

Be sure to install dependencies before running any simulation. Otherwise, car colours might not change.

Create a virtual environment. It usually pops up as you open the folder. Then, choose venv, Python version, check off requirements.txt and hit ok. It takes a few minutes to install all the dependencies.

Yellow colour vehicles = patient-carrying vehicles

Red = self-driving vehicles

Green = non-self-driving vehicles

Run `display_sim_roundabout_upper.py` to view the main ground-level intersection. Note there are no traffic lights. Traffic lights are redundant because inserting traffic lights in the roundabouts destroys the purpose of roundabouts, which is to speed up traffic flow. The arcs are the entry and exit points for the patient-carrying vehicles. Notice cars (only yellow cars) can either enter the tunnel or exit from the tunnel through these points.

Run `display_sim_roundabout_lower.py` to view the tunnel's roundabout, which is only for patient-carrying vehicles going in and out of the hospital. Note: The vehicle spawn rate is 5 times lower because the road is only for the use of patient-carrying vehicles, and the speed is 1.5 times the default speed (which is 17 m/s) due to lower overall traffic flow.

I ran `sim_average.py` by importing each of the three .py files used for simulating each of three intersections. Here is a brief result:

`base_intersection.py` (Keeping all default values)

Average Travel Time: 37.16 seconds

Vehicle Time Variance: 508.12 seconds

Vehicle Time Standard Deviation: 22.54 seconds

--- runtime: 33.45 seconds ---

`roundabout_upper.py` (since it is a roundabout, the intersection size is twice the size for `base_intersection.py`. Since no traffic lights, vehicle speed is reduced by 1.5 times the default speed (two-thirds of the default speed). All other variable values are kept constant.)

Average Travel Time: 23.07 seconds

Vehicle Time Variance: 94.29 seconds

Vehicle Time Standard Deviation: 9.71 seconds

--- runtime: 66.79 seconds ---

(avg travel time is reduced by ~38% than the base_intersection.py).

roundabout_lower.py (Two variables are changed: 1. Vehicle rate is 5 times lower because the road is only for the use of patient-carrying vehicles, 2. Increasing the vehicle speed 1.5 times the default speed due to lower overall traffic flow)

Average Travel Time: 11.49 seconds

Vehicle Time Variance: 1.12 seconds

Vehicle Time Standard Deviation: 1.04 seconds

--- runtime: 6.93 seconds ---

(avg travel time is reduced by ~50% from roundabout_upper.py and ~69% from base_intersection.py)

Default values for the base_intersection.py and some additional important values:

lane space = 3.5

intersection size = 24 (for roundabouts, the size is ~twice (49))

island width = 2

Road's length = 100 (for example, from the very EAST to the edge of the base intersection)

Vehicle spawn rate = 20 (I think it's 20 cars/minute)

Speed variance = 2.5 m/s

Vehicle speed = 17 m/s

Self-driving car amount : regular car amount = 1:2 (proportion rate 0.5)

Patient carrying vehicle = vehicle rate / 5 (I assumed on average 1 in every 5 vehicles is patient carrying.)

Patient carrying vehicle speed = 1.5 * default vehicle speed

For the ground-level roundabout, vehicle speed = default vehicle speed*2/3

Tunnel spawn rate = default spawn rate / 5

Conclusion:

1. By implementing a non-traffic light ground-level roundabout, the average travel time is reduced by ~38% than the traditional traffic light intersection even with 1.5 times reduced vehicle speed and twice a big intersection size.

2. By implementing a non-traffic light basement-level roundabout, avg travel time for patient-carrying vehicles or vehicles used for emergency medical services is reduced by ~50% from ground-level roundabouts and ~69% from the base traffic light intersection, assuming only 1 in every 5 cars on the ground-level are entering and exiting the hospital with patients are using it and so the speed of the cars is increased by 1.5 times.