Scene-aware and Social-aware Motion Prediction for Autonomous Driving

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Technical University of Munich

January 06, 2024

Agenda

1. Introduction

2. Method Description
   - The Dataset Collection
   - Stage 1 - Filtering process
   - Stage 2 - Integration Model

3. Results
   - Scenario Filtering
   - Integration Method

Introduction

Autonomous Driving Promise

- Efficiency and Safety

Challenges in Motion Prediction

- Multimodality
- Scene Dependence
- Social Acceptability

Crucial Understanding

- Human-Driven Behavior Key

Limitations of Current AI Tools

- Control Perspective Absent
- Intent Interpretation Challenge

Overview of Our Approach

Testing and Evaluating State-of-the-Art Tools

- Understanding the real-world applicability and limitations of these tools

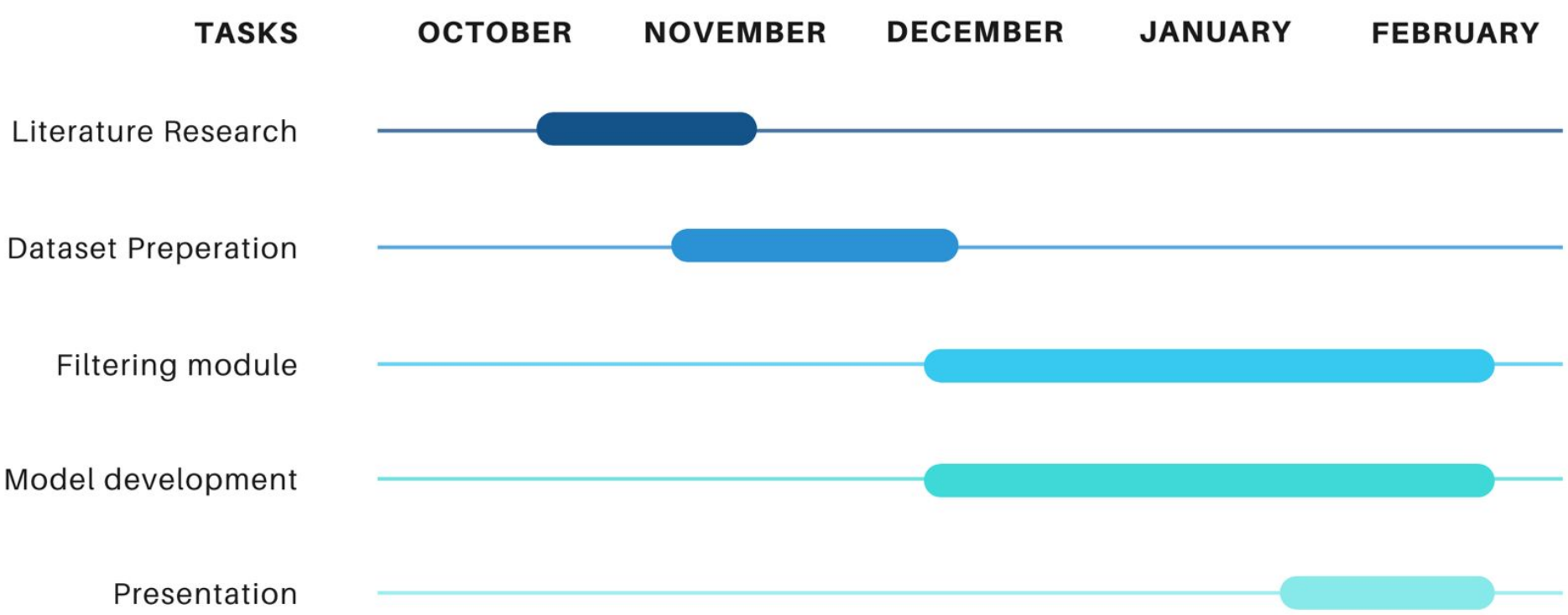
Developing Control-Oriented Tools

- Introduce virtual forces between vehicles to improve the accuracy of movement predictions

Specific Focus on Vehicle Interactions

- Formulate more accurate and socially-aware predictive models based on these analyses.

Timeline



Alfred

Literature Research
Dataset Preperation
Model development

Baris

Literature Research
Dataset Preperation
Filtering module

Agenda

Dataset Collection

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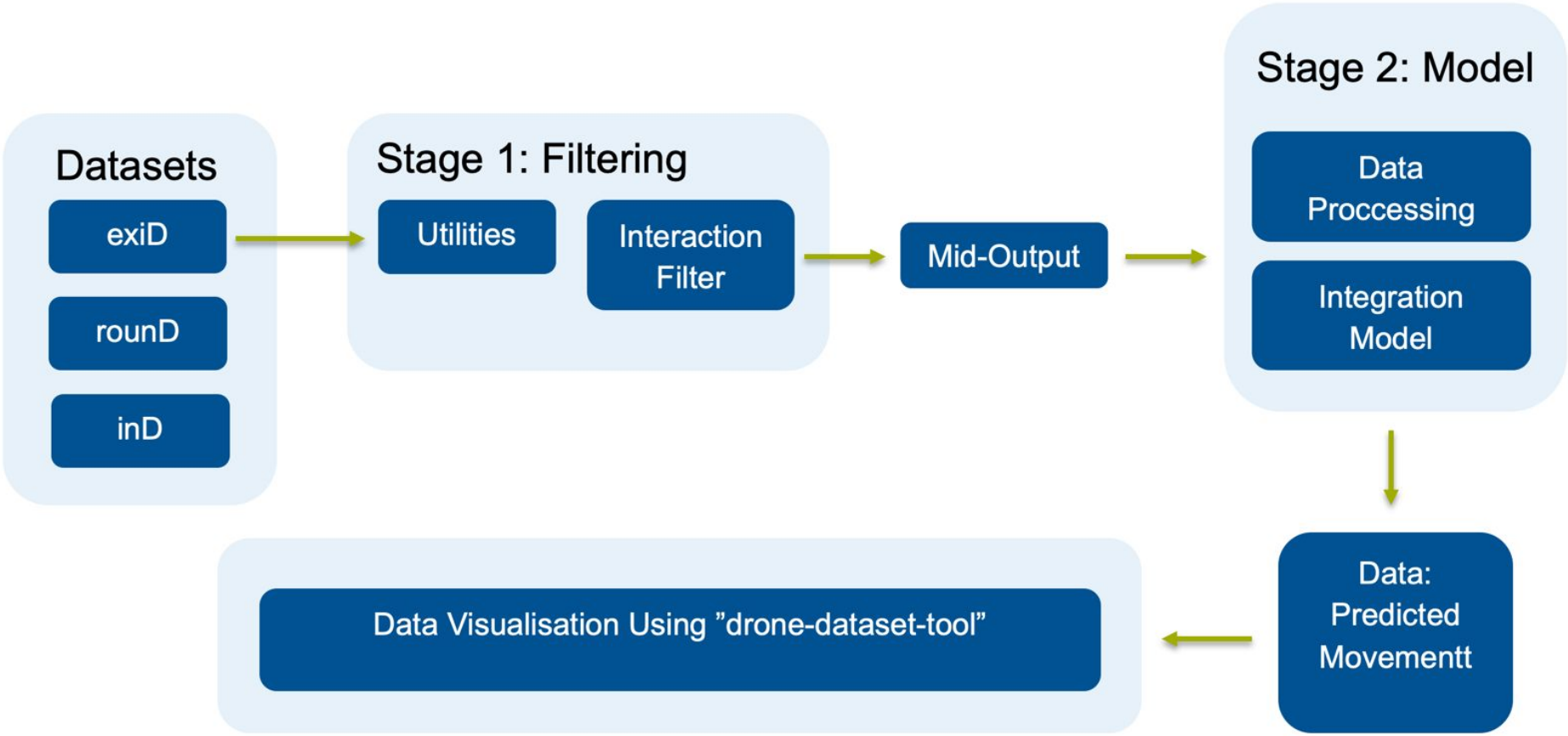
Method Description - Overview



