Technology of Autonomous Systems

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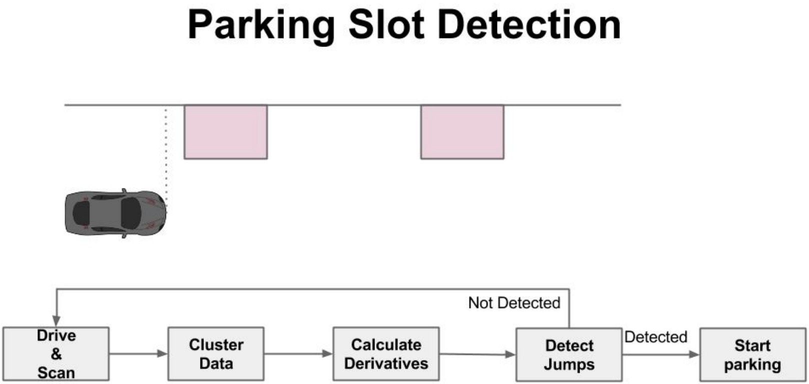
Talk Overview

Parallel Parking Approach

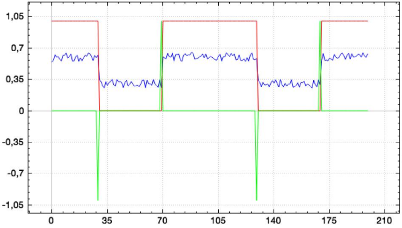
Indoor Wi-Fi Positioning

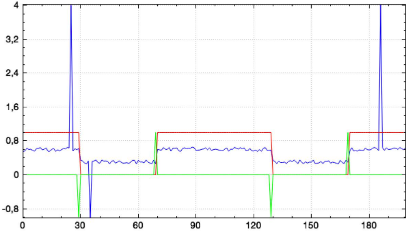
Adaptive Velocity Controller

Parallel Parking Approach I



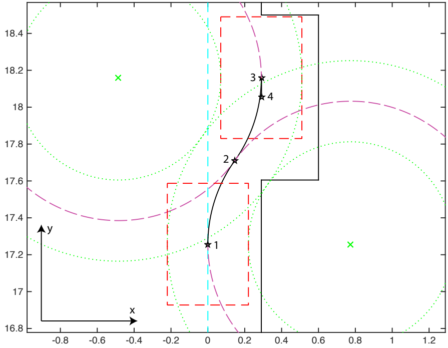
Parallel Parking Approach II





Parallel Parking Approach III

1. Parking lot was detected
2. Car positions and ranges at 1st and 2nd jump were stored
3. Calculate corners of parking lot from that data
4. Final position (4) is center of parking lot
5. Third (3) way point is at the back of parking lot (safety distances: side $\approx 6cm$, back $\approx 4cm$)
6. x coordinate of starting point (1) equals distance to wall $\rightarrow$ calculate y coordinate using the turning circle of the car
7. Wheel turning point (2) is point of intersection of circles

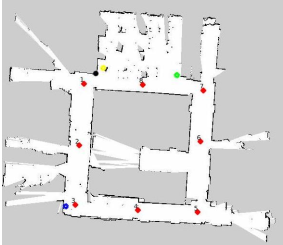


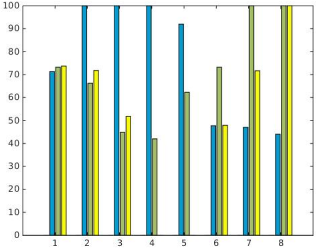
Indoor Wi-Fi Positioning

Trilateration

- Based on radio propagation model: Intensity $\propto \frac{1}{\text{Distance}^2}$
- Requires line of sight, unusable due to deviation of signal strength

Pattern Matching





- Build a database and use nearest neigbour pattern matching (Fingerprinting model)

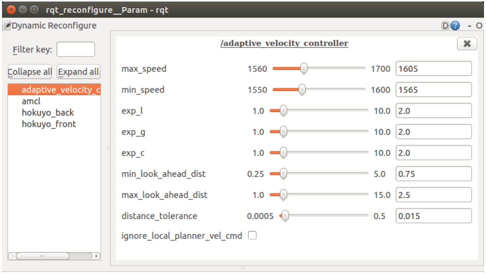
Indoor Wi-Fi Positioning

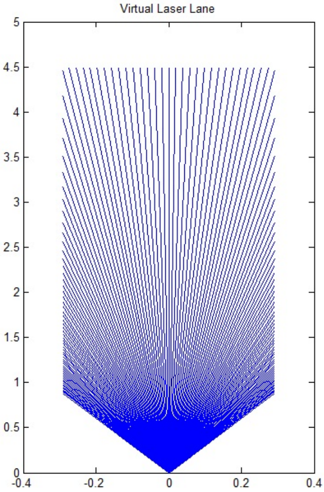
In practice:

- Able to locate the car in its initial position (x,y) for given task, in general accuracy limited by database
- Tracking of the cars movement fails due to too few accesspoints used (less features to compare) and rather slow update of wifi-signals
- performance could be improved by using more accesspoints to generate more robust features, k-nearest neigbour position estimate $(k > 1)$ (or even weighted-KNN [**shin12**]) and a bigger database

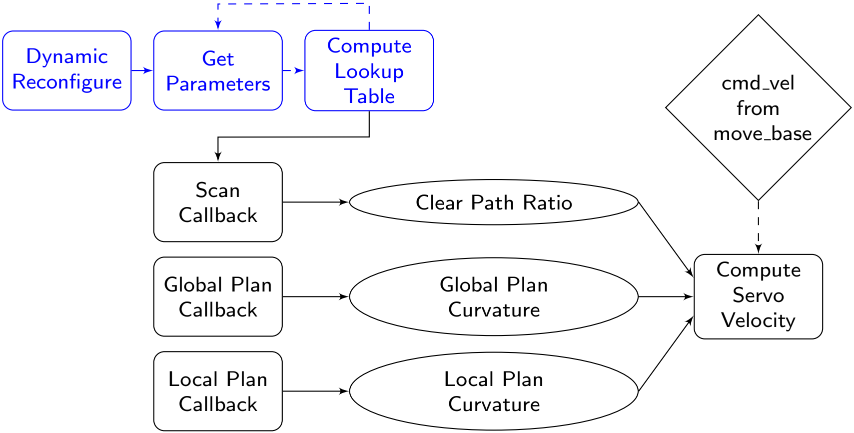
Adaptive Velocity Controller - Overview

- Dynamically reconfigurable node that controls the servo velocity based on
  - Global plan curvature
  - Local plan curvature
  - Nearest obstacle distance in virtual lane
- Linear mapping of cmd_vel
- Parameters subject to optimize





Adaptive Velocity Controller - Program Flow



SERVO VELOCITY:

$$MIN\_SPEED + (SPEED - MIN\_SPEED) * (curv_l)^{exp\_l} * (curv_g)^{exp\_g} * (\frac{min\_obs\_dist}{MAX\_LAD})^{exp\_c}$$

References

M. Buss, D. Carton, B. Gonsior, K. Kühnlenz, C. Landsiedel, N. Mitsou, et al.
Towards Proactive Human-Robot Interaction in Human Environments.
In: *Cognitive Infocommunications (CogInfoCom), 2011 2nd International Conference on*. July 2011, pp. 1–6.