

Map-aware Motion Prediction

Course 4, Module 2, Lesson 2



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Assumptions to Improve Prediction

- Positional Assumptions

- Vehicles on driving lane usually follow the given drive lane
- Changing drive lanes is usually prompted by an indicator signal



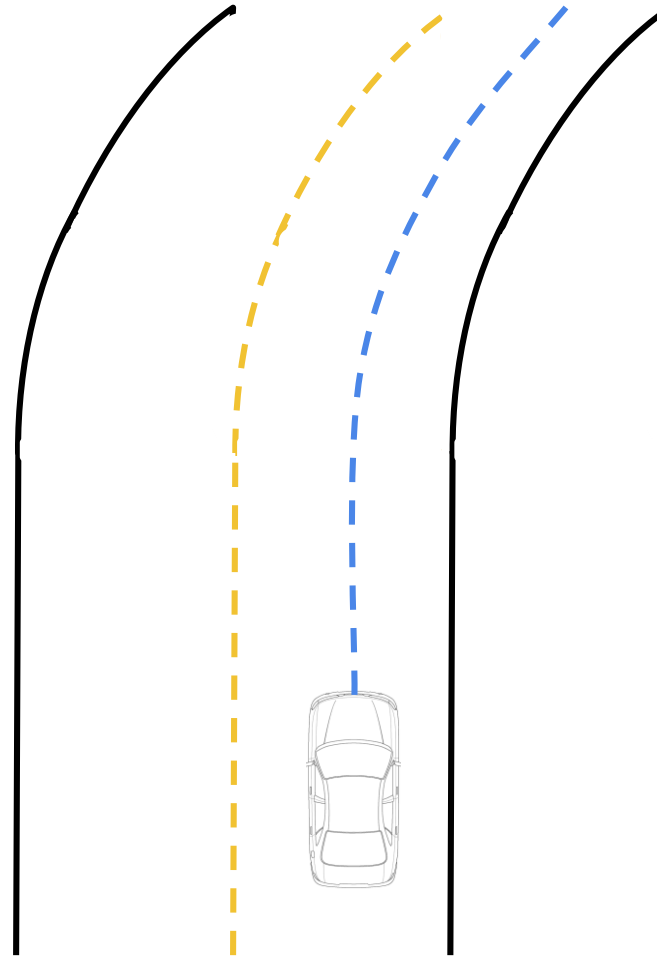
- Velocity Assumptions

- Vehicles usually modify their velocity when approaching restrictive geometry (tight turns)
- Vehicles usually modify the velocity when approaching regulatory elements