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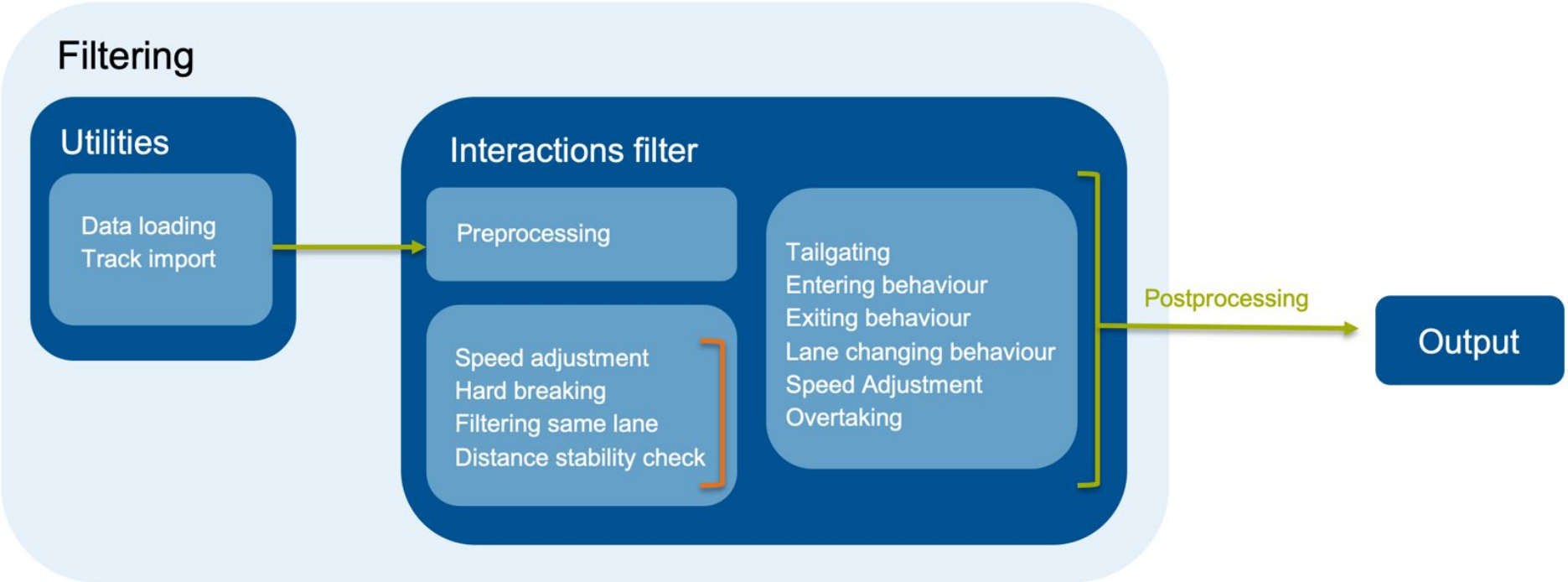
Method Descripion - Stage 1



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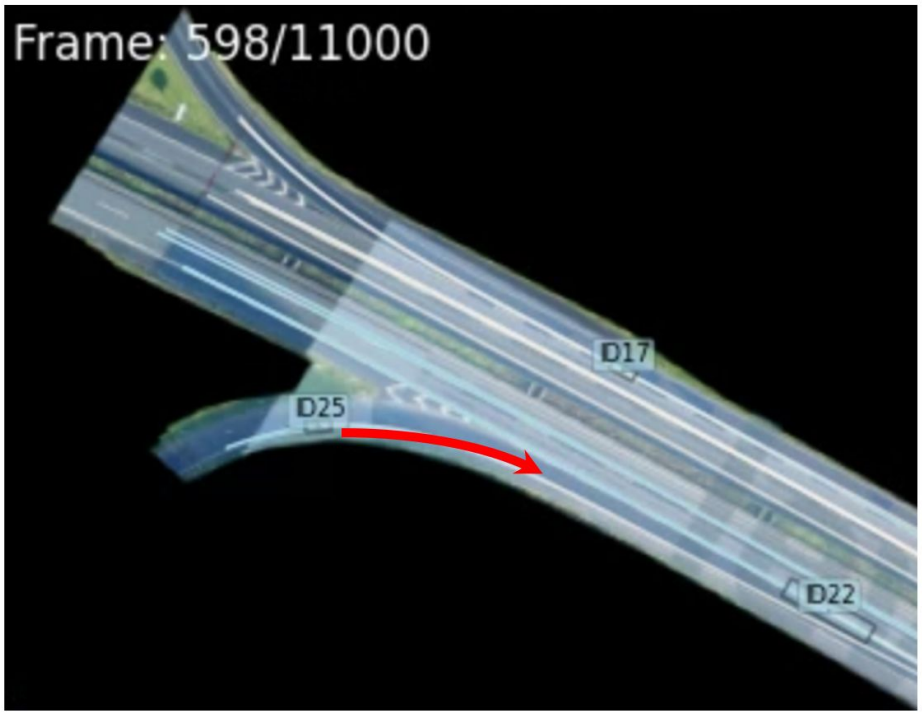
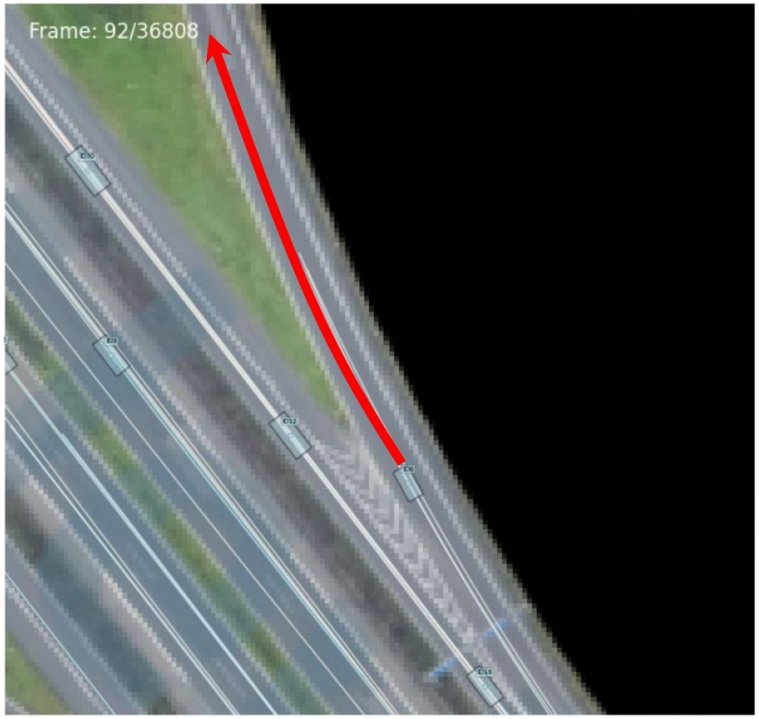


