Vehicle self-localization using Laserscanners

Fahrzeug-Eigenlokalisierung mit Laserscannern

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Motivation
General Working Principle
1. Extraction of landmarks from Laserscanner data

2. Use of digital maps including landmarks

3. Association and matching for high precision self-localisation including landmarks
General working principle (2)

1. Landmark candidate extraction from Laserscanner data

2. Association of landmarks from digital map with candidates

3. Calculation of vehicle position and orientation using “Extended Kalman-Filter with known associations”
Landmark candidate extraction from Laserscanner data
Landmark candidate extraction (1)

Create a history map of Laserscanner data
Landmark candidate extraction (2)

Find small sized objects in history map using image processing algorithms

- Street light
- Road signs
- Reflector posts
- Tree trunks…
Landmark candidate extraction (3)
Landmark association
Question:
Which landmark candidates from the Laserscanner data correspond to which landmarks from the digital map?
Create an association area surrounding a landmark from the digital map and associate all candidates in this area

Association areas
- Centre is a landmark from the digital map
- Size depends on the current Kalman covariance
Landmark association (3)

Perform triangle comparisons of landmarks and landmark candidates and disassociate mismatched triangles.
Landmark association (4)

Vehicle self-localization using Laserscanners
Tests at Munich rural road site
Tests at Ko-PER Intersection Aschaffenburg
## Results

<table>
<thead>
<tr>
<th></th>
<th>Munich road site</th>
<th>Ko-PER intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Longitudinal error [m]</strong></td>
<td>$\mu = 0.10$ m</td>
<td>$\mu = 0.07$ m</td>
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Summary

- Vehicle self-localization approach based **only on Laserscanners** has been realized to provide a basis of safety applications in vehicles.

- Method is capable to provide very precise vehicle self-localization at intersections, rural road sites and highways with road track precision.

- Stand-alone system or add-on for already built-in environment perception systems
Vehicle self-localization using Laserscanners

Fahrzeug-Eigenlokalisierung mit Laserscannern

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Algorithm (EKF with known associations)

Initialising

GPS

Vehicle

Velocity, Yawrate

Position prediction

Prediction

Digital map

Landmarks

Landmark candidate extraction

Laserscanner

Scan

Distances, Angles

Association

Update

Position & Orientation

18.09.2013

Vehicle self-localisation using Laserscanners
Tests + Results (2)
Munich rural road site

Lateral position error [m]
\[ \mu = 0,23 \text{ m} \]
\[ \sigma = 0,28 \text{ m} \]

Longitudinal position error [m]
\[ \mu = 0,10 \text{ m} \]
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Orientation error [°]
\[ \mu = 0,58° \]
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Tests + Results (4)
Ko-PER Intersection Aschaffenburg

Lateral position error [m]
μ = 0.34 m
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μ = 0.15°
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