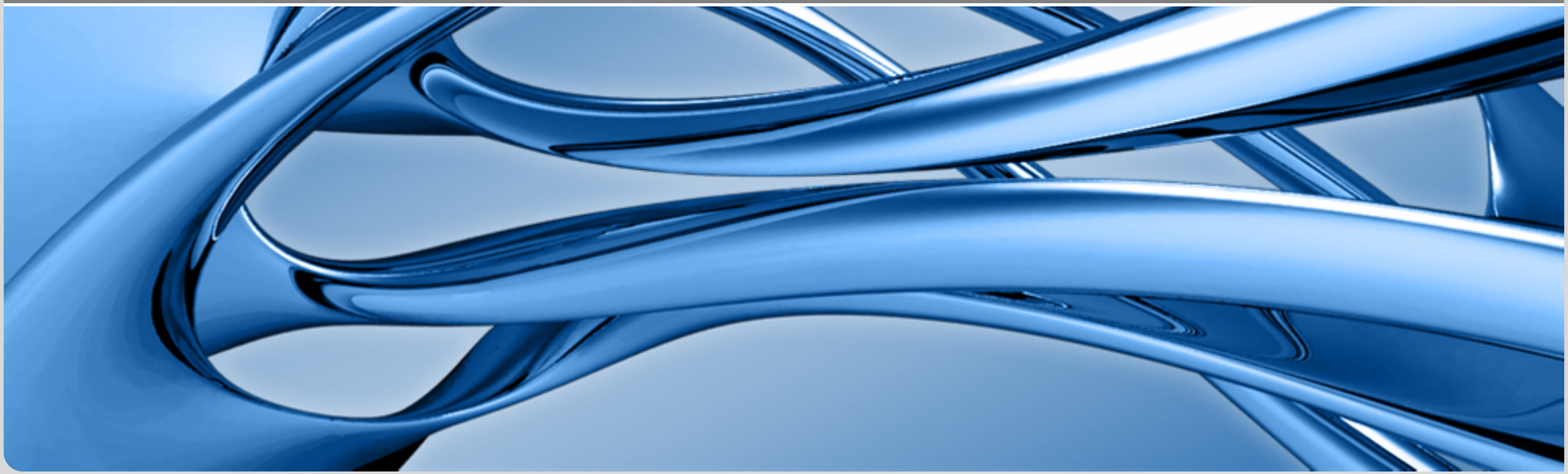
Karlsruhe Institute of Technology

Traffic Lane Detection in Urban Environments

Forschungszentrum Informatik (FZI)



KIT – University of the State of Baden-Wuerttemberg and
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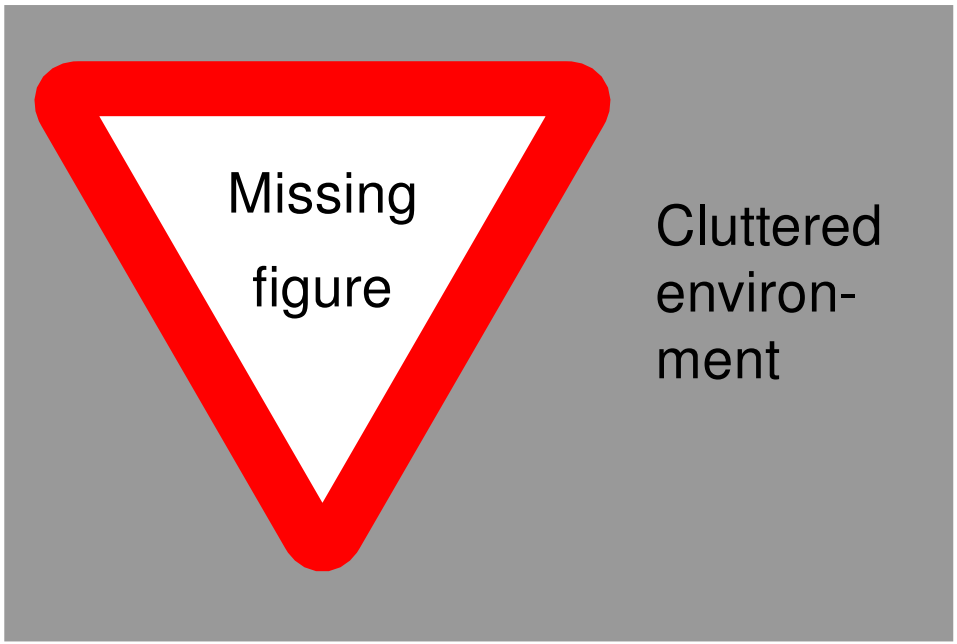
Why Urban?

