Map-aware Motion Prediction

Course 4, Module 2, Lesson 2

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Learning Objectives

- Describing a set of assumptions made by map-aware algorithms to improve motion prediction
- Define a lane follow method to improve positional prediction
  - Identify strategies to handle multiple future lane choices
- Determine methods for velocity modulation around regulatory elements
- Identify issues and short-falls with the map-aware assumptions

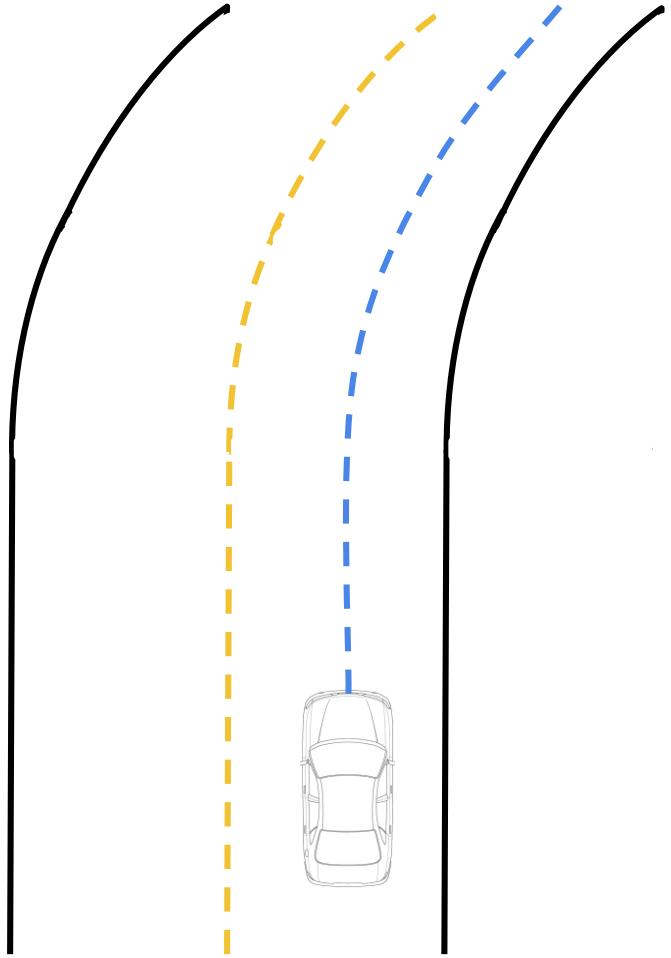
Assumptions to Improve Prediction

- 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

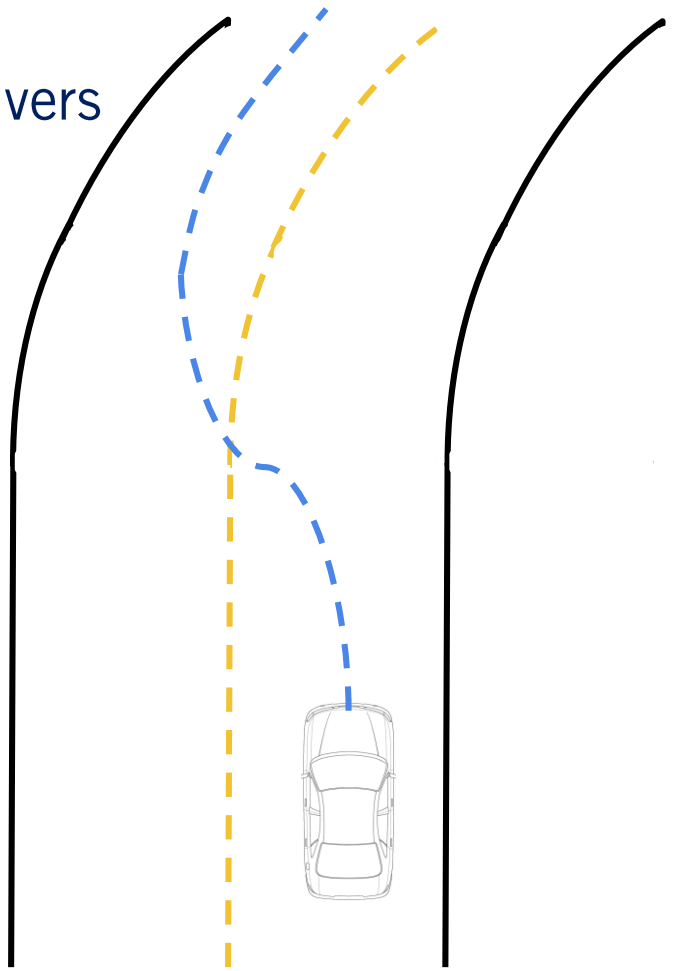
Improvement of Position Estimation

- 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



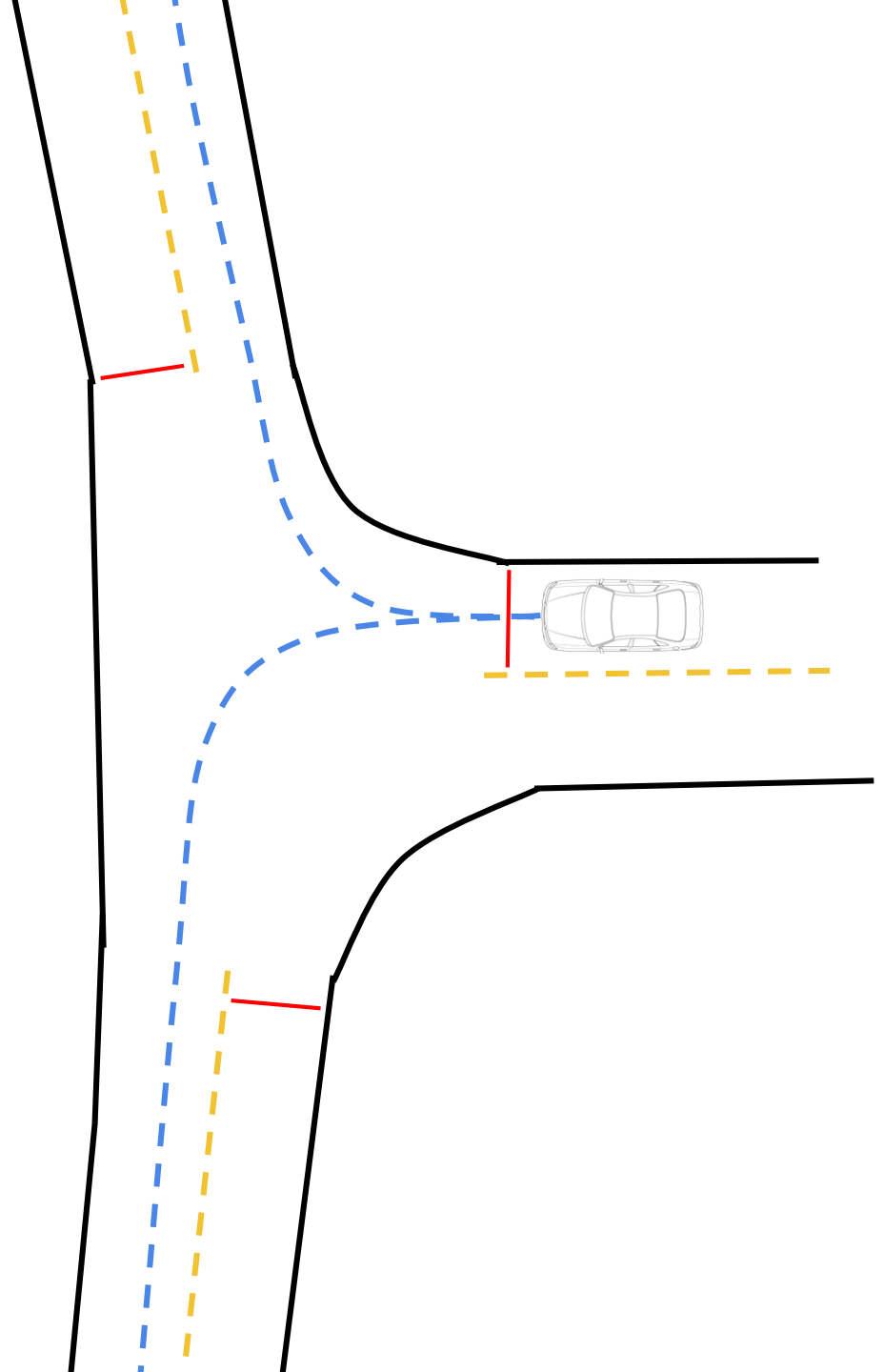
Improvement of Path Prediction

