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

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Agenda

1. Motivation
2. Method
   - Data collection
   - Filtering process
   - Integration Model
3. Results
   - Scenario Filtering
   - Integration Method
4. Future Work

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4 Future Work

Previous Integration Model

Distance and Velocity Equations (Ballistic Integration):

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$$s(k+1) = s(k) + dt \cdot v(k) + \frac{dt^2}{2} a(k)$$
$$v(k+1) = v(k) + dt \cdot a(k)$$

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Acceleration Equations (Rearranged):

$$a(k) = \frac{2}{dt^2}\Big(s(k+1) - s(k) - dt \cdot v(k)\Big)$$
$$a(k) = \frac{1}{dt}\Big(v(k+1) - v(k)\Big)$$

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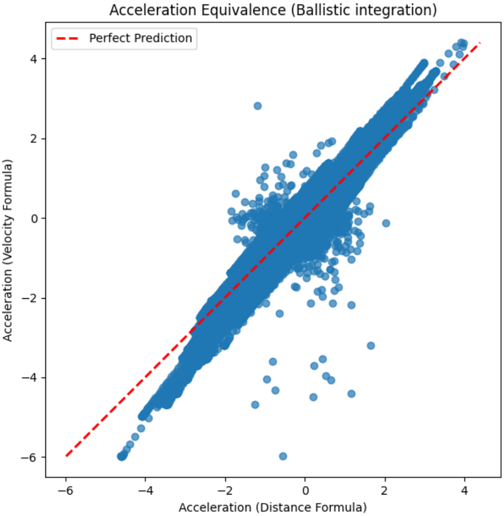
Problem: Accelerations are not equal!

Previous Integration Model - Accuracy



Our Integration Model

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$$s(k+1) = s(k) + dt \cdot v(k) + c_1 a(k) + c_2 a(k-1)$$
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Acceleration Equations:

$$a(k) = -\overline{c_1} a(k-1) + \overline{c_2}\big(s(k+1) - s(k) - dt \cdot v(k)\big)$$
$$a(k) = -\overline{c_3} a(k-1) + \overline{c_4}\big(v(k+1) - v(k)\big)$$

Our Integration Model - Matrix Form

Acceleration from Distance formula:

$$\begin{bmatrix} a(k) \end{bmatrix} = \begin{bmatrix} -a(k-1) & v(k+1)-v(k) \end{bmatrix} \begin{bmatrix} \overline{c_1} \\ \overline{c_2} \end{bmatrix}$$

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

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Scenarios we filtered the dataset with:

- Lane merging

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Video demo of the scenarios

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Reminder: Our Integration Model - Matrix Form

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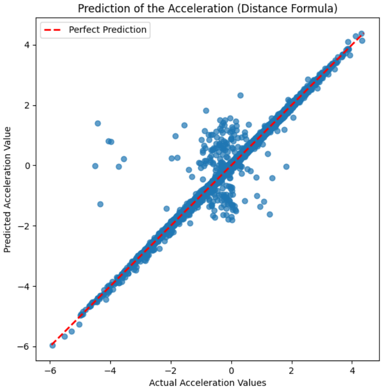
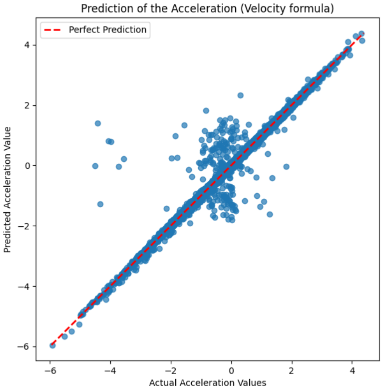
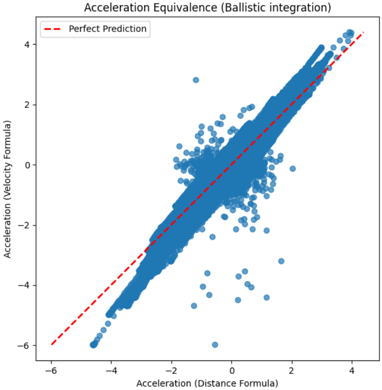
Results: Integration Method





Results: Comparison to the old acceleration model



MSE: 4.3249e-02

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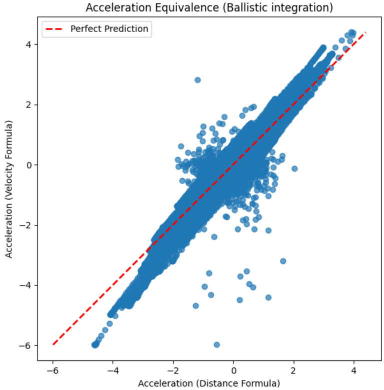

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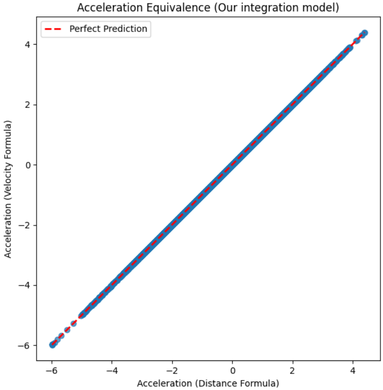

MSE: 1.9220e-09

Results: Integration Method

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

Video demo of predicted car

Results

Summary:

- Successfully implemented the filtering mechanism

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Summary:

- 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

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Future Work

Scenario Filtering:

- Specify even more scenarios for a broader range of use cases.

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- Specify even more scenarios for a broader range of use cases.
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Integration Model:

- Finetune the integration model (adding other parameteres)
- Test the integration model with the neural network for performance (task for the next team)

Questions?