Merging Lane Entering Scenario

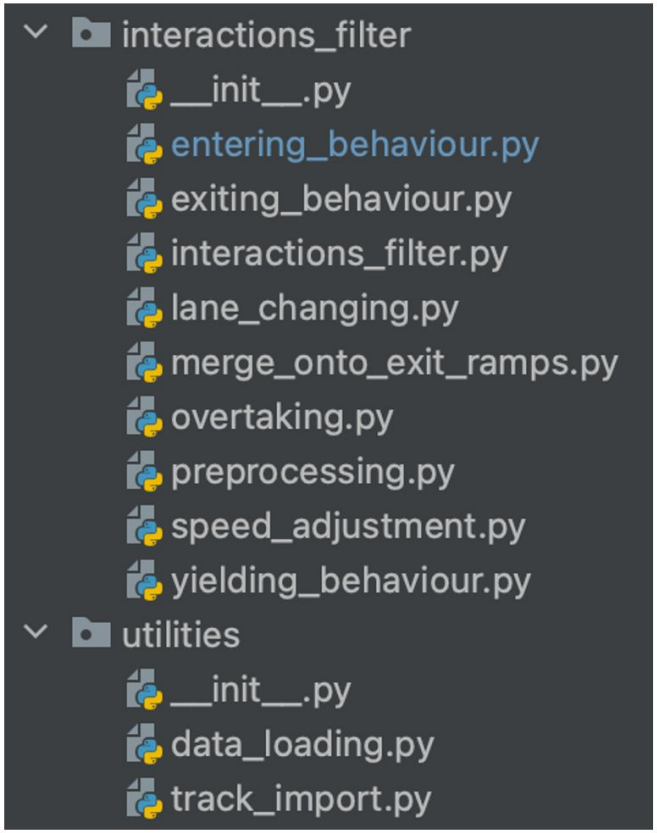


Merging Lane Exiting Scenario

Method Descripion - Stage 1

Filtering Stage: Identifying Vehicle Behaviors

- Preprocessing
- Behavior Detection
  - Entering/Exiting Behavior
- Interaction Analysis
- Lane Change Detection
- Thresholds and Conditions
- Data Grouping and Sorting



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Distance and Velocity Equations (Ballistic Integration):

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$\Rightarrow$ This can be solved using linear regression.

Agenda

Scenario filtering

Video demo of the scenarios

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Reminder: Our Model - Matrix Form

Acceleration from Distance formula:

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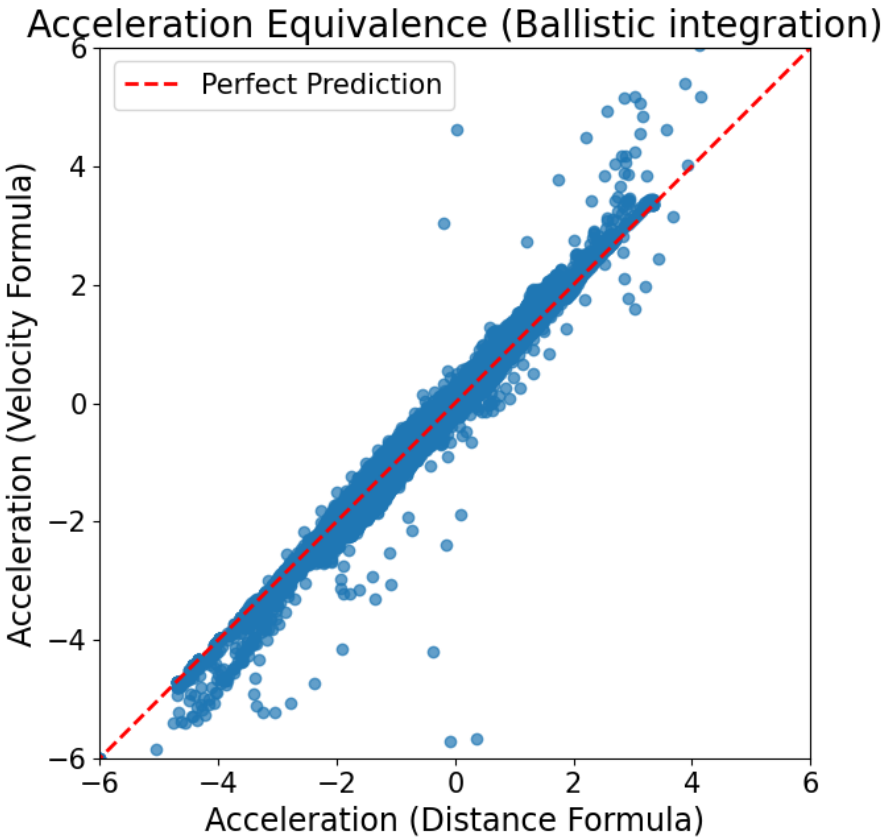

MSE: 3.0786e+02

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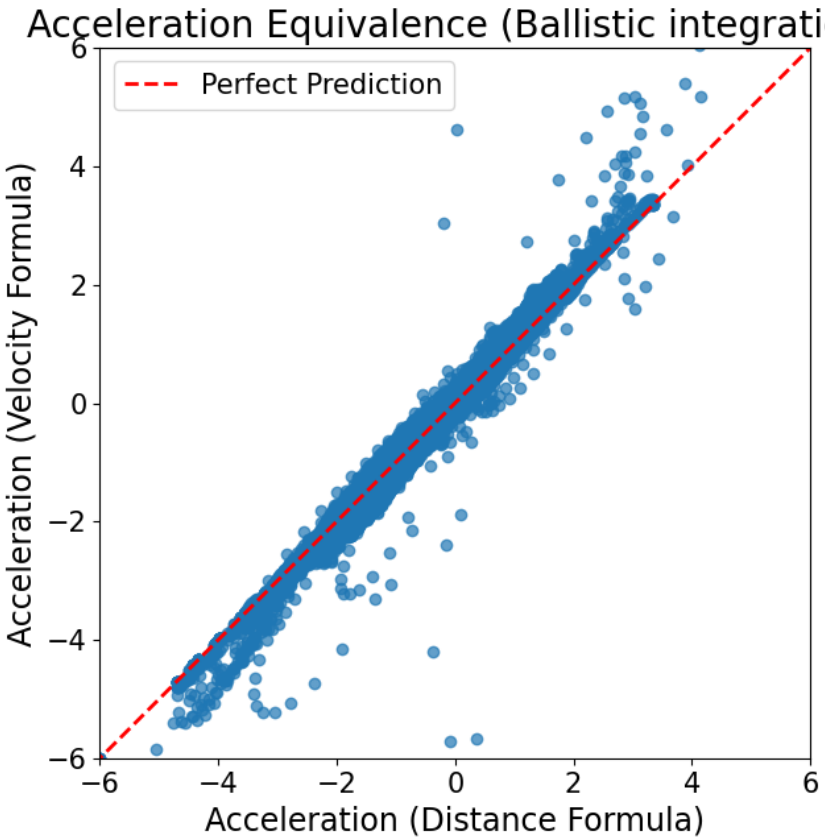

