Lab 6:
Path Planning/Following

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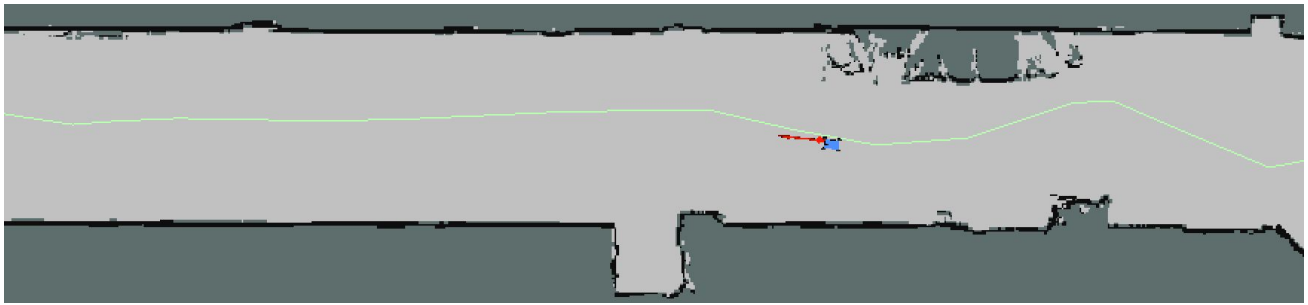
Main Objectives

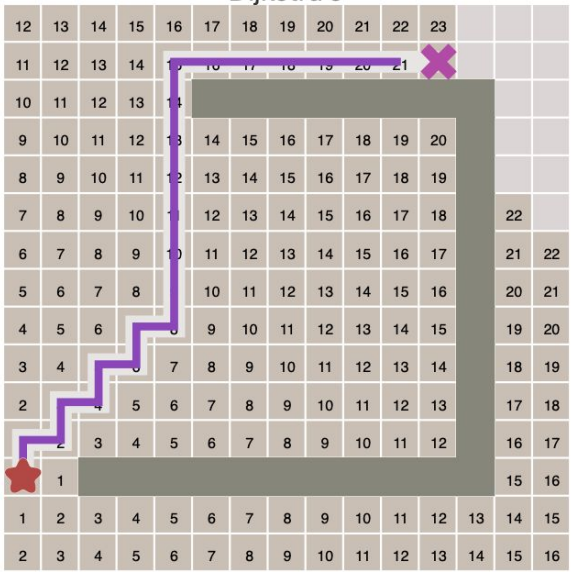
1) Plan valid paths using two different planning approaches (A* & RRT)
2) Follow a planned path using the pure pursuit algorithm
3) Demonstrate autonomous path planning and following on the real car



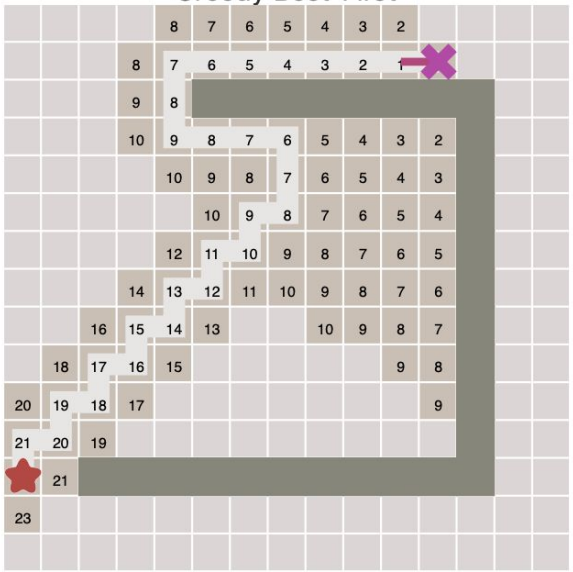
Path Planning: A* (Search based method)

Which Search Based Algorithm?