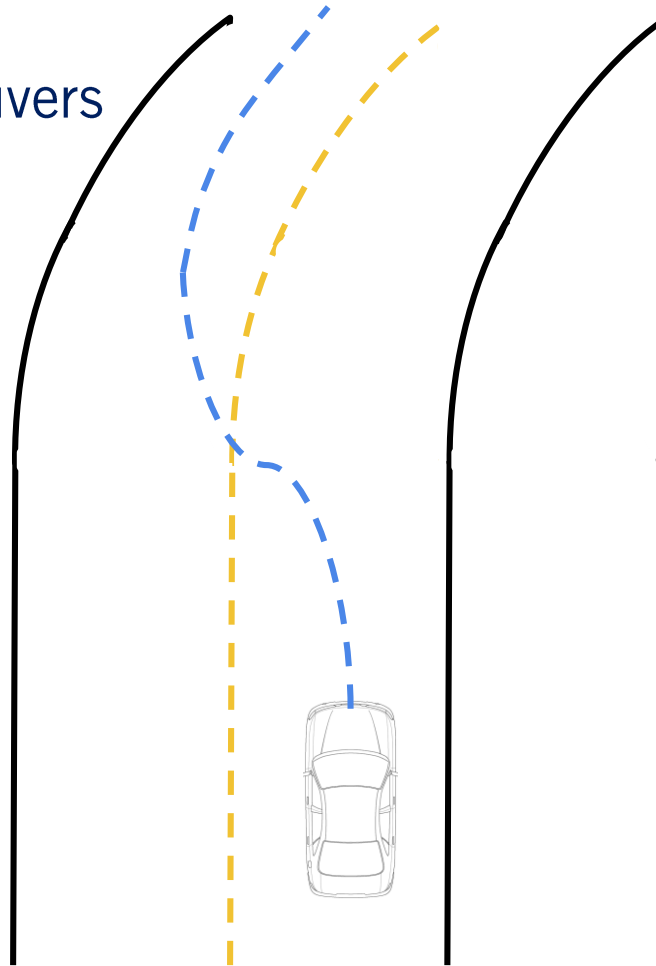
Improvement of Position Estimation

- Roadways with natural curvature
- Vehicles on drive lane usually follow the given drive lane
- The predicted path is set to follow the center of the driving lane which the dynamic vehicle is on