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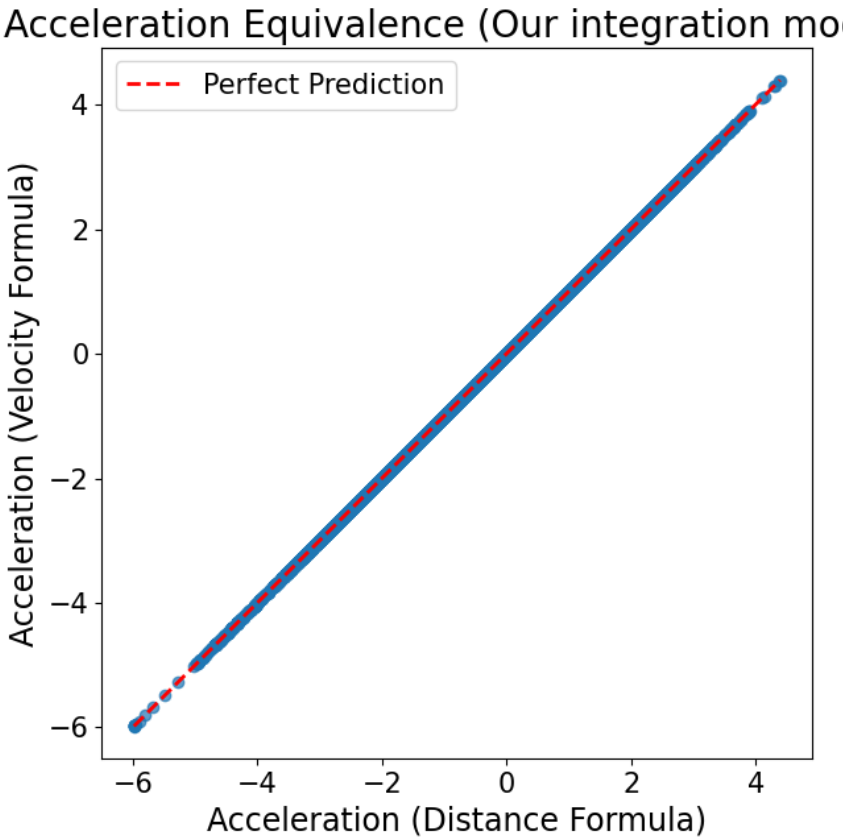


MSE: 1.9220e-09

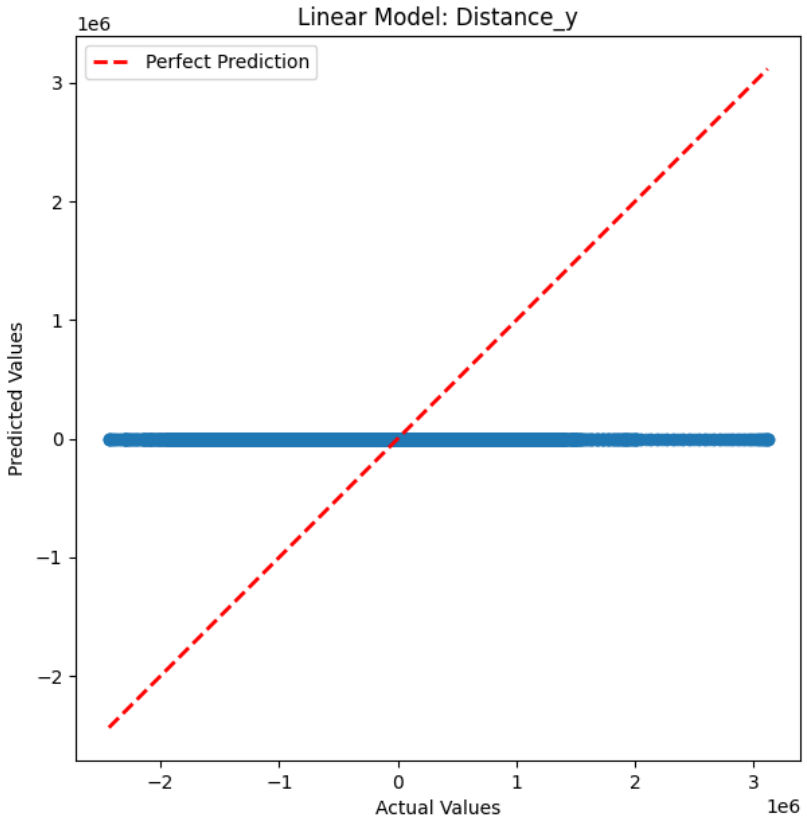
Results: Integration Method

Rearranging the formula to the distance and velocity gives us these results:

Video demo of predicted car

Q&A

Acceleration Modification in the Y-axis



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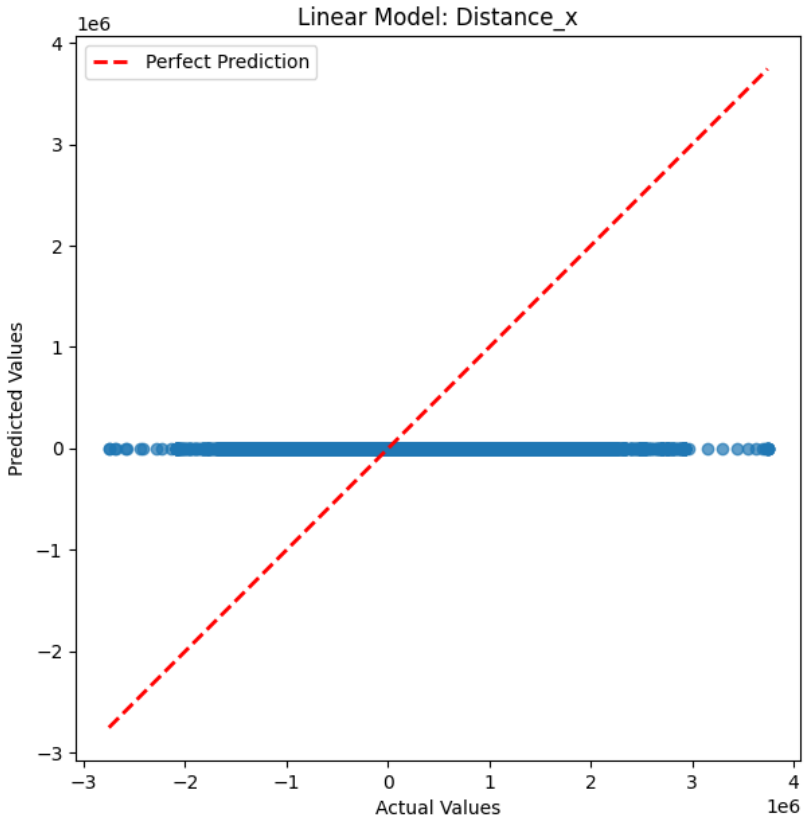

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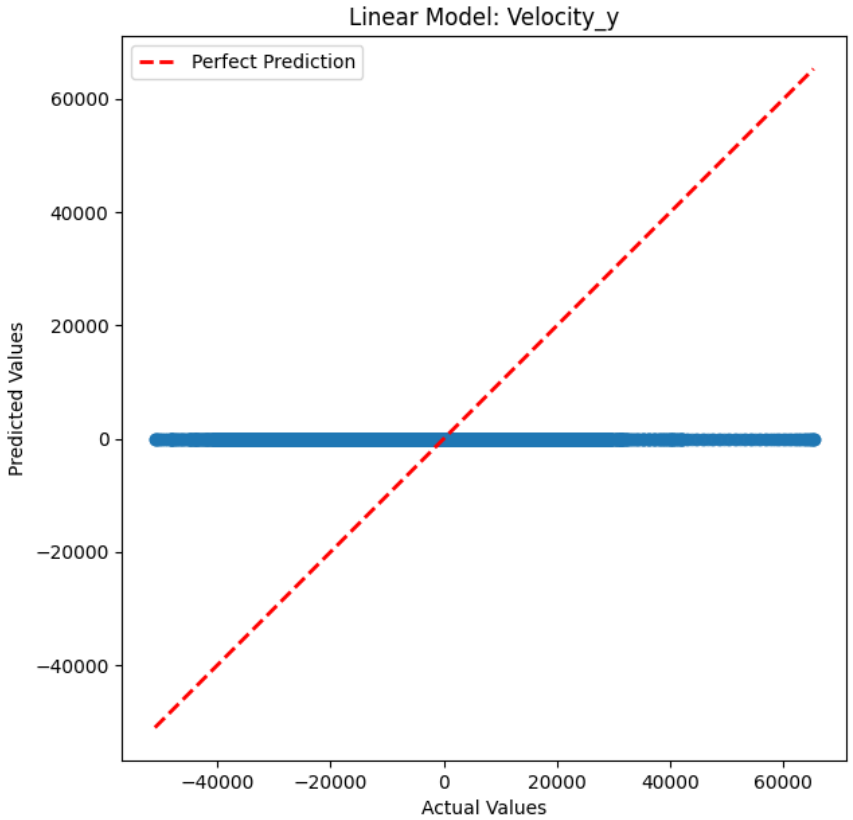