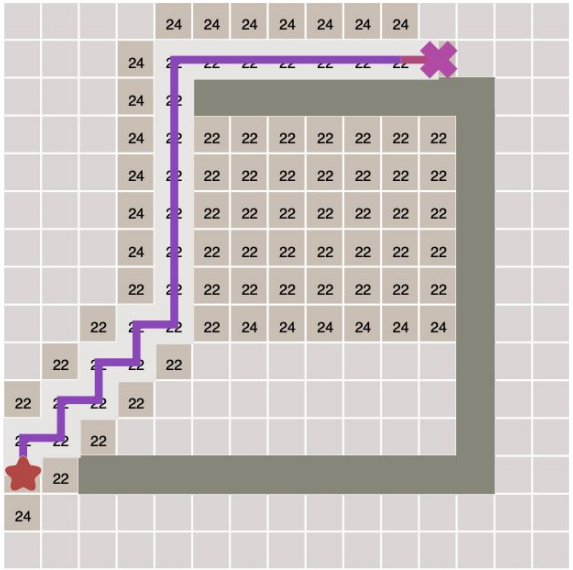
Dijkstra's



Greedy Best-First



A* Search

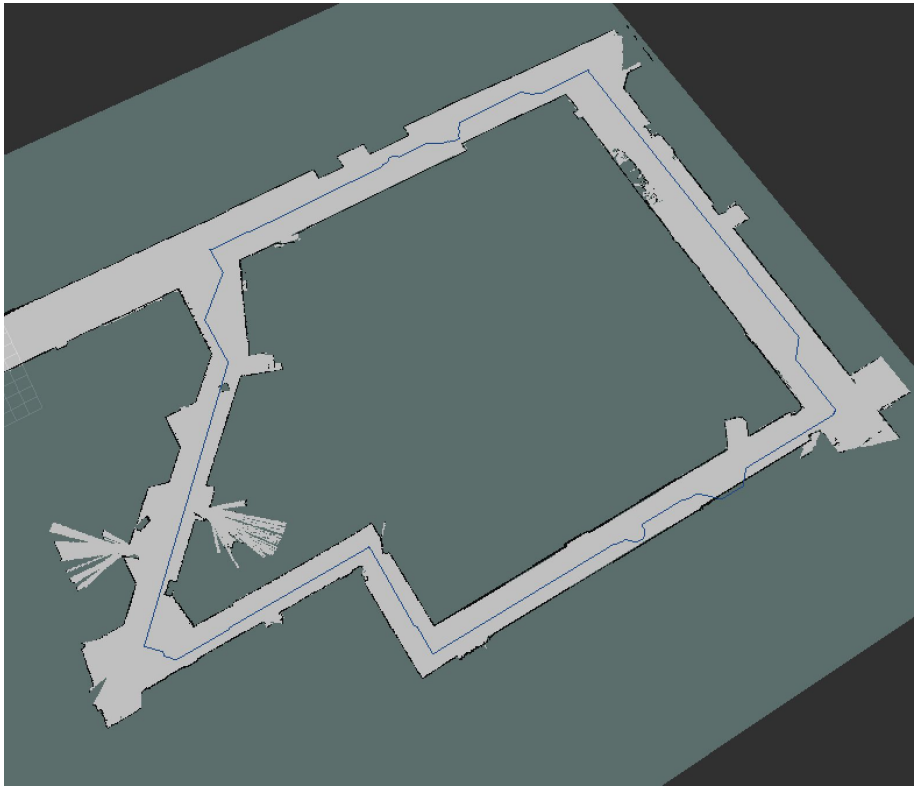


Path Planning: Map Representation

- Pixel by Pixel Representation
- Resolution of .05
- 2,249,000 nodes
- Stata Map ~45 seconds

Speed:

Anywhere from 0.01 - 10 seconds



Sampling Based Path Planning

Random exploration of space

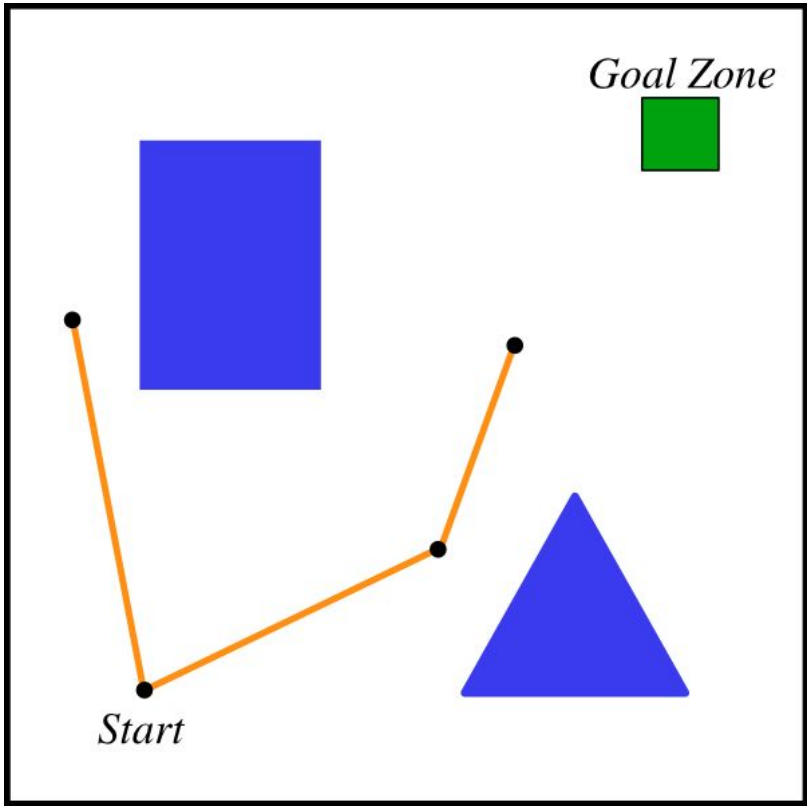
Exchange some optimality in path for speed

The Algorithm: RRT (Sampling based method)

Map Dilation: magnify boundaries by 10 pixels

Randomly choose a point on the map

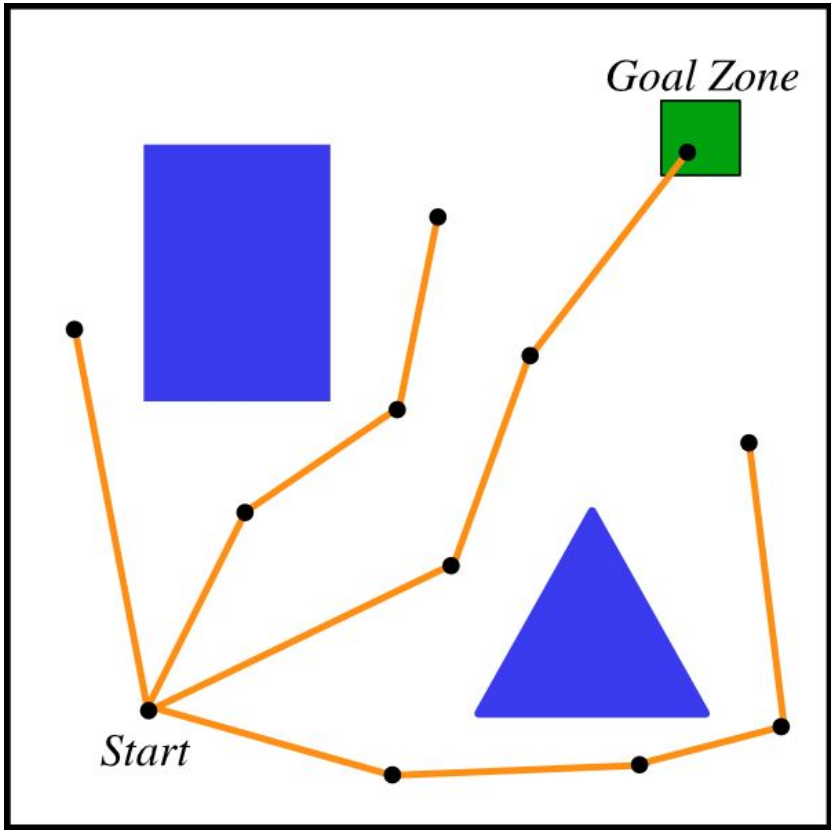
Steer the point by moving the point within a threshold distance to its nearest neighbor