- Cluttered scenery challenging detection
- Unmarked streets
- Street signs



Problems to be solved

- Object detection -
- Trajectory estimation -
- Traffic sign detection -
- Lane marking detection +
- Curb detection +
- ...

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Motivation

Lane and curb detection requirements

Lane marking detection approaches

Curb detection approaches

Conclusion

Bibliograpgy

Commonly used sensors

- 3D LADAR laser sensor
- Stereo camera
- Additional sensors for positioning and ego-motion estimation

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Improved RANSAC algorithm

- RANSAC - the most common used algorithm for lane marking detection
- Used features: edges detected by the Canny detection algorithm
- Modeling lane markings with generalized curves
- Thereafter iterative estimation of the parameters
- Advantage: The RANSAC algorithm can adapt to the complex conditions of lane estimation of model parameters and it does not need training process

$$x = \frac{a}{y - vp_y} + b(y - vp_y) + c \tag{1}$$

Improved RANSAC algorithm

TODO: ALGORITHM

Improved RANSAC algorithm

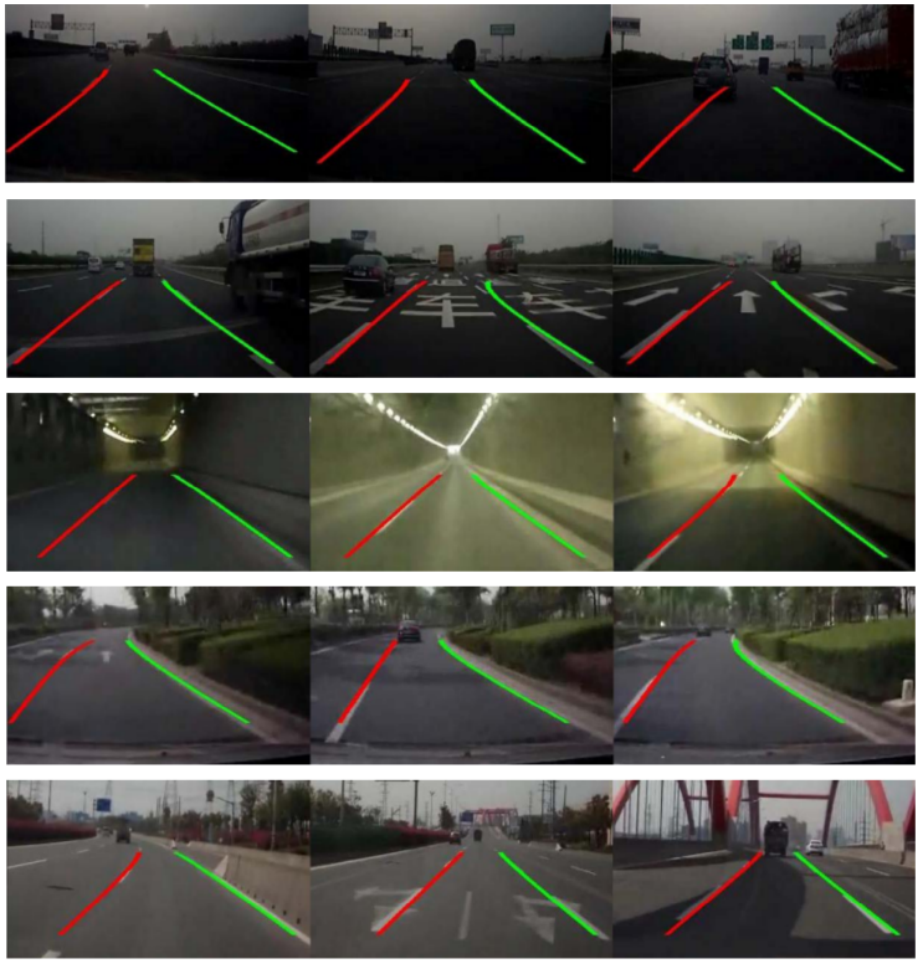

Figure: Good detection results

Improved RANSAC algorithm

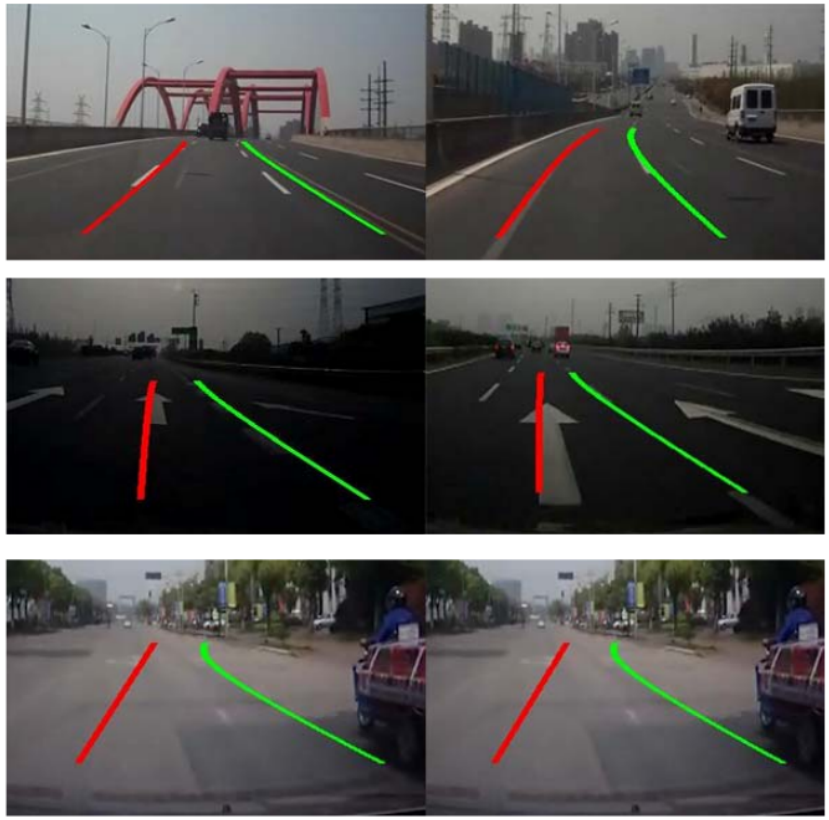

Figure: Bad detection results

Tree based graphical model for lane detection

- Goal: capture the way the joint distributions over random variables can be decomposed into a product of factors
- After the tree is generated, search tree with a search strategy
- Shortcoming: assume a flat road surface

