictive **machine learning models** of the short-distance delivery and prescribe the optimal tradeoff between fuel and time.

ACKNOWLEDGEMENTS

- A special thanks to our corporate partner mentors: Andrej Ivanco, Connor Jones, and Eric Applegate, as well as the Data Mine staff.