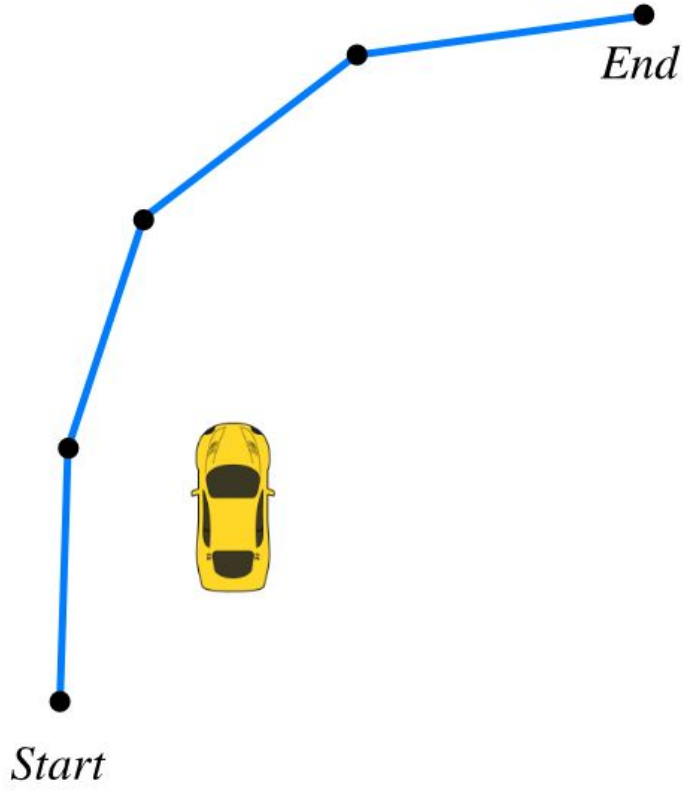
The Algorithm: RRT (cont.)

Check for collisions along the line between the point and its neighbor

Add points until reach goal zone

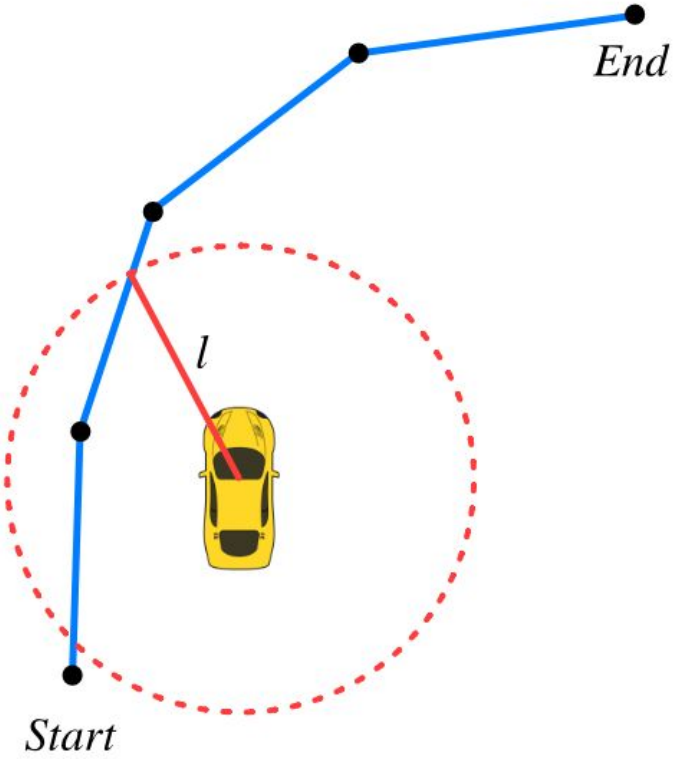


Path Following: Pure Pursuit



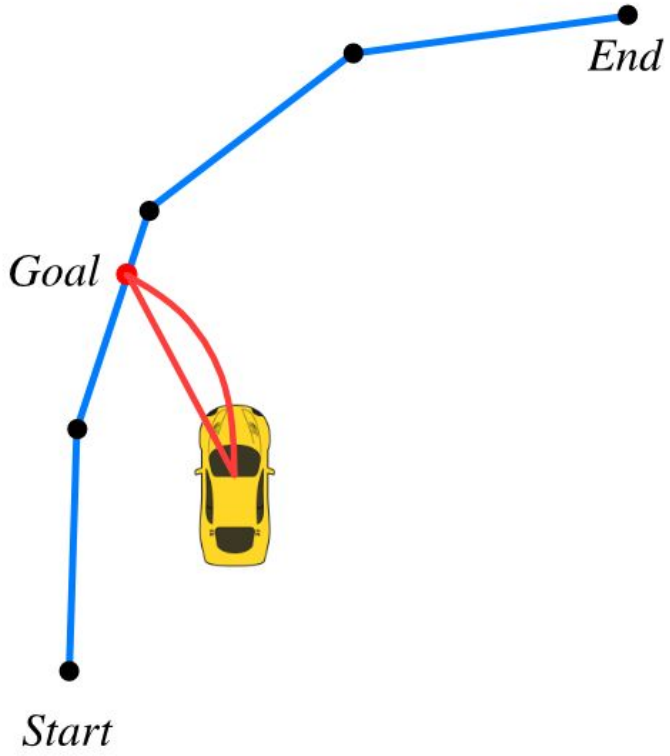
1) Path planner provides a sequence of points