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



Improvement of Path Prediction

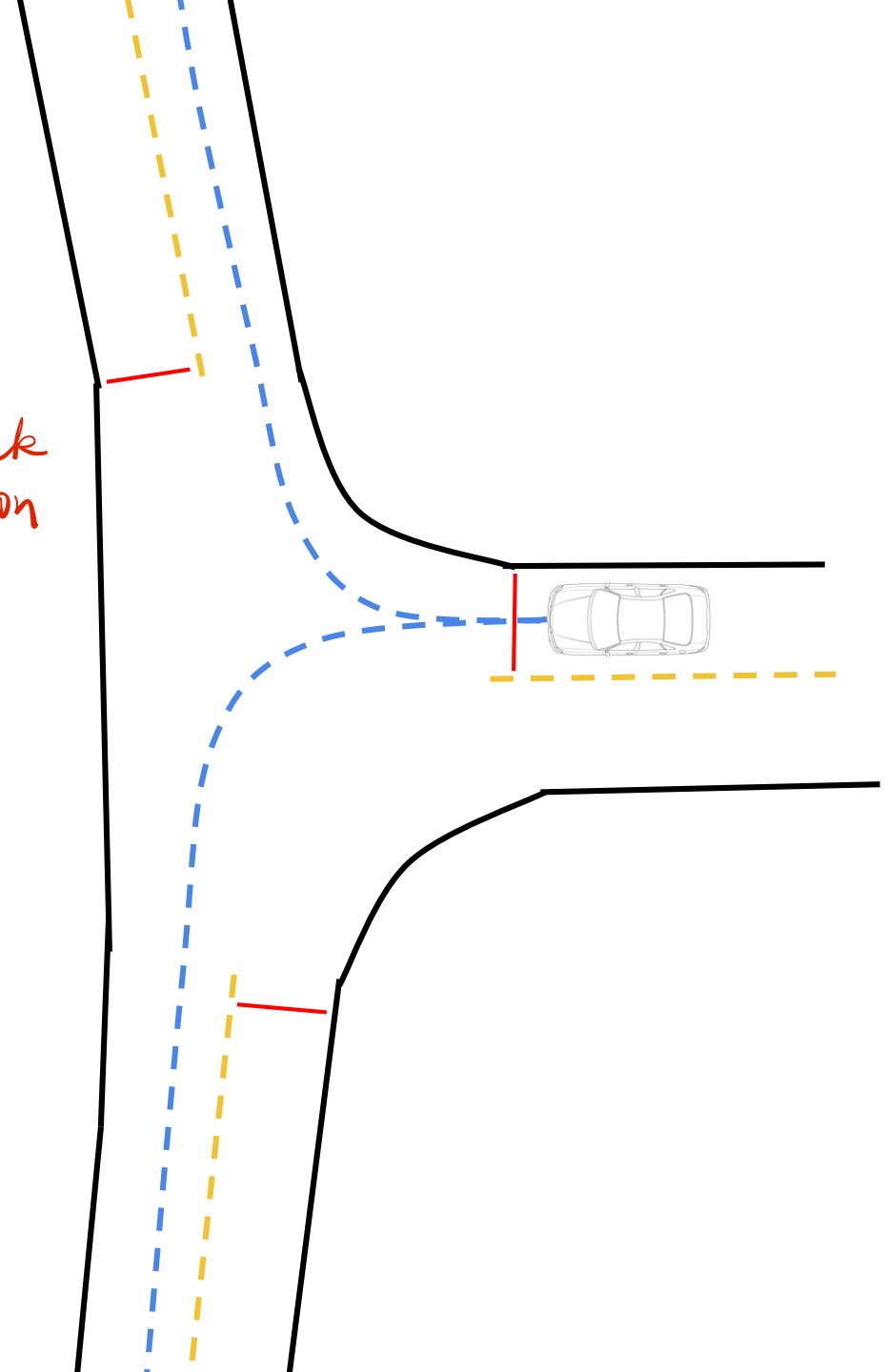
- Problems with the model:
  - Difficult to predict lane change maneuvers without extra information
  - Multiple possible lanelets such as when on an intersection



Improvement of Path Prediction

- Solution with the model:
  - Most likely prediction
  - Multi-hypothesis prediction