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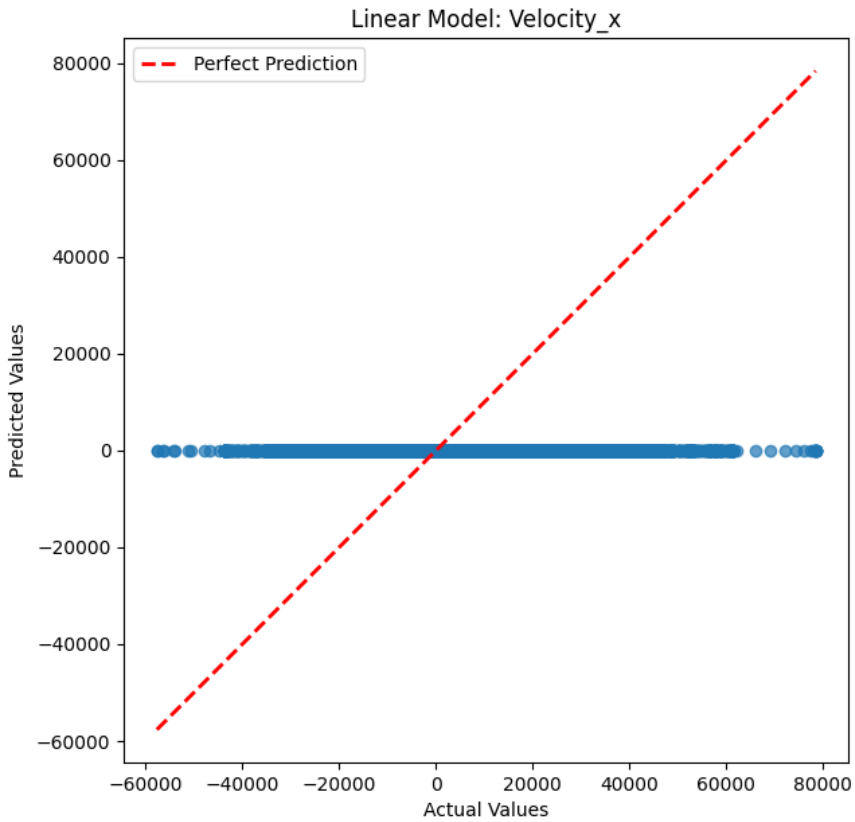
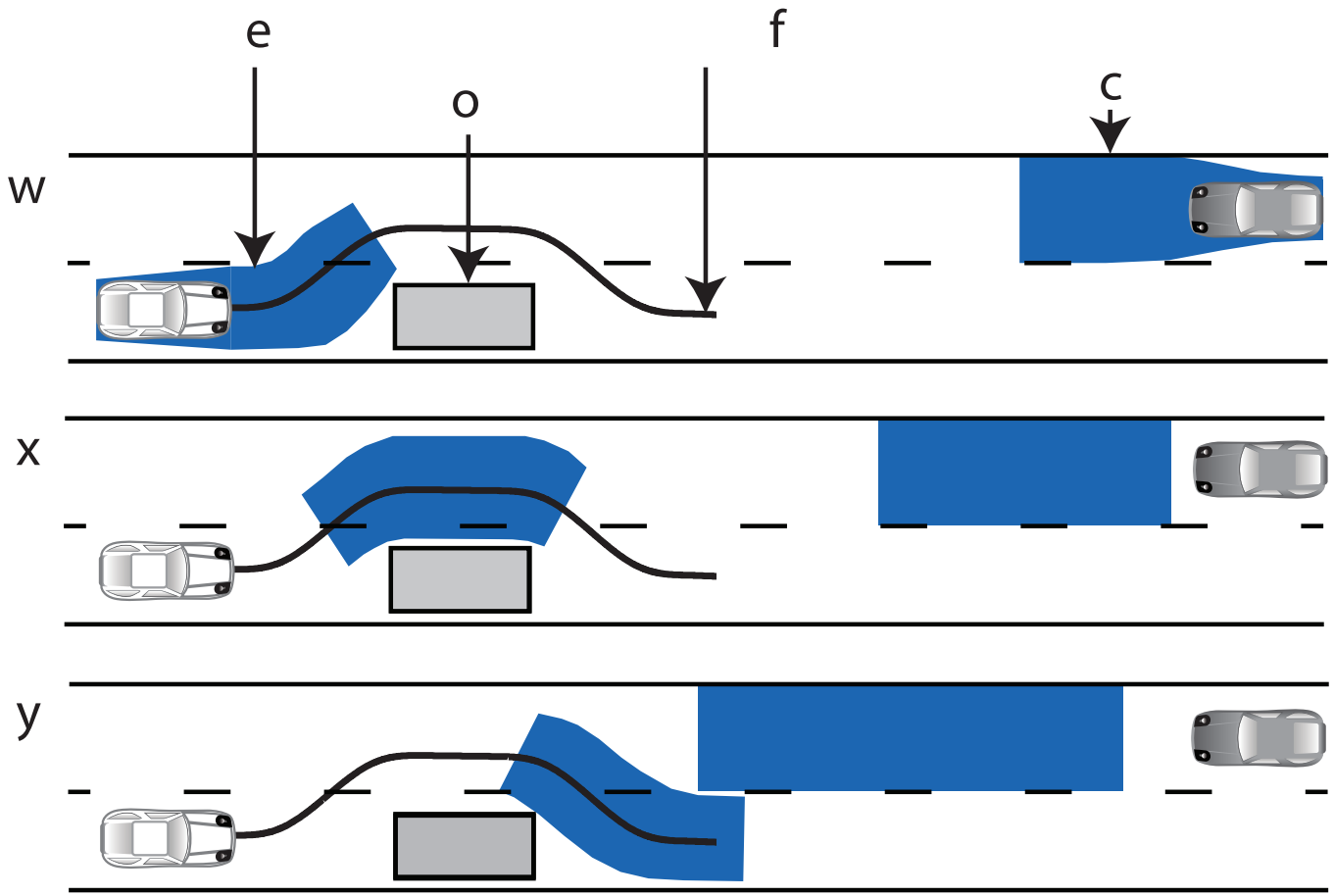


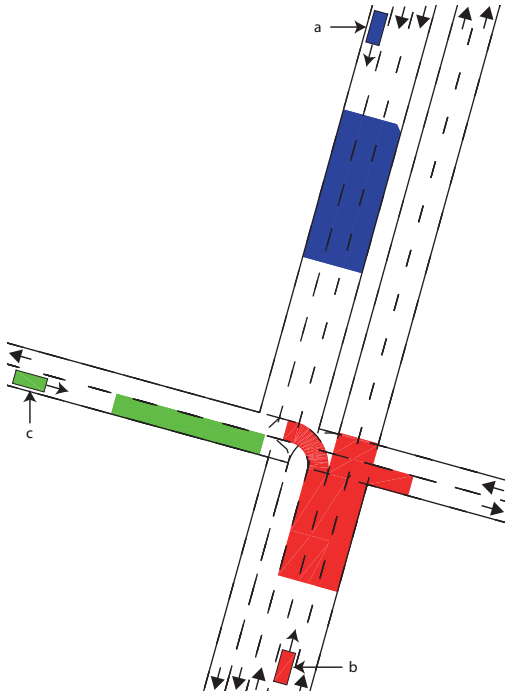
Motivation for Set-Based Prediction [1]



[1] M. Althoff and S. Magdici, "Set-based prediction of traffic participants on arbitrary road networks," IEEE Transactions on Intelligent Vehicles, vol. 1, no. 2, pp. 187–202, 2016.