Path Following: Pure Pursuit



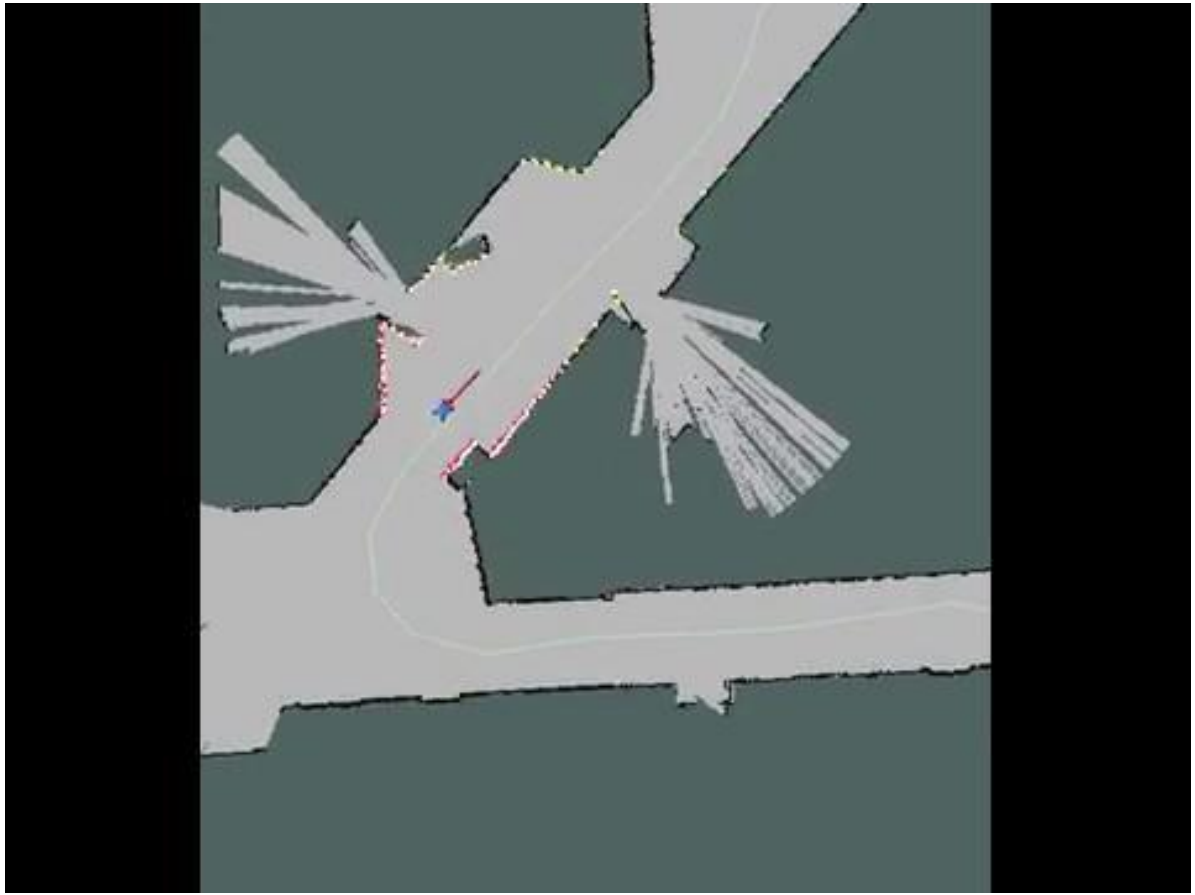
1) Path planner provides a sequence of points
2) Find the point on the path one “lookahead” distance away from the car