Tree based graphical model for lane detection

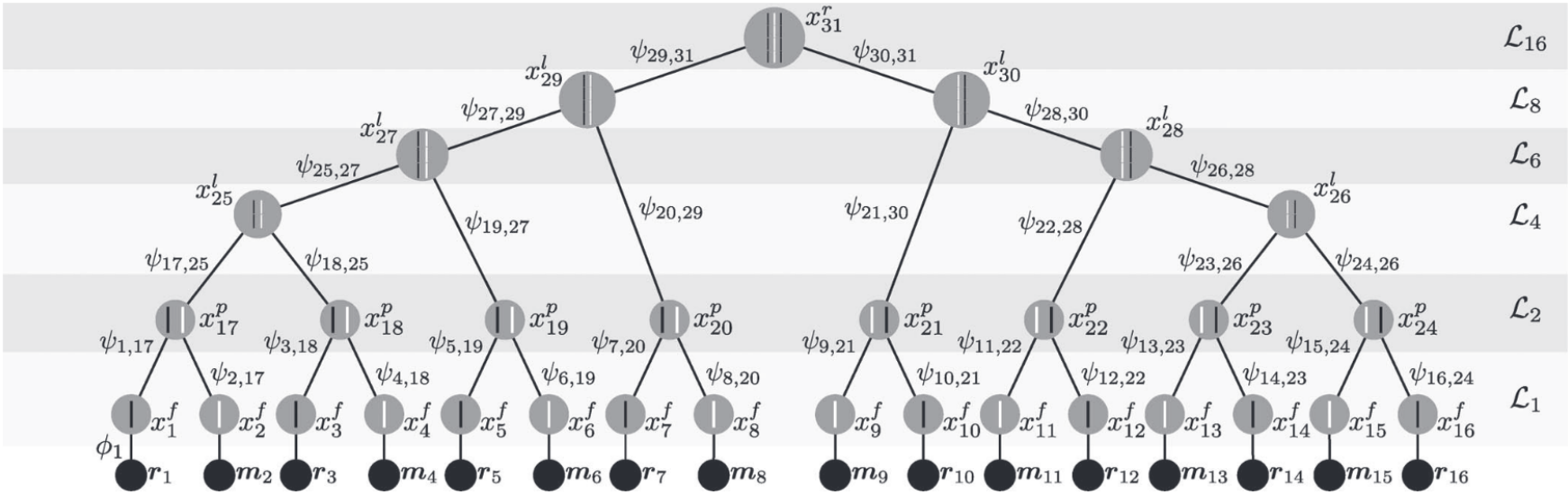

Figure: CHM of a two-lane road. This figure shows the factorization of the joint probability distribution in (2) using an undirected graphical model. Hidden random variables are depicted in gray and symbols illustrate their type, i.e., features, patches, lanes, and multilane roads. Observable variables are shown in blackand dependencies between random variables are highlighted using edges.

Tree based graphical model for lane detection

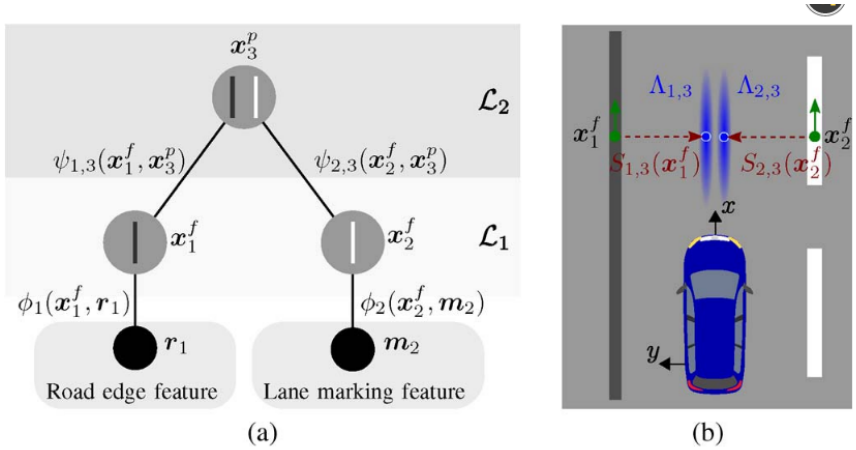

Figure: CHM of a patch and illustration of the modeled spatial constraints, two tree leaves make a patch. (a) Patch is decomposed into a left and a right lane boundary, which are directly observable. (b) Illustration of the modeled spatial constraints, where spatial uncertainties are illustrated by showing 2-D Gaussian distributions, where dark colors correspond to more likely locations.

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Elevation mapping techniques with stereo camera

- Based on elevation maps

1. Generate point cloud from stereo camera
2. Transform the point cloud from the sensor coordinate system to the map coordinate system

Different mapping techniques

Laserscanner based road curb detection

Laserscanner based road curb detection

Conclusion

Bibliography