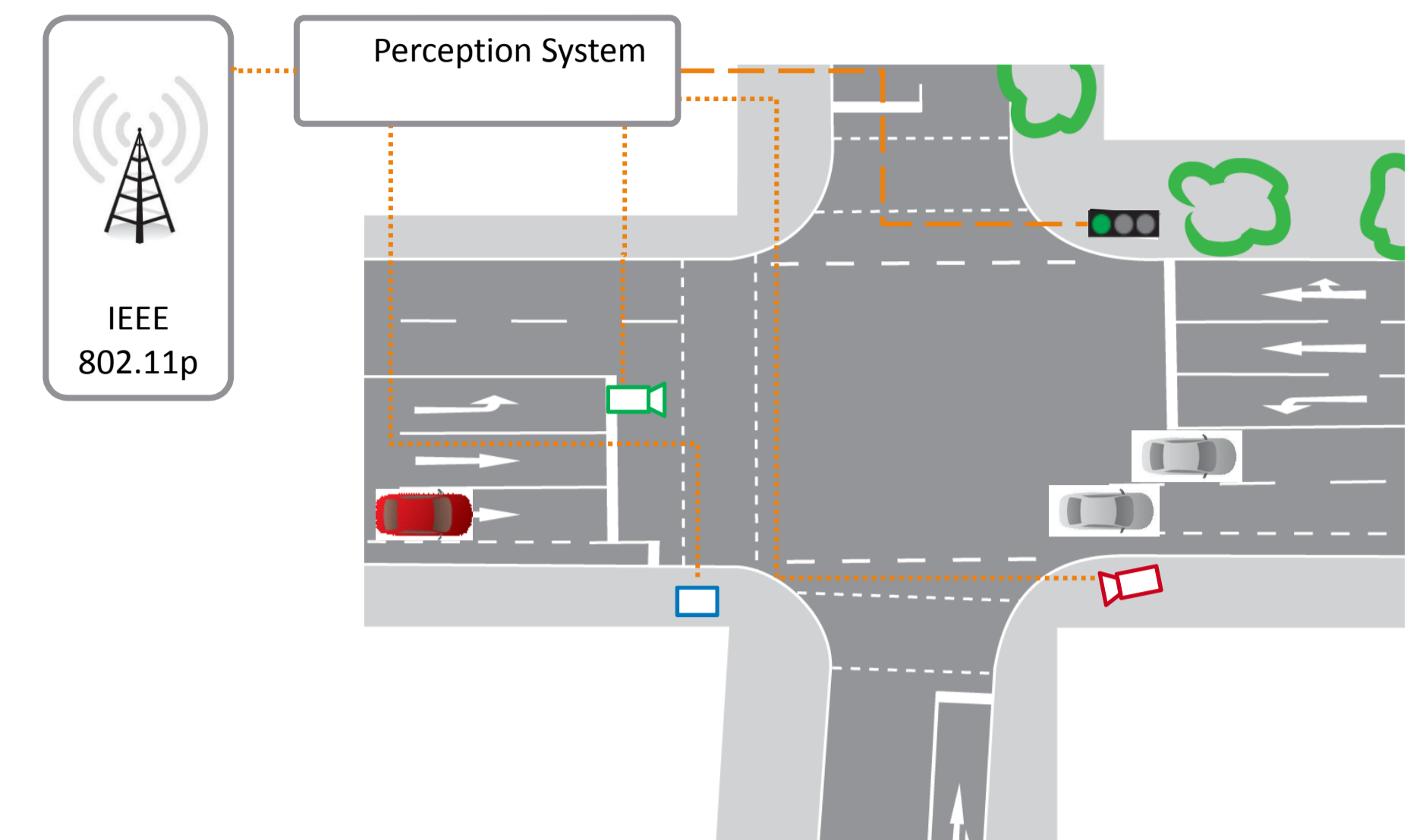


# Laser- and Video-Based Detection of Road Users at Intersections

## Motivation

For advanced driver assistance systems a reliable object recognition is required. Therefore the intersection has been equipped with a complementary sensor setup.



## The Algorithm

**LS** Laserscanners

- + detection of surrounding with depth
- + illumination independent
- low resolution in far regions
- no texture information

**SK** Monochrome Cameras

- + good resolution in application area
- + provides texture information
- dependent on illumination
- no depth information

**Background Subtraction**

- Gaussian-Mixture Model for every laser beam
- Adaption of model to background changes
- Robust against moving background objects

**Vehicle Detection**

Detection by classification

Boosted Cascade

ROIs → Stage 1 → Stage 2 → ... → Stage M → Non-objects

**DBSCAN Clustering**

Measurements with a minimum number  $C_{min}$  of other measurements within an area  $\epsilon$  are clustered.

- Knowledge on no. of clusters not required
- Search area can have an arbitrary shape
- Outlier detection

**Classification**

$$p(c_j|M)^{(i)} = \frac{p(c_j) \prod_{k=1}^K p(m_k|c_j)^{(i)}}{\sum_{j=1}^{N_C} \left( p(c_j) \prod_{k=1}^K p(m_k|c_j)^{(i)} \right)}$$

- Bayes classifier
- Distinguish cars, pedestrians, bicycles and trucks
- Static features of point clouds

**Transformations from Image to World**

Video detector → Ground plane measurement

- Image detections are transformed to world coordinate system
- Transformation is based on the assumption of a flat world

**Laser Detections**

**Video Detections**