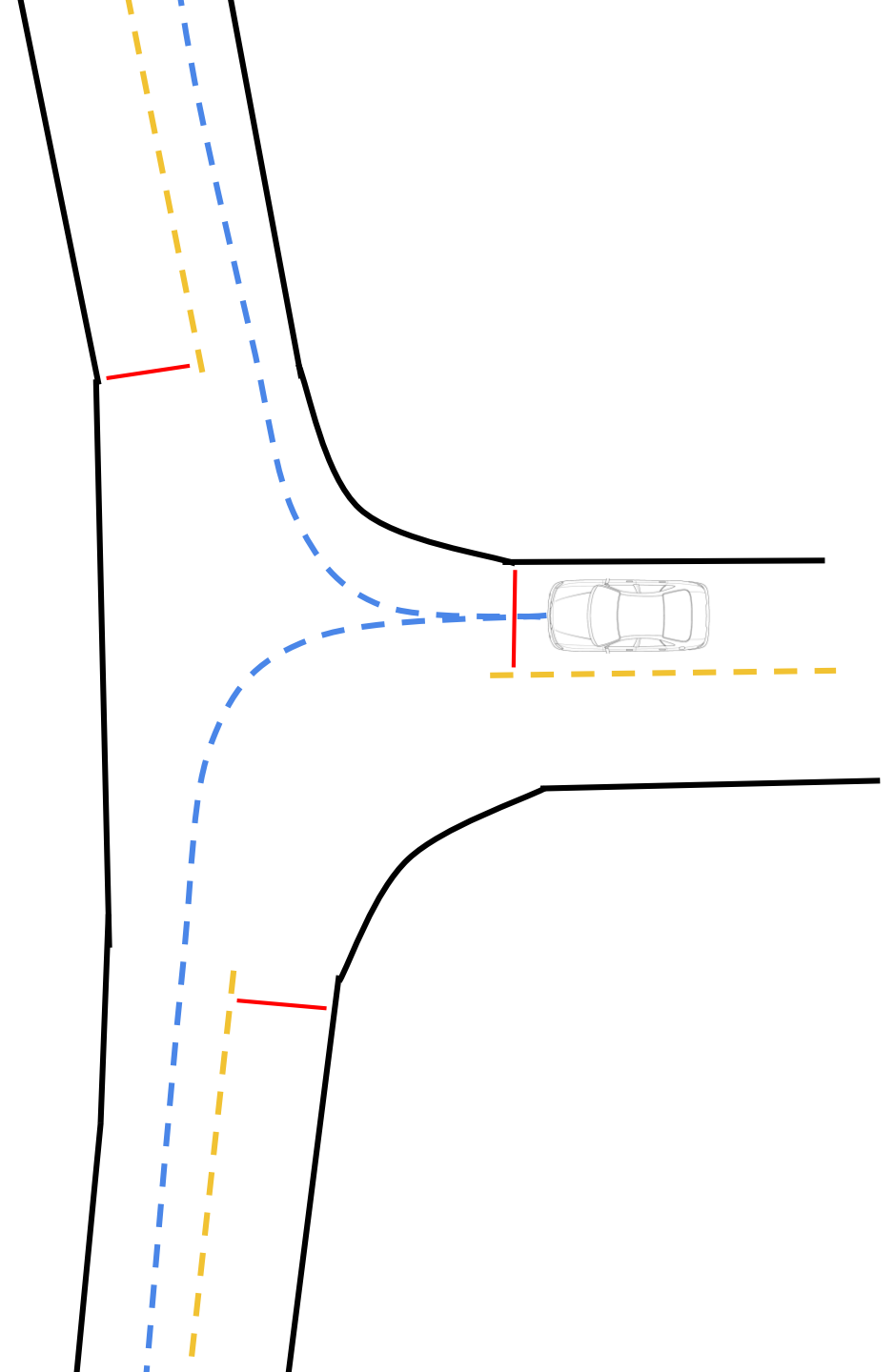
Improvement of Path Prediction

- Problems with the model:
 - Difficult to predict lane change maneuvers without extra information