Path Following: Pure Pursuit



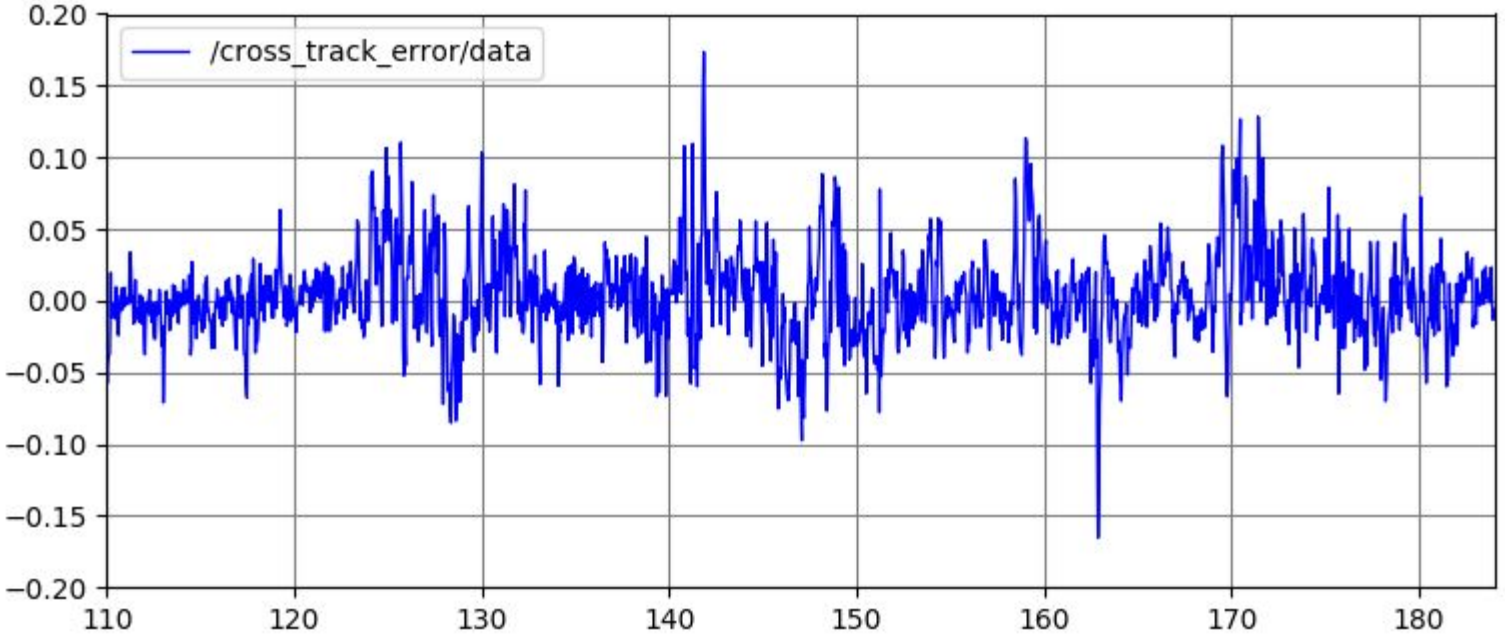
1) Path planner provides a sequence of points
2) Find the goal point on the path one “lookahead” distance away from the car
3) Calculate the steering angle needed to drive to the goal point

