

Team Dirty Gerty

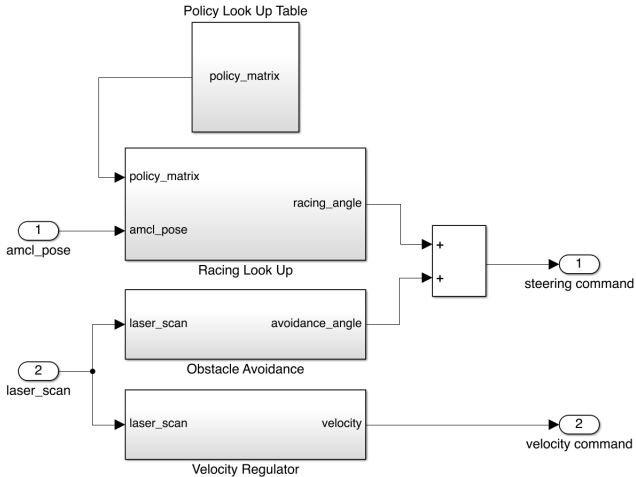
Technik Autonomer Systeme - Final Presentation

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Signal Flow



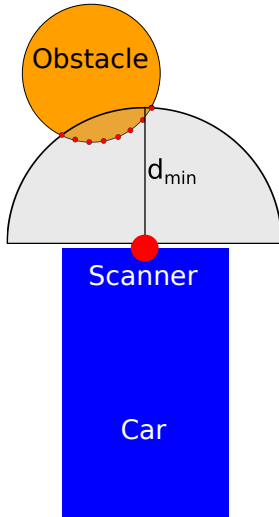
Lookup Table Creation

- Racing as optimal control problem
- (arbitrary) model assumptions:
 - Discrete state space and discrete time
 - Constant speed
 - 3 steering angles
 - Stochastic vehicle dynamic
- Simple cost function:
 - Progress is rewarded
 - Accidents are penalized
 - Discounted, infinite horizon problem

⇒ Can be solved by Dynamic Programming.

⇒ Optimal policy is computed via asynchronous Value Iteration.

Obstacle Avoidance



The lookup table cannot handle unexpected obstacles.

⇒ Need for additional security mechanism

Idea:

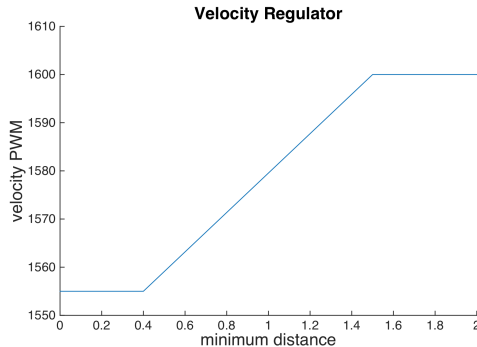
→ Divide laserscan in two sections

→ Count data points with $d < d_{min}$ in both sections

→ If obstacle detected: Bypass on the side with fewer "dangerous" points

Velocity Regulation and Initial Pose Estimate

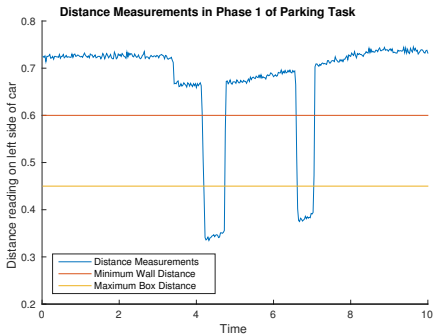
Idea: The car has to drive slowly when obstacles are in its path.
⇒ Use minimum distance in the laser scan to regulate the velocity.



Pose Initialization: Car always initialized for starting position one.

Parking

- **Approach:** Actions subdivided into 5 phases.
- Initial phase pertains to parking spot discovery.
 - Dependent upon Gerty's left side laser scan $\equiv x_{left}$.
 - If $x_{left} < x_{boxmax} \Rightarrow$ box found.
 - If $x_{left} > x_{wallmin} \Rightarrow$ wall found.
- Actions of remaining phases governed by Δt_i , $i = 2, 3, 4, 5$.