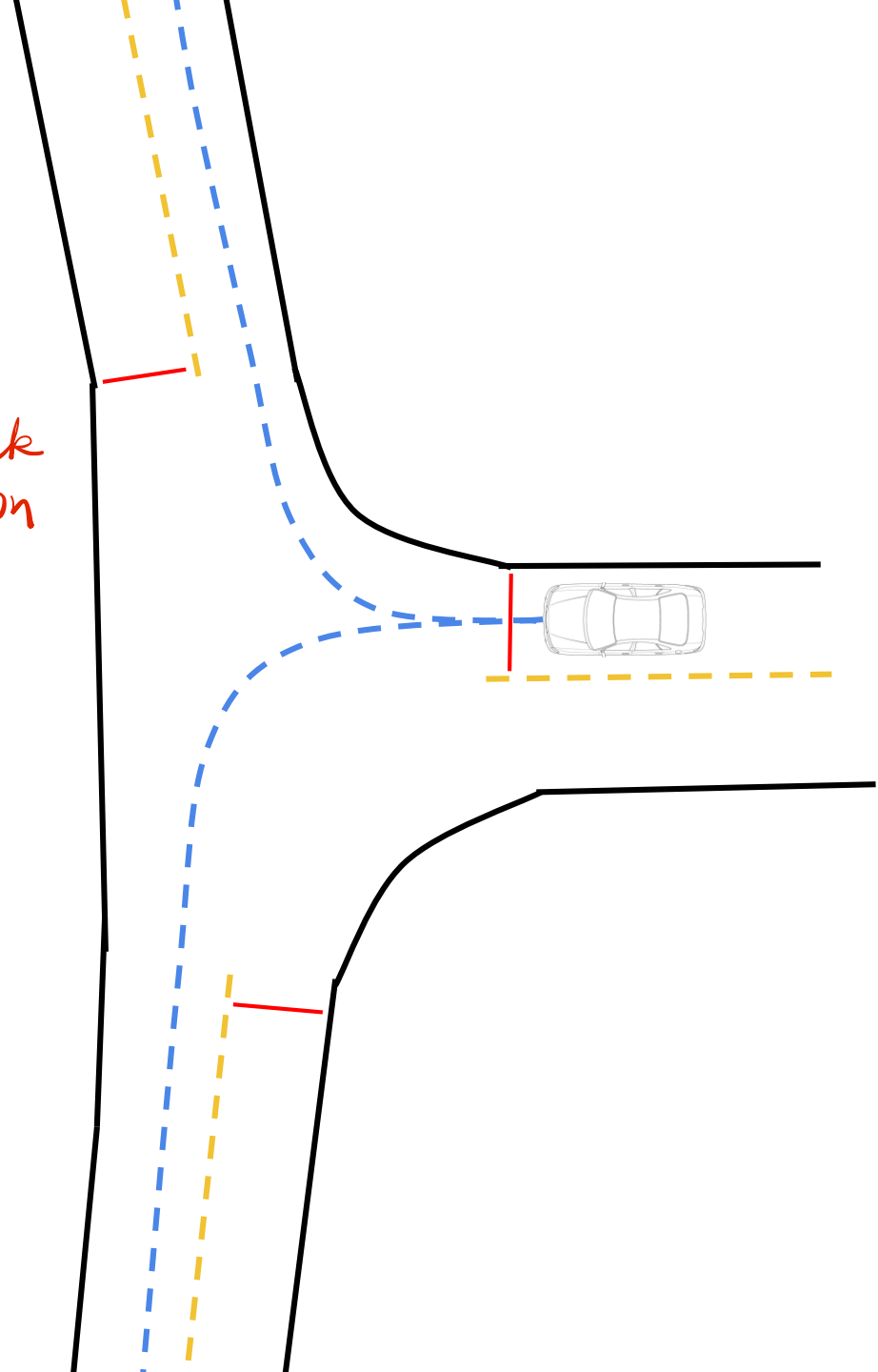
Improvement of Path Prediction

- Problems with the model:
 - Difficult to predict lane change maneuvers without extra information
 - Multiple possible lanelets such as when on an intersection



Improvement of Path Prediction

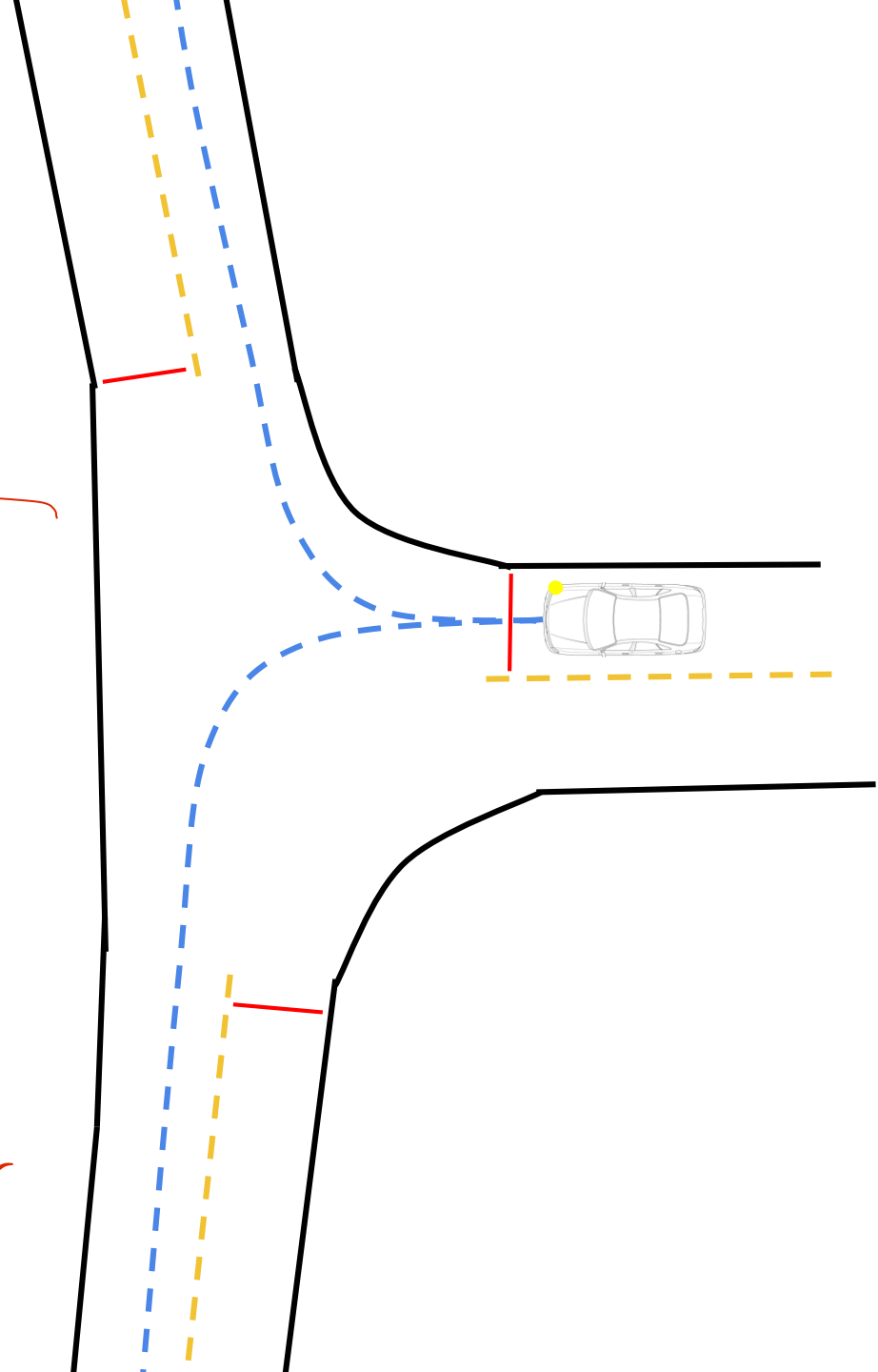
- Solution with the model:
 - Most likely prediction
 - Multi-hypothesis prediction
- using object state
appearance & track
information*