Pure Pursuit Demo



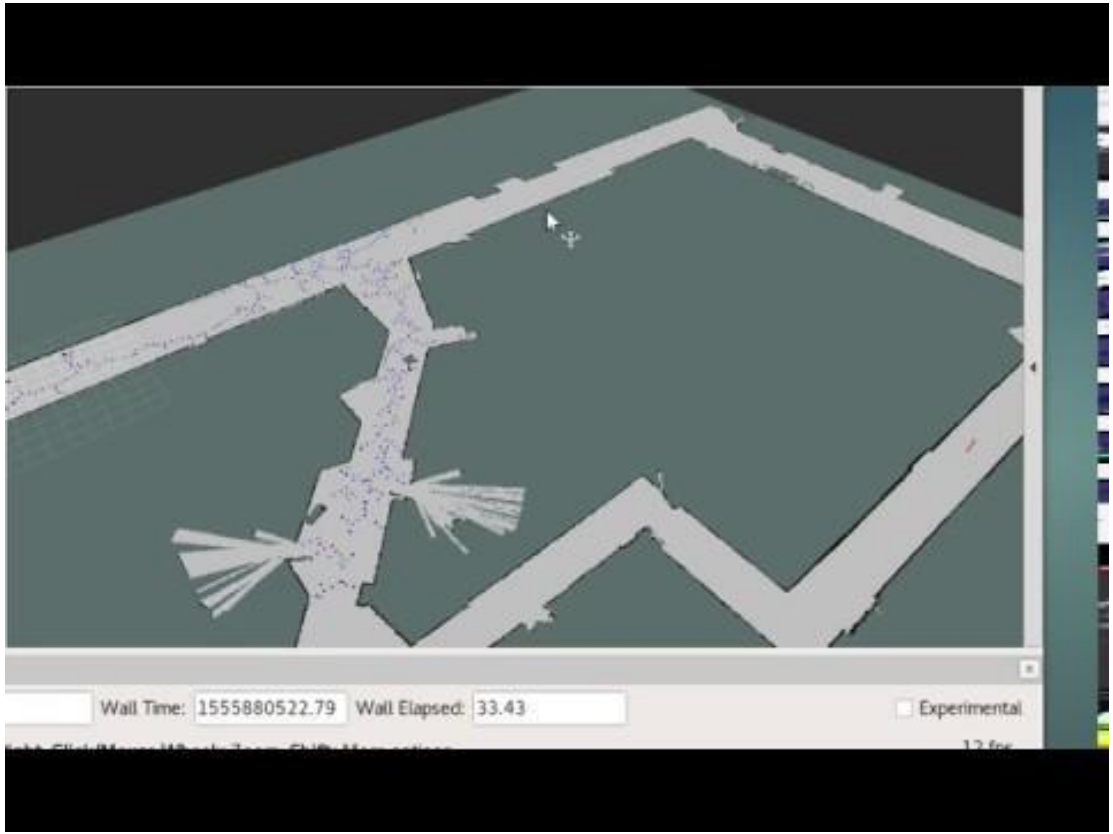
Pure Pursuit Performance: Cross Track Error

Meters

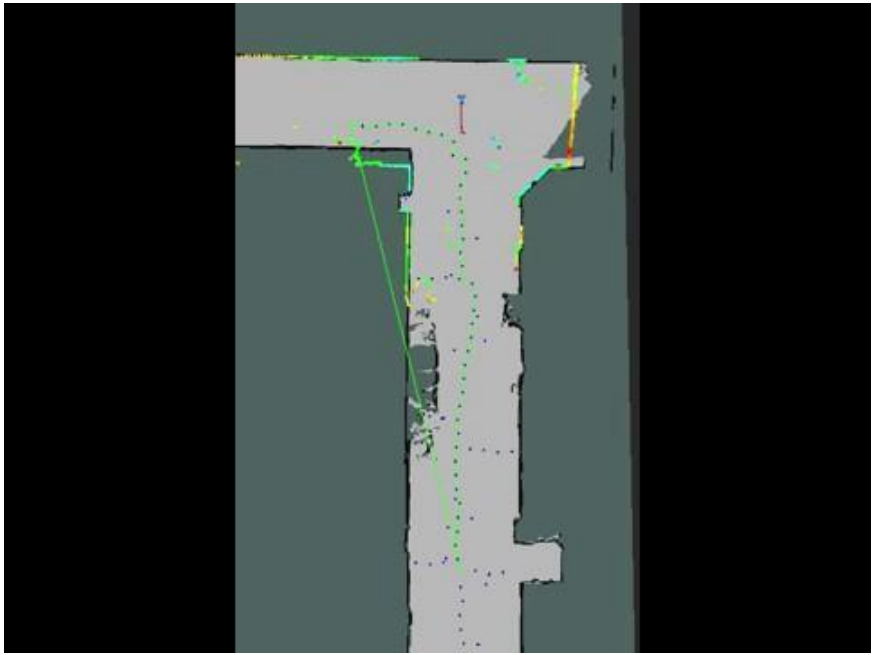


Time

RRT Integration with Pure Pursuit



Real Life Demo



Lessons Learned

- Pure pursuit can be improved by implementing a variable lookahead distance
- Implementing RRT* could’ve greatly improved our ability to search paths in less time
- Improving the map state to prevent holes in path searching

Questions?