SPOT

SPOT: A tool for set-based prediction of traffic participants [2]



Initial configuration and $\mathcal{O}(t)$ for $t \in [1.5\,\mathrm{s}, 2.0\,\mathrm{s}]$

[2] M. Koschi and M. Althoff, "SPOT: A tool for set-based prediction of traffic participants," in Proc. of the IEEE Intelligent Vehicles Symposium, pp. 1679–1686, 2017.

Conclusions

- Item
- Item
- Item

beginframe
Distance and Velocity Equations:

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onslide¡2¿
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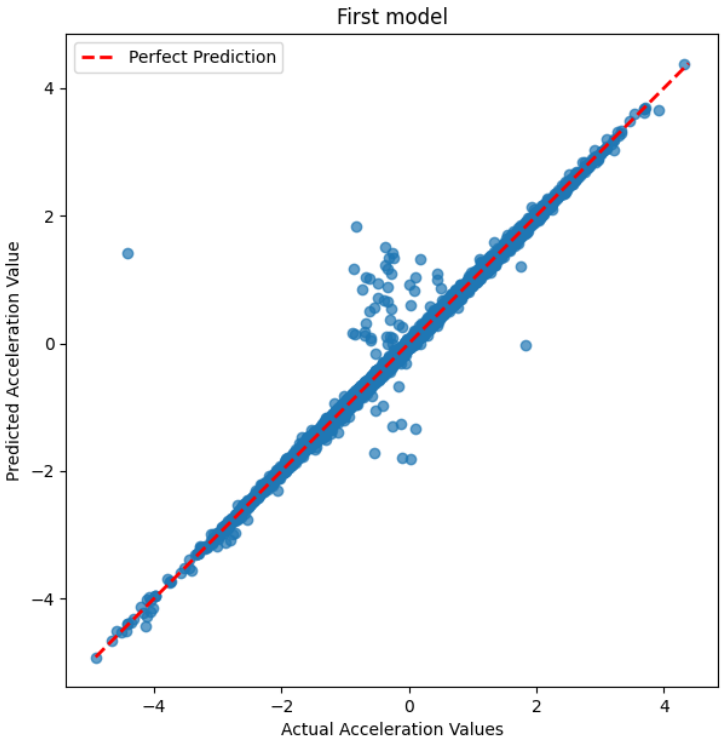
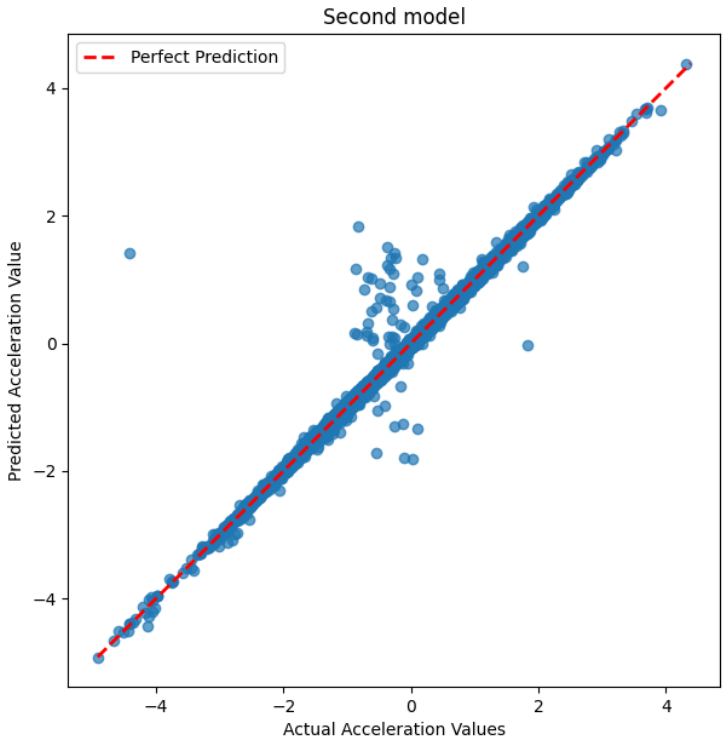
endframe

Results: Integration Method





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Our Integration Model

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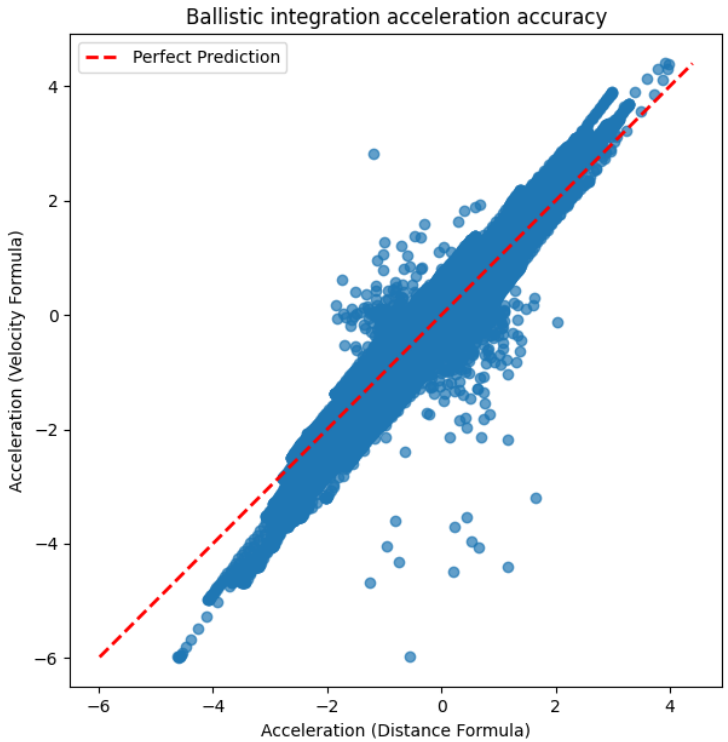
Accuracy of the prediction for the acceleration using the Ballistic Integration method (MSE): 4.3249e-02



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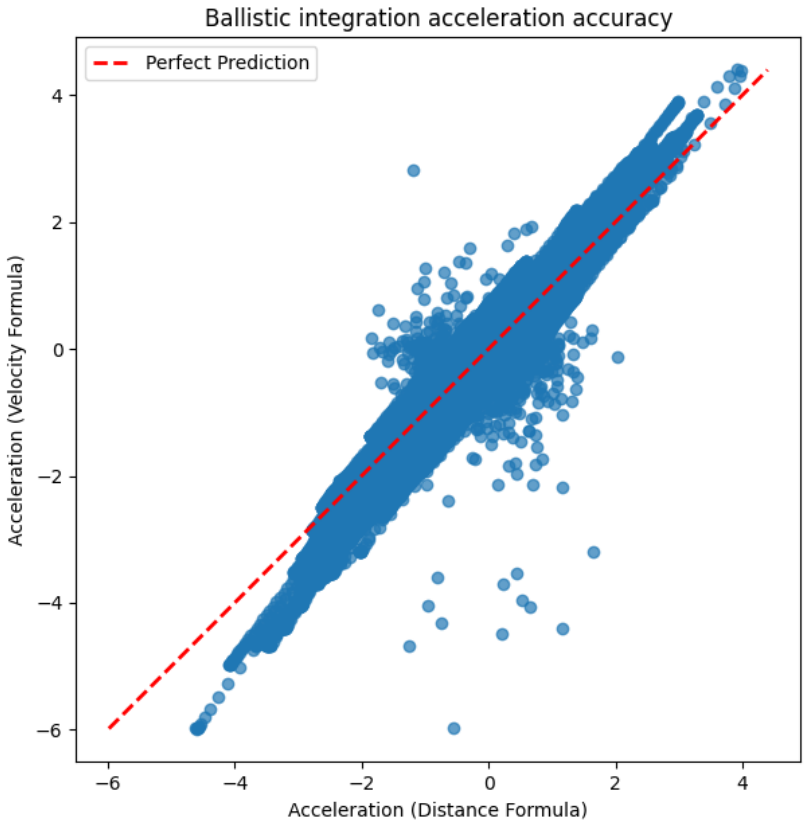