Multi-hypothesis Approach

- Consider the range of all possible motions
 - Left, right, stay stopped
- Provides more information to local planner
- Safer due to human error (forgotten turn signal)

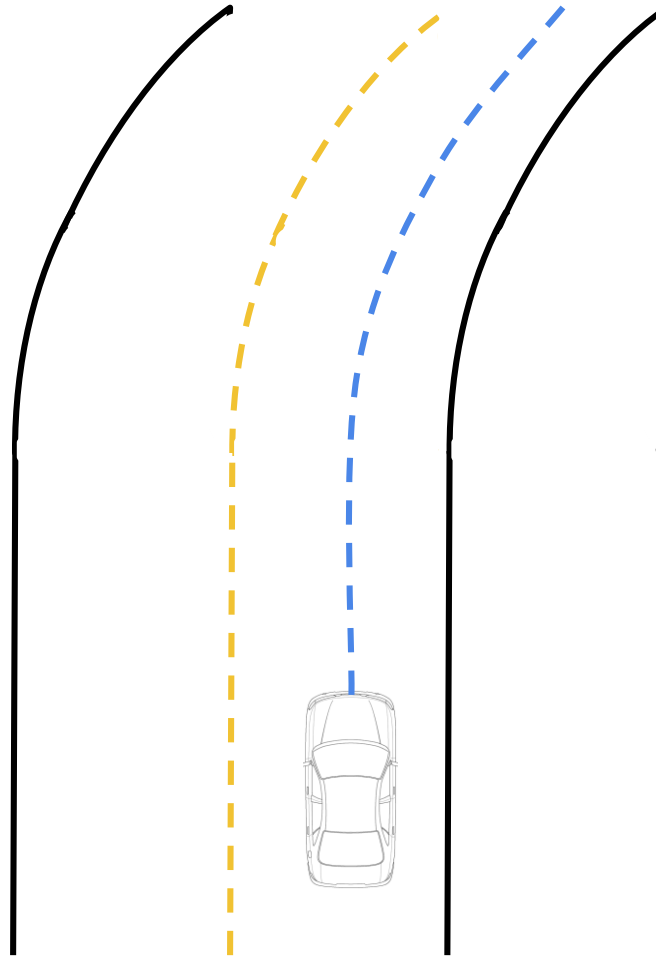
update probabilities of belief
based on indicator signals, position to the left or
right of the center line & state of the vehicle



Improvements to Velocity Prediction

- Road curvature can be used to improve the velocity prediction over the path
 - Maximum lateral acceleration:
 $0.5 - 1 \text{ m/s}^2$

Vehicle reduces speed when entering curves.