using object state appearance & track information

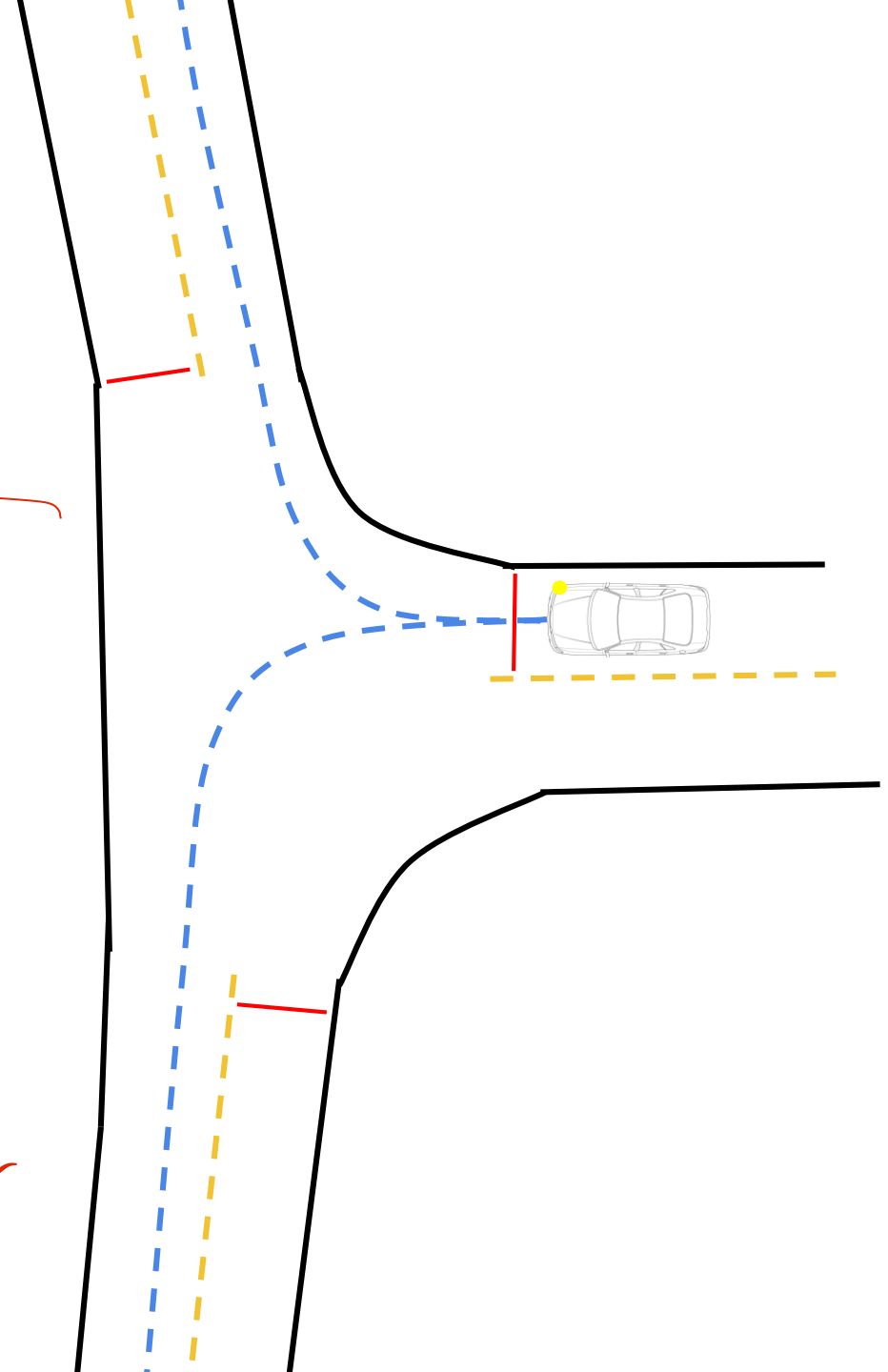


Multi-hypothesis Approach

- 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)

+o consider multiple scenarios simultaneously.

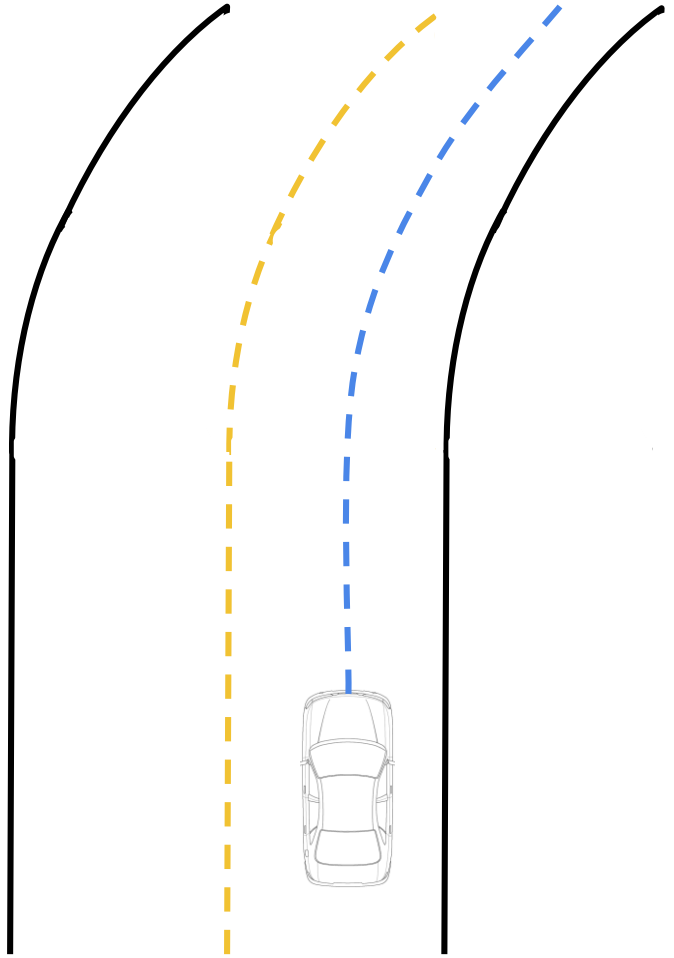
update probabilities of belief based on indicator signals, position to the left or right of the center line & state of the vehicle



Improvements to Velocity Prediction

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

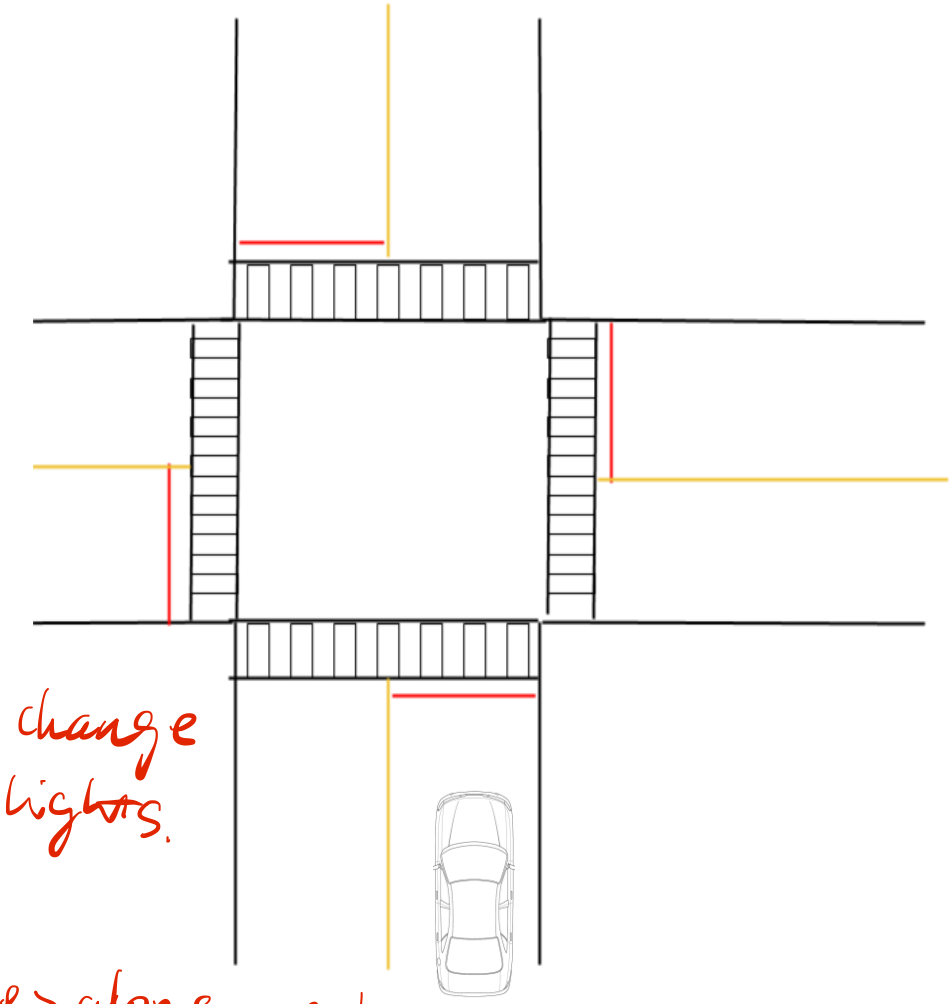
Vehicle reduces speed when entering curves.



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/yield signs, speed limit change or traffic lights.
  - 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 generated multiple hypotheses
- Identified issues with the map-aware assumptions

- **Next**: Calculating time to collision