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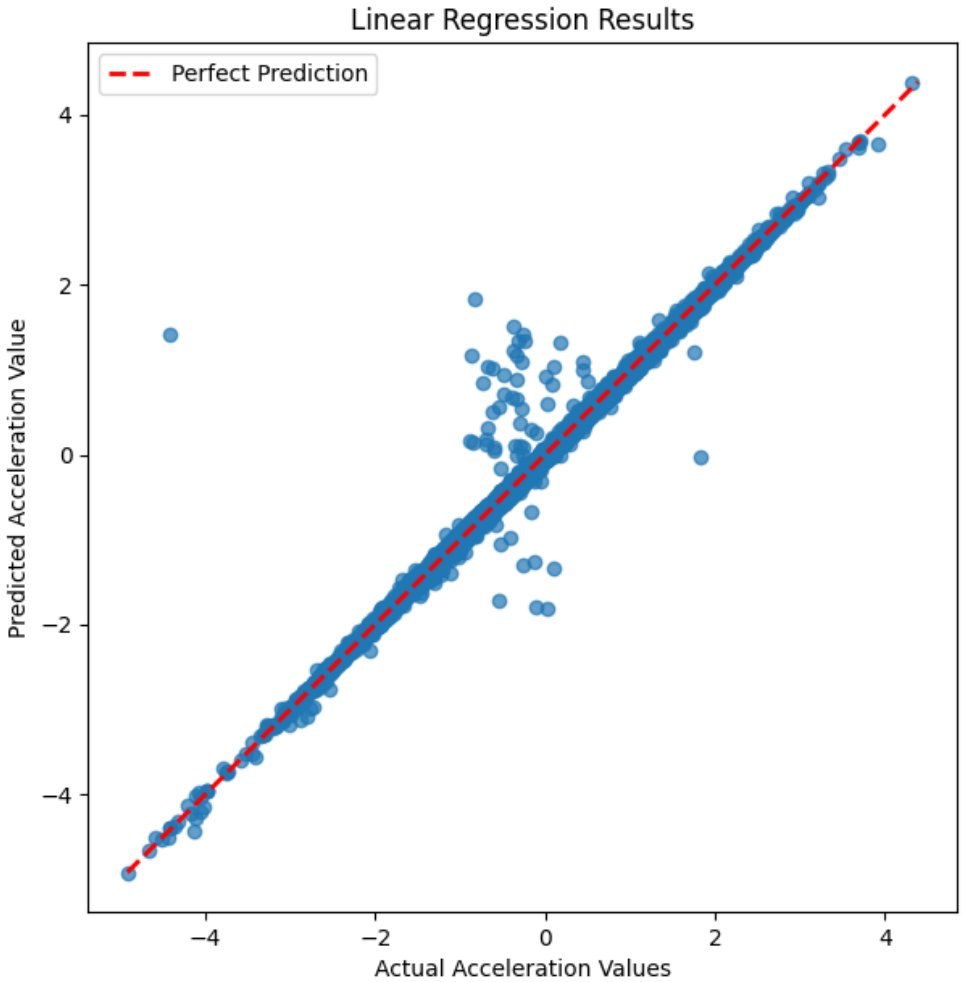

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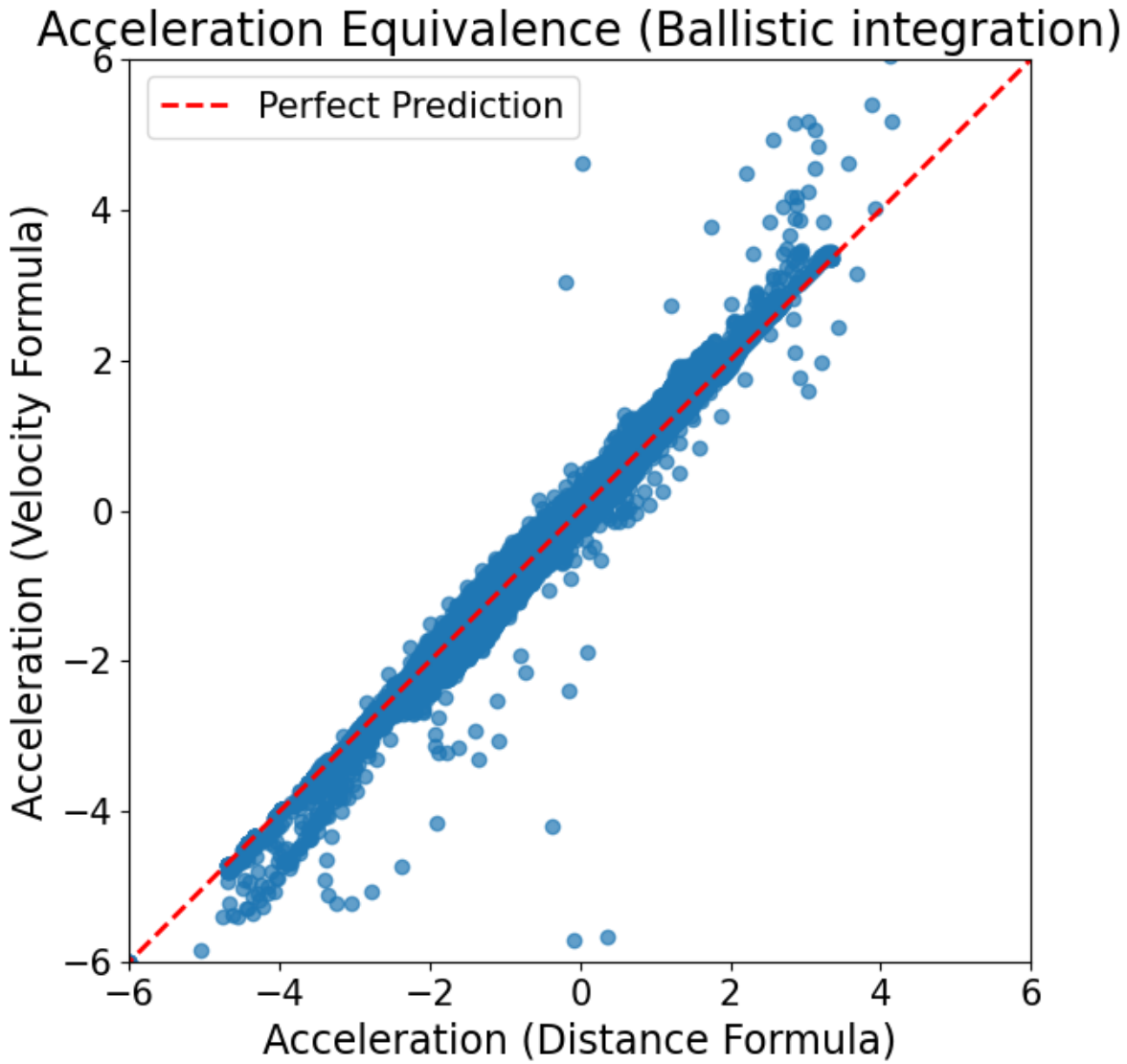

