ECE 484 - MP0

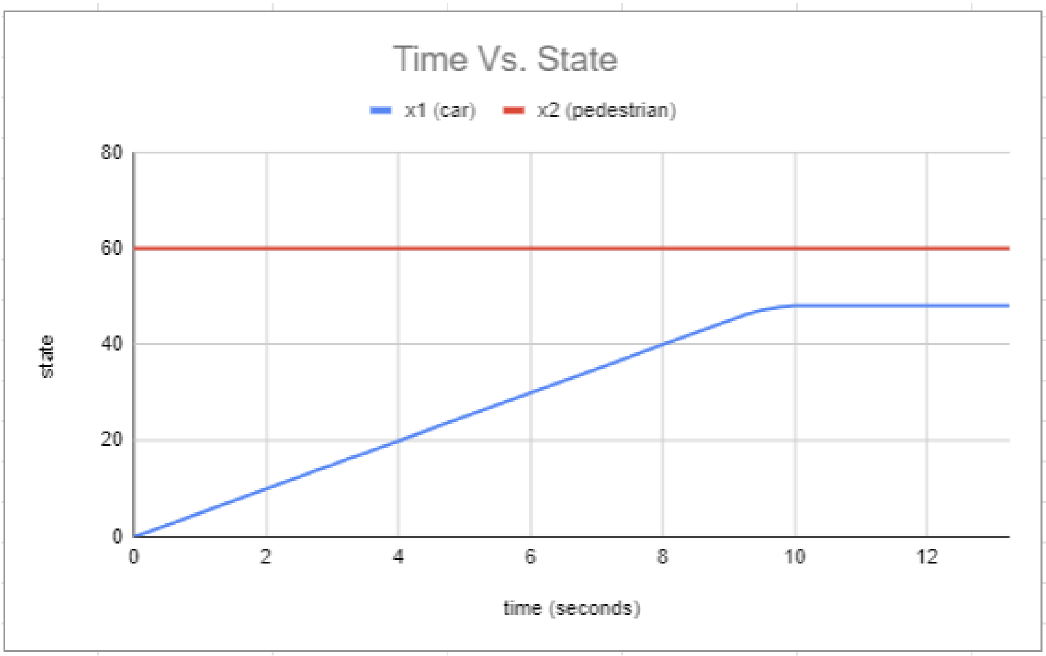
- **Carla McCarface**
  - Tracy Tang (tracymt2)
  - Taylor Xia (tyxia2)
  - Amith Ramdas Achari (amithr3)
  - Peng Han (penghan2)

Problem 5 (15 points). Record a video for one example execution of this scenario. The video should include the Gazebo window, the Rviz window, and the terminal window that runs MP0 code. Provide a link to the video and include the link in the report. In addition, plot the time versus state variables (x1(t), x2(t)) for this execution.

<u>Arguments</u>:
d_sense: 15
v_0: 5
a_b: 5
t_react: 0.00

Simulation recording:
https://www.youtube.com/watch?v=jQP4QlXp9g4&t=1s

Time vs. state plot:

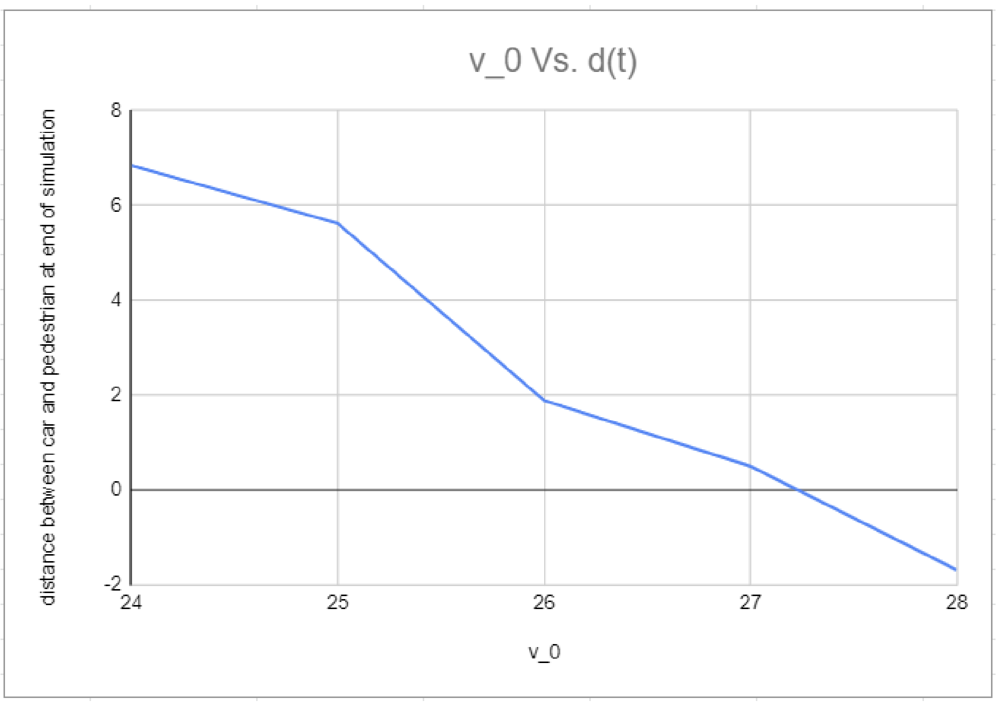


Problem 6 (20 points). Fix d_sense and a_b, and choose 5 different values for v_0. Try to choose interesting values or "corner cases" that could make the system safe and unsafe.

<u>Arguments</u>:
d_sense: 15
a_b: 50
t_react: 0.00

v_0	**d(t) (t @ end of simulation)**
24	6.84
25	5.62
26	1.88
27	0.49 (front of car is actually touching pedestrian)
28	-1.70 (car hit pedestrian!)

(a) For each of these choices, plot the final value of d(t) vs your choice of v_0.



(b) Are there any choices that violate the safety of the system?

A v_0 of 27 does not technically make d(t) 0, where t is the time that the car stops, but the front of the car touches the pedestrian in the simulation. A v_0 of 28 causes the car to hit the pedestrian (d(t) = -1.7), so this choice violates the safety of the system.

(c) Try reducing d_sense. How does this affect the safety of the system in relation to v_0?

v_0	**d(t) (t @ end of simulation)**	
	d_sense = 15	**d_sense = 10**
24	6.84	2.28
25	5.62	-0.09

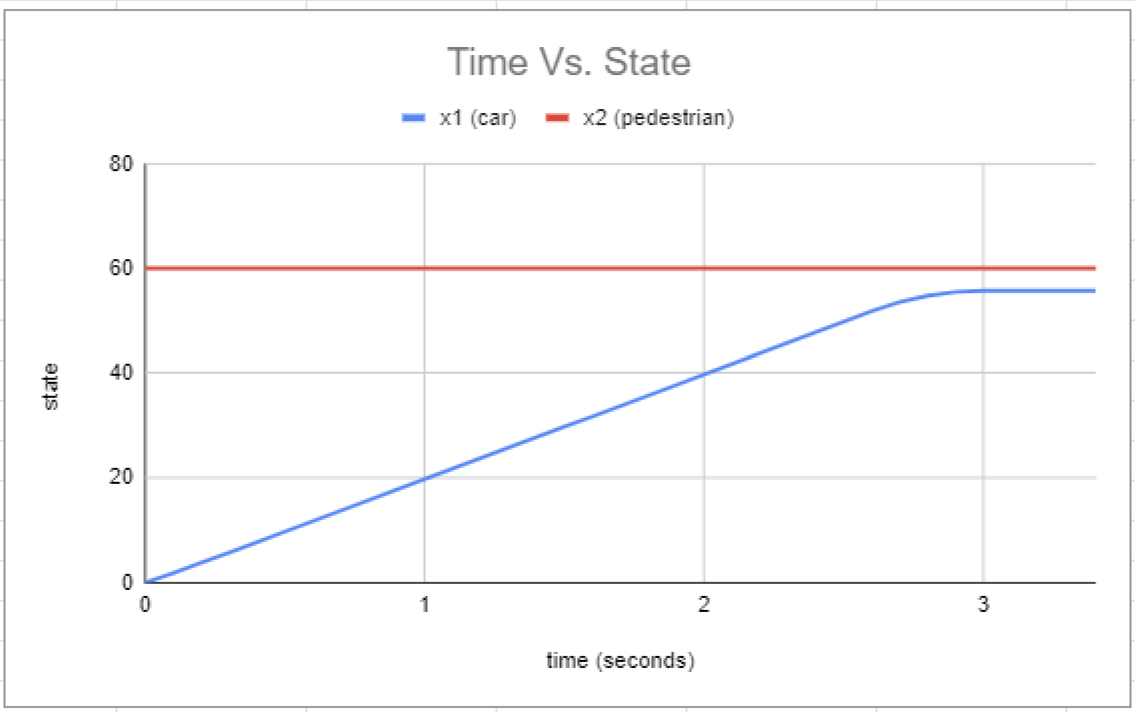
Decreasing d_sense negatively impacts the safety of the system in relation to v_0. As shown in the table below, decreasing d_dense results in the car stopping much closer to the pedestrian. Some previously safe systems are no longer safe. This makes sense, because the car has less time to slow down with the same deceleration constant.

