Hard Stop and Momentary Stop of Vehicle

***Abstract*—** This research includes a detailed investigation of vehicle paths at signalized junctions. The emphasis is on distinguishing between two different stop conditions: "Momentary" and "Hard." Momentary stops occur when a vehicle comes to a halt owing to a red signal and then resumes travel when the signal turns green. On the other hand, hard stops are vehicles that remain immobile during their journey, similar to parked cars. Furthermore, the paper includes an in-depth explanation of feature extraction and data preparation, as well as a little bit of algorithm discussion, which serves as the foundation of the analysis. The study's findings have important ramifications for traffic management and urban development, resulting in safer and more efficient road networks.

***Keywords*—** Data Analysis, Trajectory, Feature Extraction, Detection, Identification

I. Introduction

This study explores vehicle trajectories at signalized intersections, focusing on differentiating between two distinct stop conditions: "Momentary" and "Hard." Additionally, the report delves into feature extraction and data preprocessing techniques underpinned by algorithmic approaches, forming the analysis's cornerstone. This research contributes to a better understanding of driver behavior and traffic dynamics at signalized junctions by elucidating the nuances between Momentary and Hard stops. The findings hold significant implications for traffic management and urban planning initiatives aimed at enhancing road safety and efficiency.

II. Methodology

In our study, we have developed a meticulous methodology for extracting significant features from vehicle trajectory data, specifically using the NGSIM US-101 dataset. Our analysis focuses primarily on the dynamics of lane changes in traffic scenarios. Our methodology is divided into four key phases.

The first phase involves the identification of change points. We utilized change point analysis to detect instances indicating lane changes among ego vehicles. This was achieved by implementing an advanced algorithm specifically designed to identify significant behavioral transitions in vehicle trajectories.

The second phase is frame-based data segmentation. We segmented the continuous trajectory data into discrete time intervals or frames to effectively manage it. This segmentation facilitated a detailed analysis and streamlined the data processing by grouping trajectory data by frame ID.

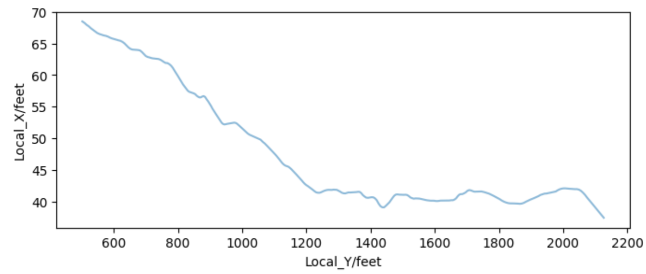
The third phase is the identification of lane change frames. We pinpointed the frame IDs corresponding to the beginning and end of lane change events. This critical step allowed us to focus on the temporal aspects of lane changes, enabling precise subsequent analysis.

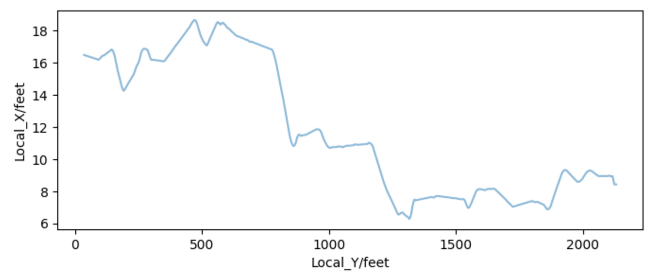
The final phase involves vehicle trajectory filtering and analysis. Filtering was essential to isolate data segments directly related to the lane change events. We applied specific criteria to exclude irrelevant data, focusing solely on the trajectories contributing to lane change dynamics. Additionally, we conducted spatial and temporal analyses to capture the surrounding vehicular environment and the timing of lane changes, offering insights into the influences and patterns of vehicular movement during these events.

III. Results

In preprocessing, we analyze vehicle trajectory data, focusing on lane changes from lane 2 to lane 1. We began by loading the dataset, which includes various attributes such as vehicle ID, lane ID, local X and Y coordinates, and velocity. We then segmented the data based on the lane ID and created a list of unique vehicle IDs for each lane. To identify vehicles that were present in multiple lanes, we implemented functions to find common elements between different lists of vehicle IDs. We also calculated the lateral velocity for each vehicle using the local X and Y coordinates.

We identified the change points for the analysis of lane changes, which are the instances when a vehicle changes from lane 2 to lane 1. This was achieved by finding the first lateral velocity in each file that is less than -1.0. We also manually adjusted the change points for specific files to ensure accuracy. The change points were then stored in a dictionary for easy access and manipulation. Finally, we visualized the trajectory of each vehicle and calculated the lateral velocity at each point in the trajectory. This comprehensive analysis of vehicle trajectories provides valuable insights into traffic patterns and driver behavior.





IV. Discussion

The data reported in this paper clarifies the essential distinction between momentary and hard pauses in vehicle trajectories at signalized junctions. Understanding these stop circumstances is critical for traffic management and urban planning initiatives to improve road safety and efficiency.

This study provides insights into driver behavior and traffic dynamics by distinguishing between momentary pauses, which occur during red lights, and hard stops, which are similar to parked cars. Accurately identifying these stop circumstances allows more focused actions and initiatives to reduce congestion and improve overall traffic flow.

Furthermore, the feature extraction and data preparation techniques demonstrate a methodical approach to analyzing vehicle trajectories. The study thoroughly explains vehicle movement patterns by segmenting data into frames and recognizing lane change occurrences. This information is beneficial for creating junction layouts, improving signal timings, and implementing intelligent transportation systems.

Furthermore, the examination of algorithmic techniques emphasizes the need of advanced analytics in extracting valuable insights from trajectory data. The use of change point analysis and velocity calculations indicates the effectiveness of computational tools for detecting significant behavioral changes and assessing spatial-temporal dynamics.

Overall, the report's results and techniques provide practical insights for legislators, urban planners, and transportation engineers working to improve road safety and efficiency. By utilizing data-driven methodologies and sophisticated analytics, stakeholders may make educated decisions to manage traffic issues and improve the overall quality of transportation networks.

References

[1] Title: Extracting Stops from Spatio-Temporal Trajectories within Dynamic Contextual Features Website title: Semantic Scholar URL: https://pdfs.semanticscholar.org/a1fb/b84d70e7de9ca1888368f5432f6d9cfa450a.pdf Date published: January 12, 2021 Date accessed: March 16, 2024