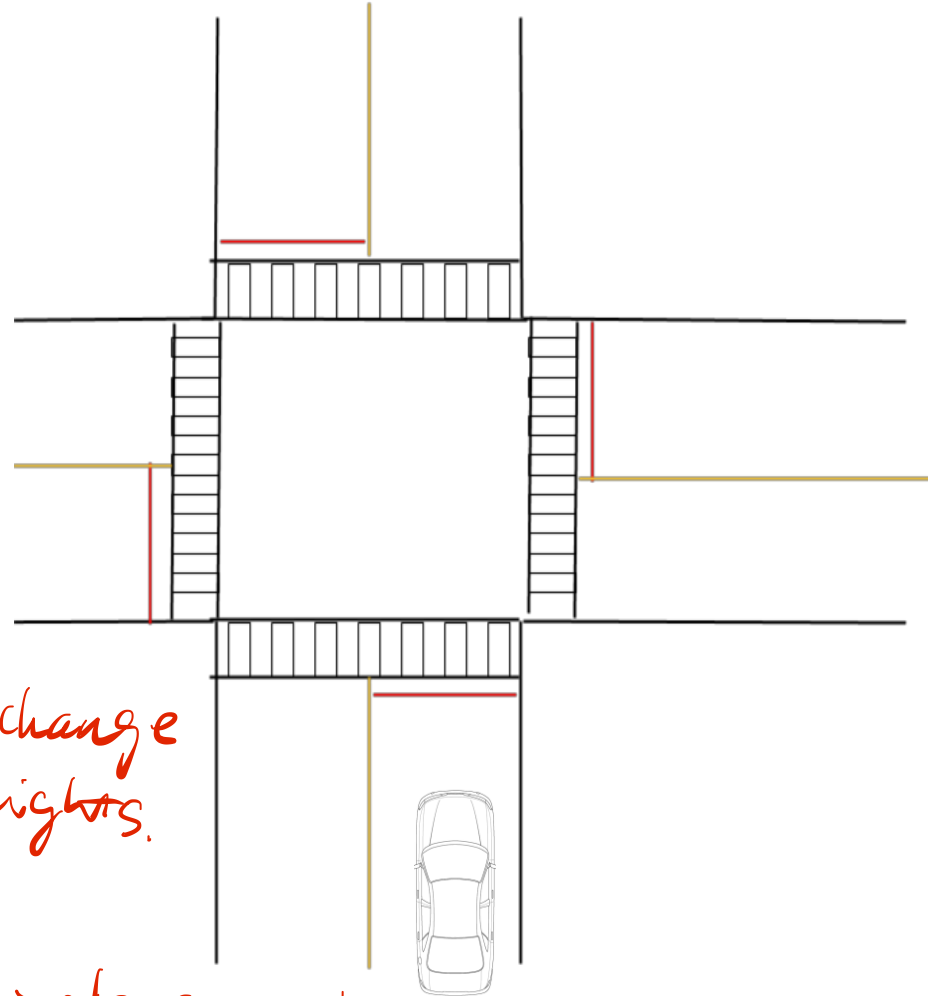
Improvements to Velocity Prediction

- Road curvature can be used to improve the velocity prediction over the path
- Improve the velocity prediction based on regulatory elements in the environment

- Stop locations, deceleration profiles
- Lanelet priors

preprocess map for nominal trajectories along each way.

multihypothesis priors based on nominal driving behaviour



Issues with the Assumptions

- Vehicles don't always stay within their lane or stop at regulatory elements
- Vehicles off of the road map cannot be predicted using this method

*dynamic
vehicles react to potholes & bouncing balls.*

Summary

- Described a set of assumptions made by map-aware algorithms to improve motion prediction
- Defined position-based and velocity-based prediction enhancements
 - Identify strategies to generate multiple hypotheses
- Identified issues with the map-aware assumptions
- **Next:** Calculating time to collision