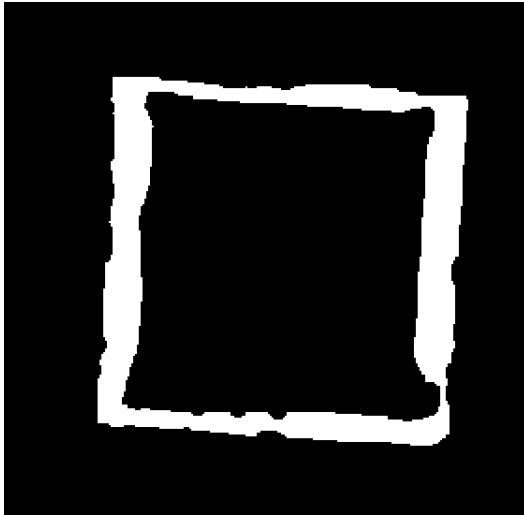
References



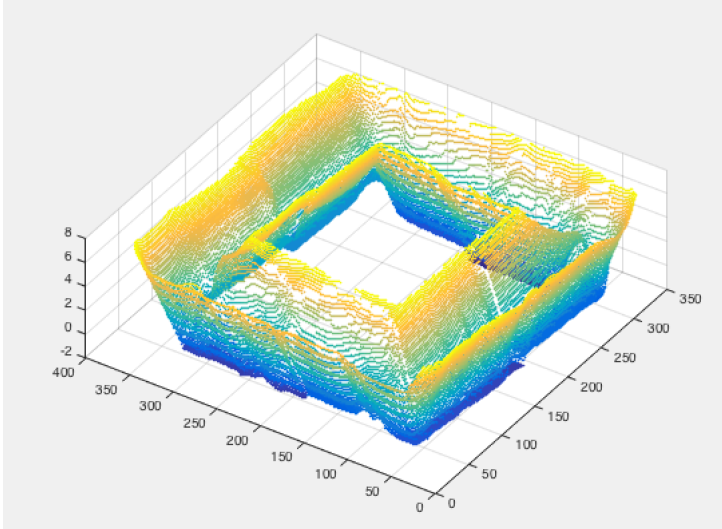
D.P. Bertsekas. **Dynamic programming and optimal control—volume 2**. Athena Scientific, 1999.



