Introduction to Intelligent Vehicles
[6. Cooperative Adaptive Cruise Control]

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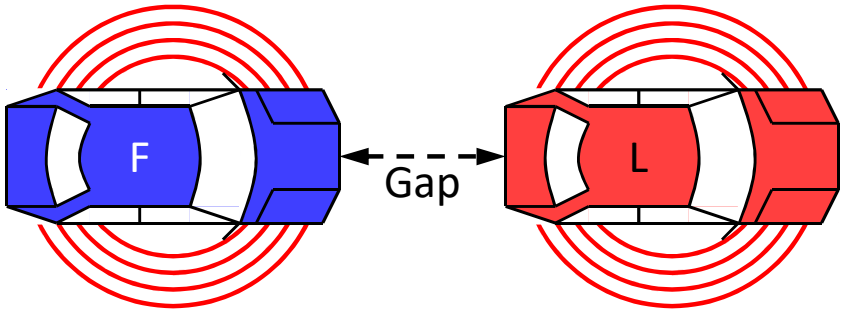
Adaptive Cruise Control (ACC)

- What is ACC?
  - Adjust vehicle speed to maintain a safe distance from the vehicle ahead
- Why is ACC helpful?
  - Maintain a safe distance and avoid a collision
- When is ACC working?
- Where is ACC working?
- Who develops ACC?
- How does ACC work?
  - Sense the distance from the vehicle ahead (also consider the speed itself)
  - Decide if it is safe
  - Maintain a safe distance from the vehicle ahead or brake if needed

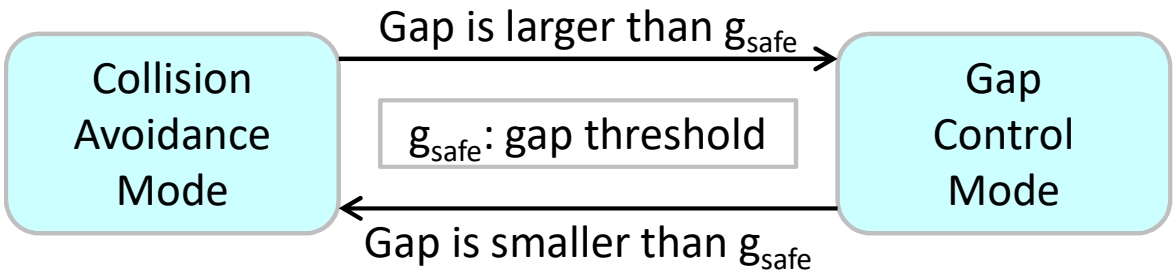
Cooperative Adaptive Cruise Control (CACC)

❑ Two simplified CACC modes

- ➢ Gap control mode
  - The following vehicle (F) decides acceleration based on the gap, speeds, and accelerations of the two vehicles



- ➢ Collision avoidance mode
  - The following vehicle (F) decelerates with its maximum deceleration



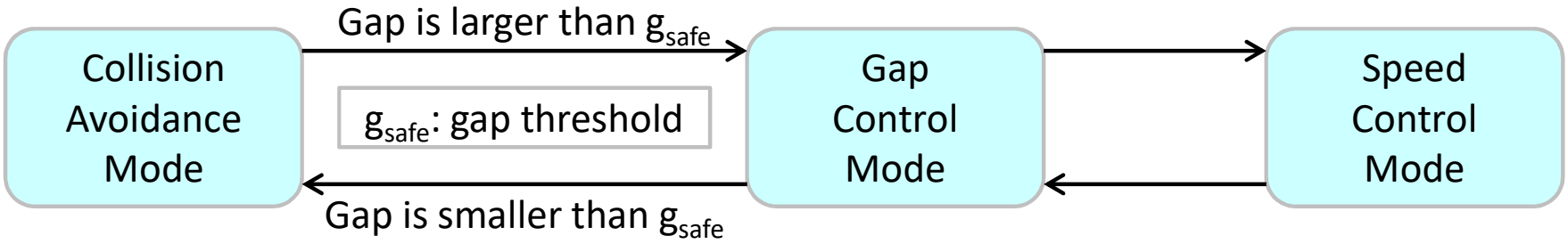
❑ Information and its sources

- ➢ Gap, speeds, and accelerations
- ➢ Camera, radar, lidar, and communication messages (e.g., 10Hz)

Random Stuff

A more complicated model

- One more mode: speed control mode



Math behind it

- $g_{safe} = 0.1\ v + (v^2 / 2D) - (v'^2 / 2D') + 1.0$
  - 0.1: CACC message/task period
  - v: velocity of the following vehicle
  - v': velocity of the leading vehicle
  - D: maximum deceleration of the following vehicle
  - D': maximum deceleration of the leading vehicle
  - 1.0: minimum gap requirement

Benefits

- ACC systems, like human drivers, may not exhibit string stability [Wikipedia]

- With more information, CACC can perform vehicle-following better
  - CACC may also consider multiple leading vehicles

Q&A