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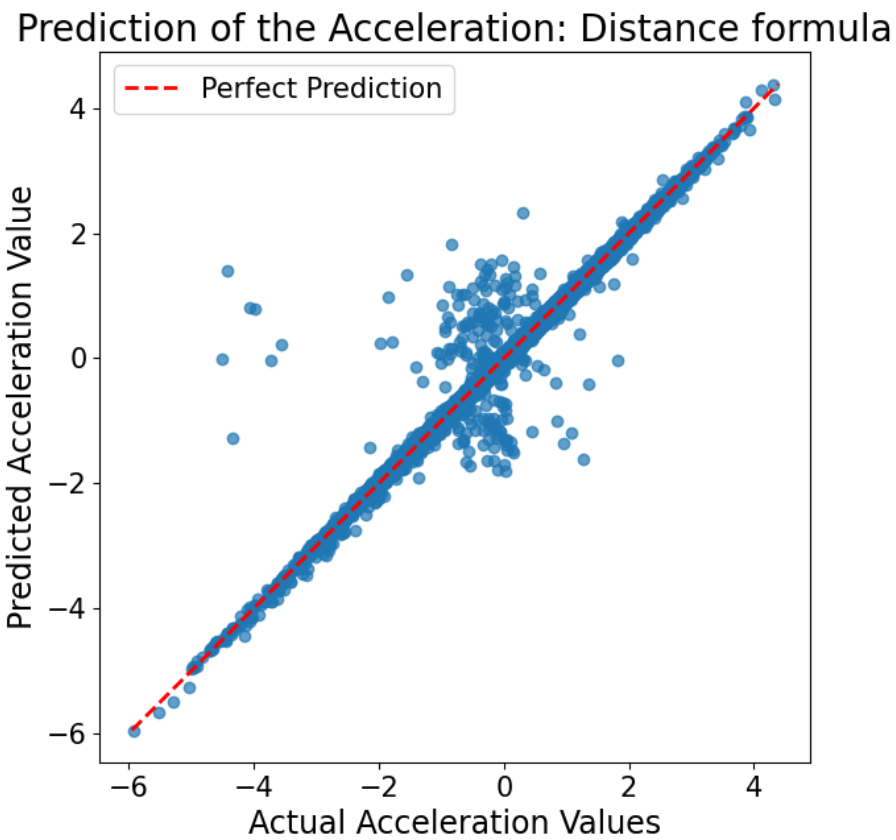

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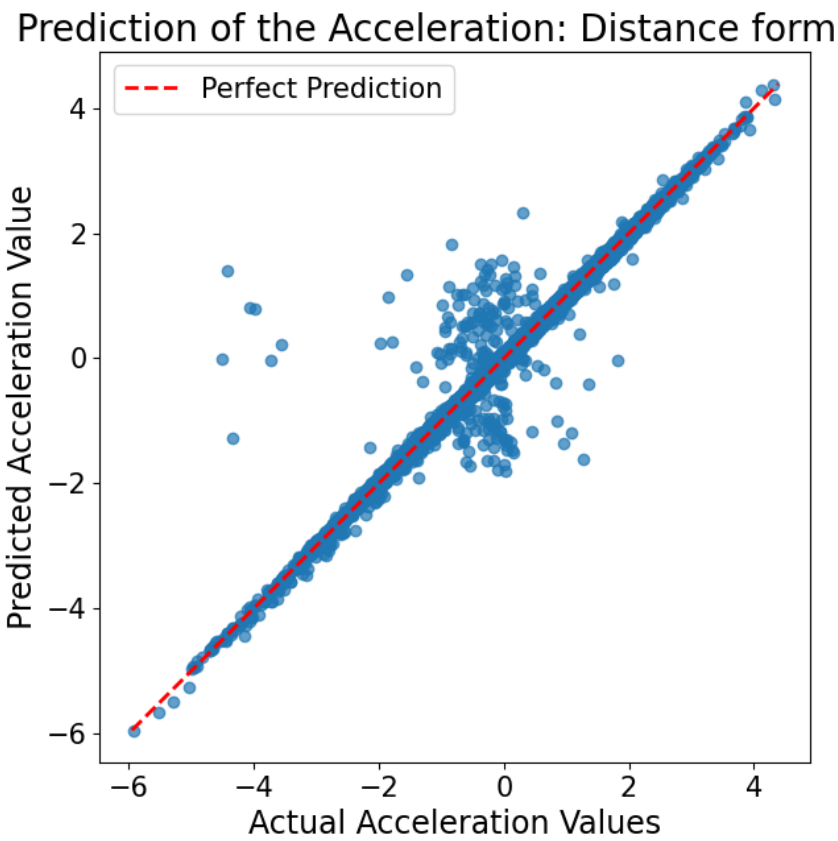

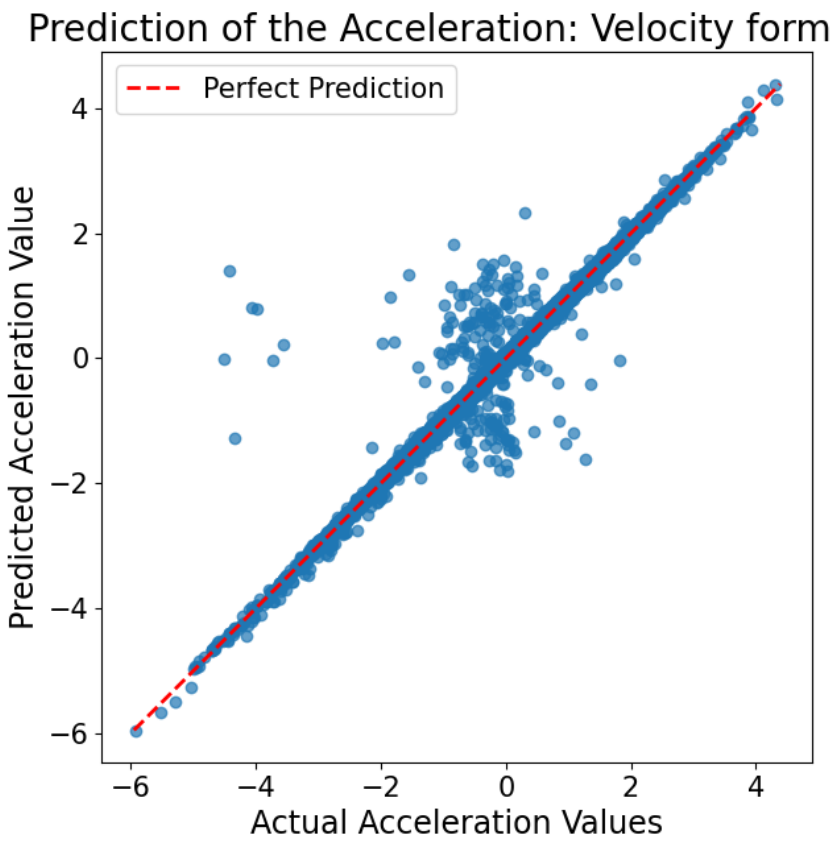

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- Successfully implemented the filtering mechanism
- Able to filter out X different scenarios in Y datasets
- Found a better integration method where the accelerations match
- Able to visualize the integration method and modulate the movement of a car