Problem 7 (15 points). Record a video for one example execution of this scenario. The video should include the Gazebo window, the Rviz window, and the terminal window that runs MP0 code. Provide a link to the video and include it in the report. In addition, plot the time versus state variables (x1(t), x2(t)) for this execution.

<u>Arguments</u>:
d_sense: 15
v_0: 20
a_b: 50
t_react: 0.2

Simulation recording:
https://www.youtube.com/watch?v=uIACOlgJ3ww

Time vs. state plot:

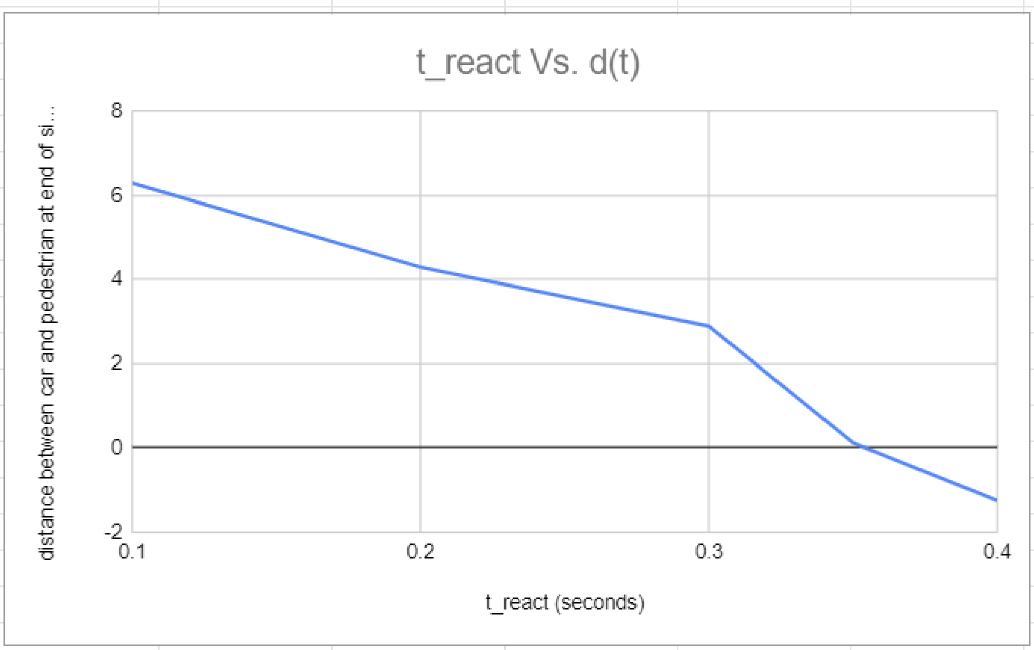


Problem 8 (15 points). Fix d_sense, v_0, a_b, and choose 5 different t_react. Try to choose interesting values or "corner cases" that could make the system safe and unsafe.

Arguments:
d_sense: 15
v_0: 20
a_b: 50

t_react	d(t) (t @ end of simulation)
0.1	6.30
0.2	4.30
0.3	2.90
0.35	0.12 (front of car is actually touching pedestrian)
0.4	-1.25 (car hit pedestrian!)

(a) For each of these choices, plot the final value of d(t) vs your choice of v_0.



(b) Are there any choices that violate the safety of the system?

A t_react of 0.35 seconds causes the front of the car to touch the pedestrian, but it does not technically violate the safety of the system. A t_react of 0.4 seconds does violate the safety of the system, as it hits the pedestrian with a d(t) of -1.25 (where the value of t is the time at the end of the simulation)

(c) Try modifying a_b. How do different choices of a_b affect the safety of the system in relation to t_react?

t_react	**d(t) (t @ end of simulation)**		
	a_b = 70	a_b = 50	a_b = 30
0.1	3.24	6.30	1.27
0.2	2.44	4.30	-0.12

Decreasing a_b decreases the safety of the system. In each case, the car stops closer to the pedestrian. Alternatively, Increasing a_b increases the safety of the system. This makes sense because the more time it takes for the car to stop once it starts braking, the further it will move.