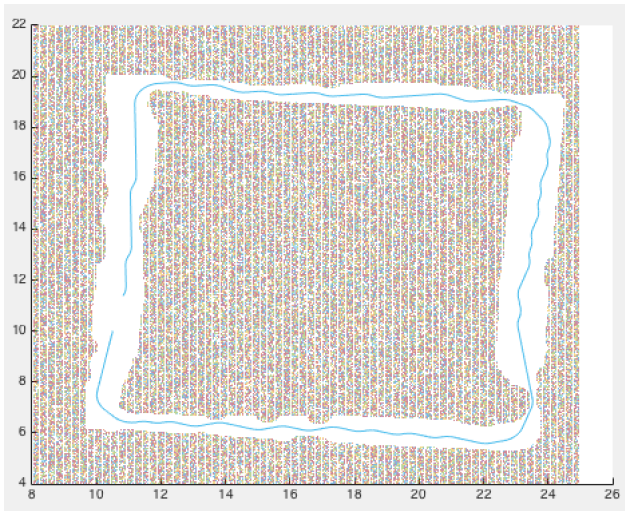
Backup - Obstacle Growing



Backup - Value Function

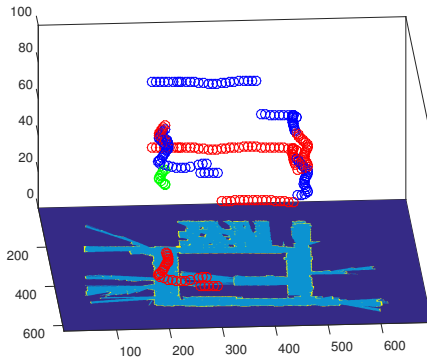


Backup - Simulation

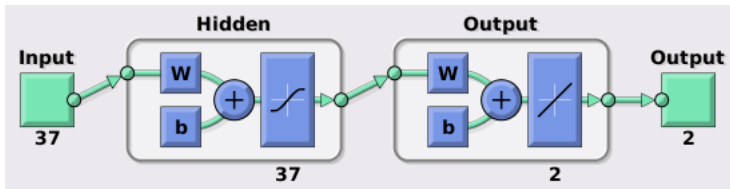


Backup - WLAN Localization

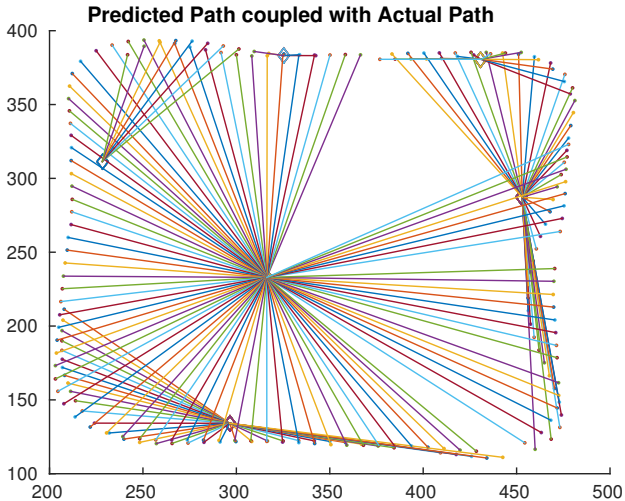
WLAN Signal Strength Over Map



Backup - WLAN Neural Network

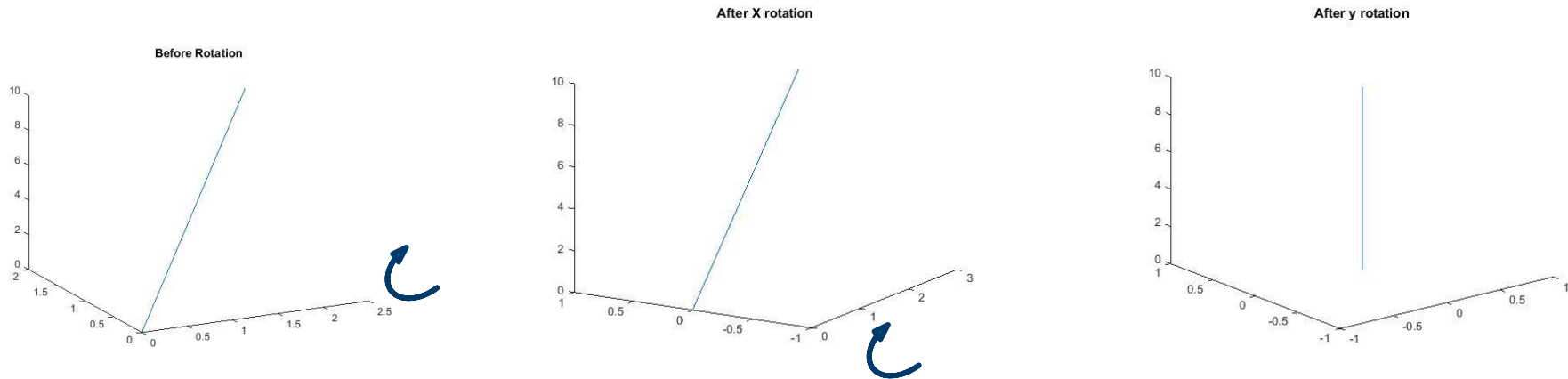


Backup - WLAN Prediction



Backup - IMU Rotation

- IMU Data with still standing car: X and Y rotation



- Z rotation with car tilted to face gravitation in x direction:

