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Automated Driving Applications and Technologies for Intelligent Vehicles

Close-Distance Scenarios

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Final Event
Aachen, Germany
28 June 2017

//Challenges

Localization

Blueprint vs digital map from sensor

Understanding parking space

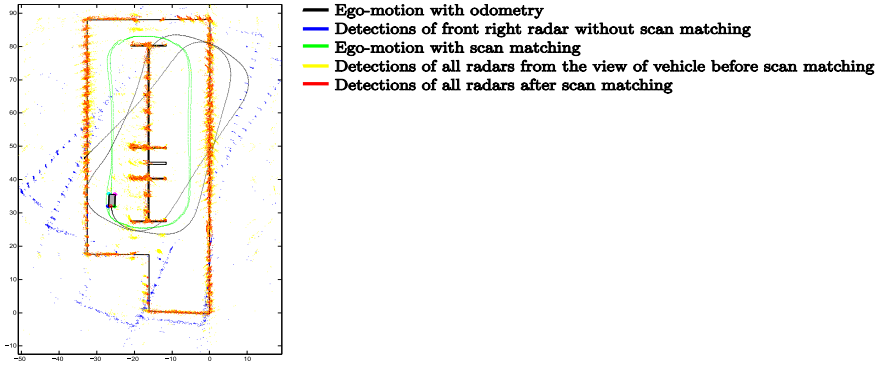
Longitudinal control (NVH, curb, uphill)

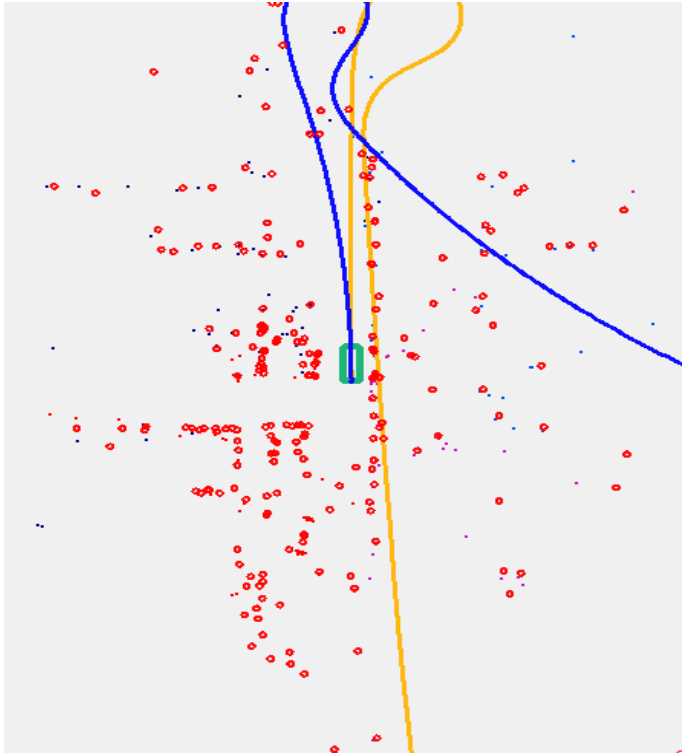
Mixed environment

//Solutions I

Localization

- Odometry – improve filtering
- Ego-Motion and radar Doppler-signal

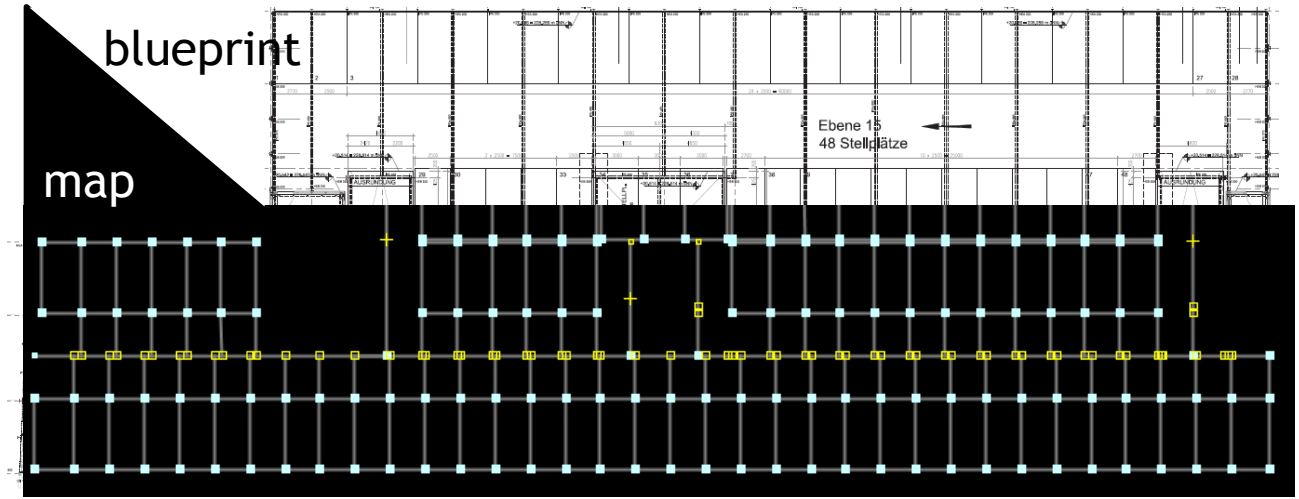




// Solutions II

Digital Map

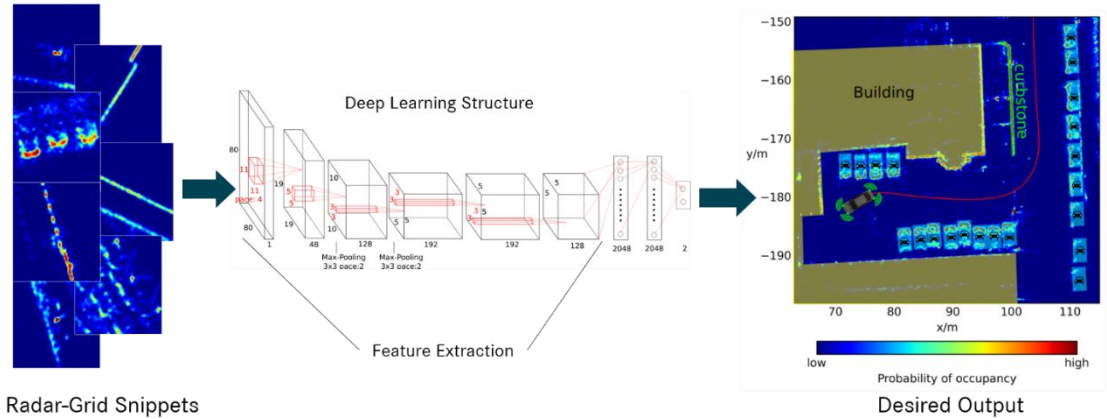
- Conversion of blueprint map using OSM-format
- Improved localization
- Map-based trajectories



//Solutions III

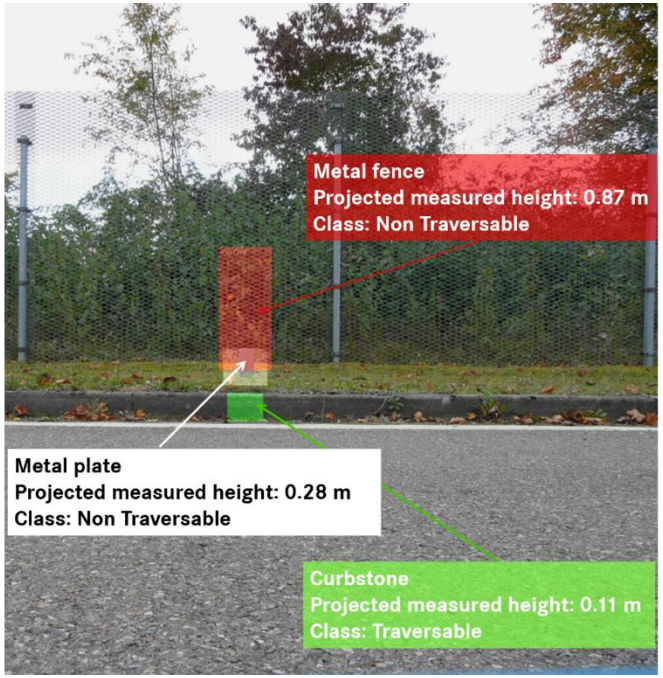
Understanding Parking Space

- Object classification with radar



Radar-Grid Snippets

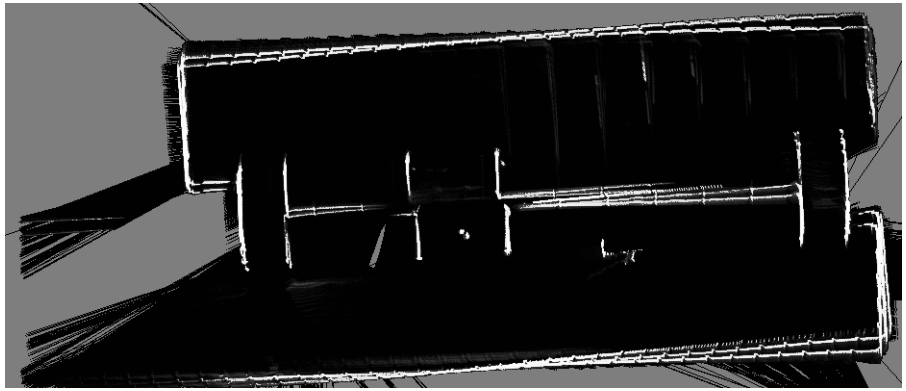
Desired Output



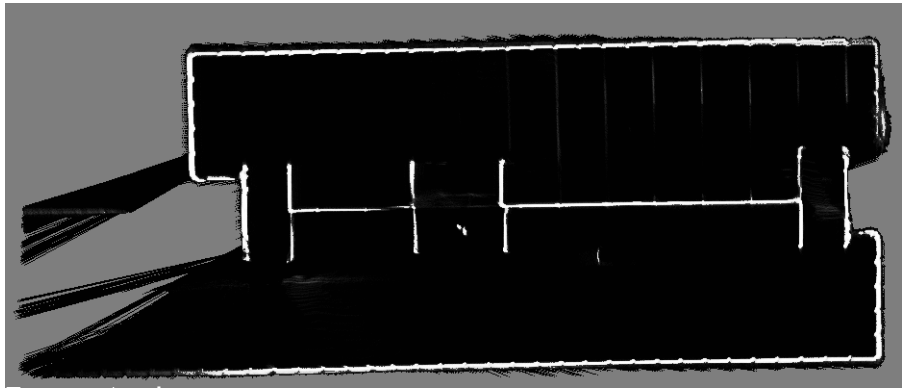
//Solutions IV

Groundtruth map generation when no apriori map available

- Structured environment
- LiDAR-based
- Feature-based approach



Occupancy grid map based on pure odometry

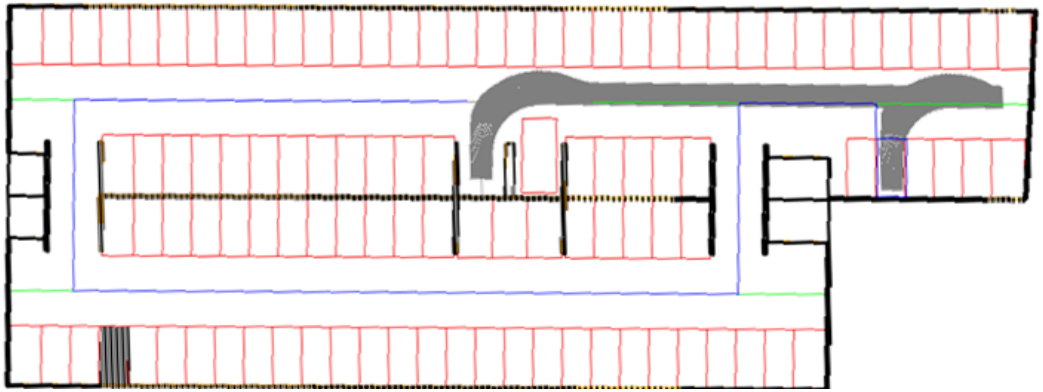


Occupancy grid map based on corrected position

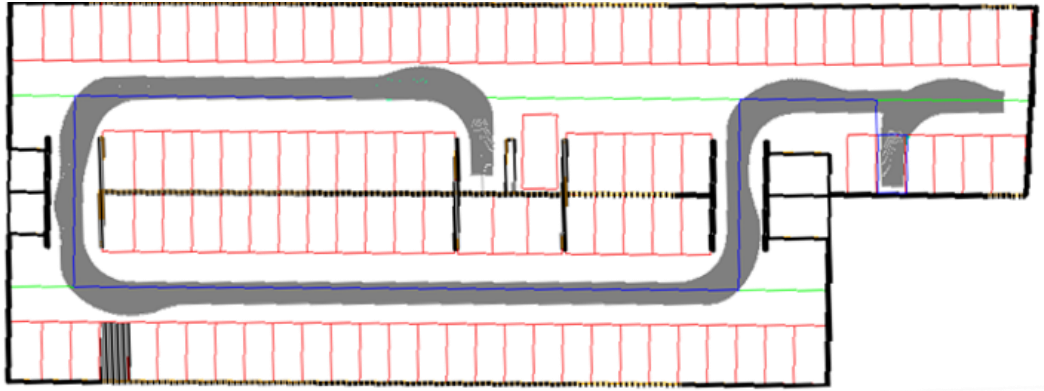
//Solutions V

Path Planning

- Based on OSM-map
- Incorporates lane-network from map to obey traffic rules in parking garage
- Is used for automated valet parking



Without infrastructure information (driving the wrong way)



With infrastructure information (obey the driving direction)

// Key achievements I

- Digital map generation
  - OSM format extended for parking scenarios
  - Convert blueprints to digital maps
  - Lidar for online mapping as groundtruth

- Path planning algorithm
  - Trajectory planning between drop-off and selected locations
  - Push / Pull your car

// Key achievements II

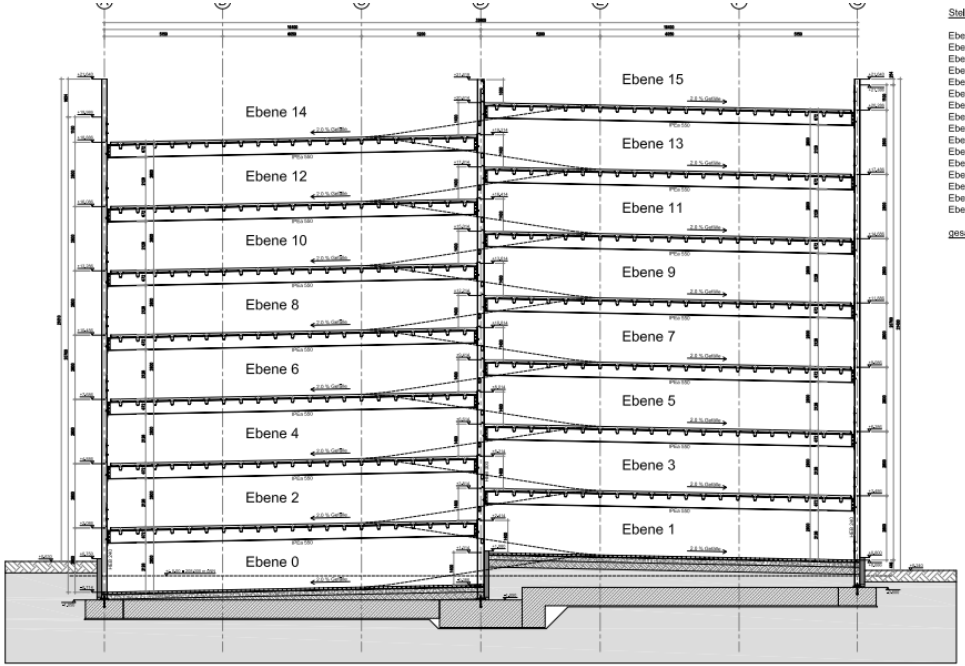
- Localization with digital maps
  - Orientation with fusion of map features
  - Spot selection and drive via smartphone
- Localization without maps
  - SLAM implementation and adaptation
  - Loop closure with 10cm accuracy
- Implementation
  - Three demonstrators at RWTH garage

//Demonstrator

Trajectory learning
Trajectory replay
Longitudinal Control
Driver inside

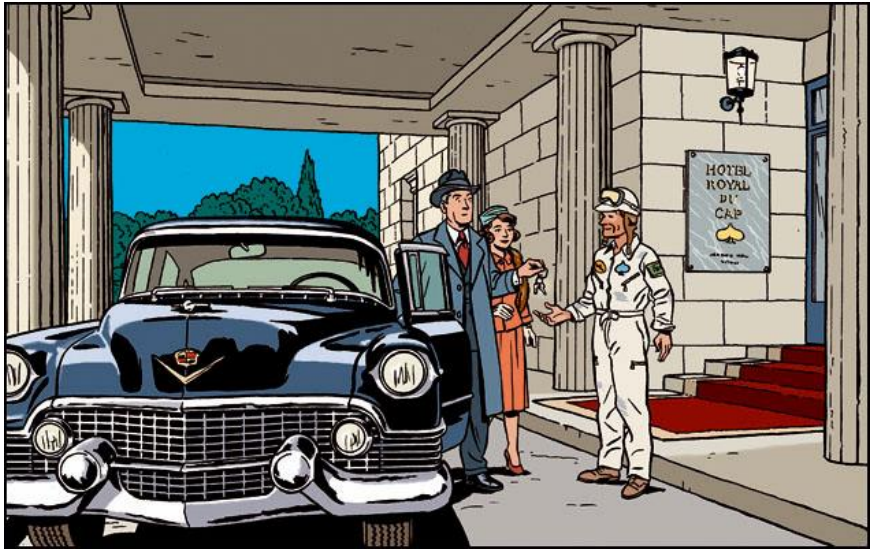
Trajectory learning
Trajectory replay
Driver inside

Automated valet parking function
Choose parking spot via smartphone
Driver outside



//Outlook

- Level 2 parking automation is reality
- Level 3 needs further development
  - Home parking
  - Dedicated garages
- Level 4
  - standards
  - V2I
  - Valet parking
  - Driver outside?



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Co-funded by
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Thank you.

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