

Remote Sensing Technology Institute

# **SAR data based Landmark Navigation** for highly precise Vehicle Localization



David Richter<sup>1 2</sup>, Thomas Abmayr<sup>2</sup>, Hartmut Runge<sup>1</sup>

DLR German Aerospace Center, Remote Sensing Technology Institute, Germany (1)Munich University of Applied Sciences, Department of Geoinformatics, Germany (2)

### **Motivation**

- **GPS** not constantly reliable in **urban areas** (shading, disturbance, etc.)
- Static urban objects (streetlamps, traffic light posts) are detected in radar images and function as precise Landmarks in georeferenced map (Project "DriveMark<sup>®</sup>")
- Development of additional and redundant positioning solution related to GPS: Detection of Landmarks with low-cost LiDAR and estimation of ego position within precise map

# **High precision landmark map**

DriveMark<sup>®</sup> provides Ground Control Points (GCPs) via remote sensing data with an accuracy within the cm level

### **B** Particle filter-based Landmark-Navigation

- Probabilistic state estimation method
- Global localization (no initial position in known environment)



- Generated out of satellite **Synthetic Aperture Radar** (**SAR**) data by SAR Geodesy Processor
- GCPs are specific objects at the roadside (lamp poles, traffic lights, traffic signs)



TerraSAR-X image of test region

> Lamp post as Landmark (white point)

> > 14.23 m

# **O** Mobile experimental platform



### Landmark detection Low-cost LiDAR Sensor (Hokuyo UTM-30LX-

EW)

- Range and bearing measurement
- max range: 30 m
- Angular resolution: 0.25°
- FOV: 270°

#### **Position Validation**

#### **Differential GPS (DGPS)**

- Real Time Kinematic (RTK)
- Accuracy < 5 cm
- Attached to local coordinate system of LiDAR in position
- Position reference for Particle Filter





# **4** Results

- Improvement of **position accuracy** with regard to conventional GPS
- Vehicle **position accuracy** (on average):
  - Mean Coordinate deviation: 0.37 m
  - Standard deviation: 0.04 m





### Outlook

Testing with other sensors (vehicle radar, TOF-Camera) •

measurement:

Sensor fusion

Comparison of trajectories

#### Reference

H. Runge, U. Balss, S. Suchandt, R. Klarner, X. Cong: "DriveMark – Generation of High Resolution Road Maps with Radar Satellites", 11<sup>th</sup> ITS European Congress, Glasgow, Scotland, 2016; Paper number EU-TP0348 H. Runge, U. Balss, S. Suchandt: "Hochgenaue Erfassung der Autobahnen für das automatisierte Fahren, das Projekt DriveMark", Nationales Forum für Fernerkundung und Copernicus, Berlin, Germany, 2015

#### Contact

David Richter david.richter@dlr.de Tel. +498153 283043

