

# Safe and Dynamic Driving towards Vision Zero

**SensePlanAct**

Chassis & Safety

**Continental** 



## Senses for Safety.

Driver assistance systems help save lives.

## MathWorks Automotive Conference 2015

Verkehrsszeichenerkennung in Fahrerassistenzsystemen  
– MATLAB @ Continental –



# Continental Corporation

## Five Strong Divisions

### Chassis & Safety

Vehicle Dynamics

Hydraulic  
Brake Systems

Passive Safety &  
Sensorics

Advanced Driver Assistance  
Systems (ADAS)

### Powertrain

Engine Systems

Transmission

Hybrid Electric  
Vehicle

Sensors &  
Actuators

Fuel &  
Exhaust Management

### Interior

Instrumentation &  
Driver HMI

Infotainment &  
Connectivity

Intelligent Transportation  
Systems

Body & Security

Commercial Vehicles &  
Aftermarket

### Tires

PLT,  
Original Equipment

PLT, Repl. Business,  
EMEA

PLT, Repl. Business,  
The Americas

PLT, Repl. Business,  
APAC

Commercial  
Vehicle Tires

Two Wheel Tires

### ContiTech

Air Spring Systems

Benecke-Kaliko  
Group

Compounding  
Technology

Conveyor Belt  
Group

Elastomer Coatings

Fluid Technology

Power Transmission  
Group

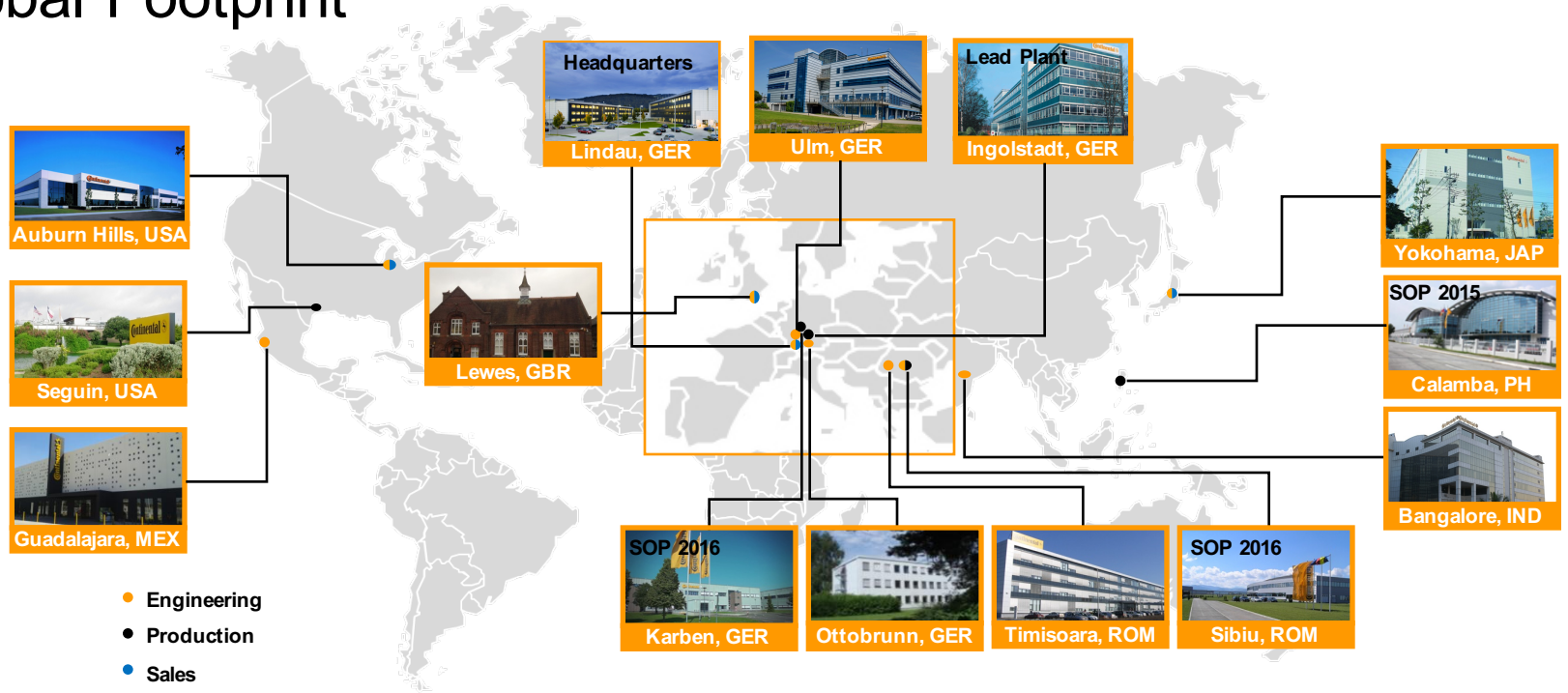
Vibration Control

PLT – Passenger and Light Truck Tires



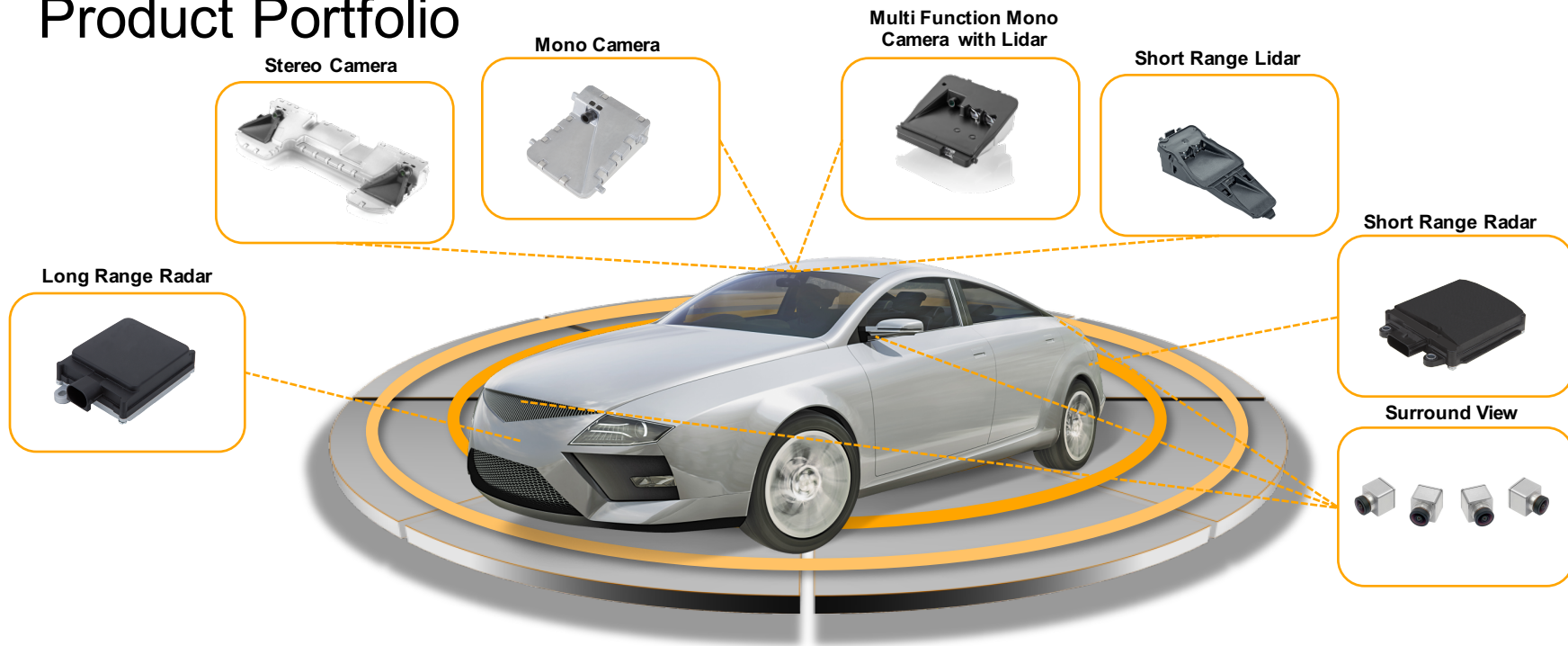
# ADAS Business Unit

## Global Footprint





# ADAS Product Portfolio



# ADAS Functions

## Overview & Motivation



Traffic Sign Assist



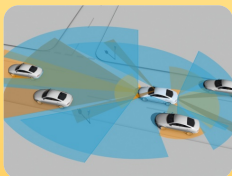
Emergency Brake Assist



Lane Departure Warning



Adaptive Cruise Control



Surround View



Blind Spot Detection



Intelligent Headlamp Control

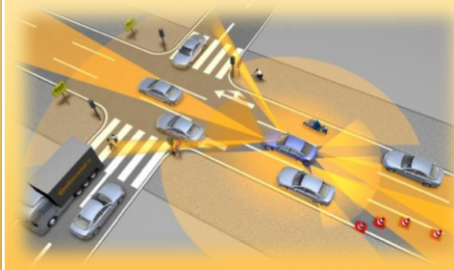


Rear Cross Traffic Alert

**“95% of all road accidents involve some human error, in 76% of the cases the human is solely to blame”**

**European Commission\***

**Increase safety & comfort is our mission!**

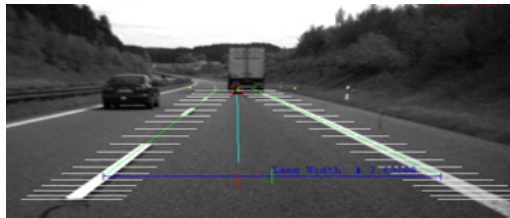


\* Directorate General Information Society and Media, Informal document No.: ITS-13-07

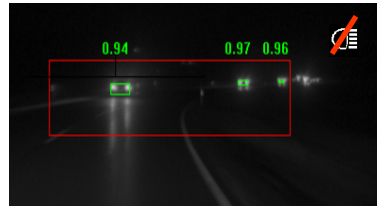


# Multi Function Mono Camera

One Camera for Multiple Functions



Lane Recognition



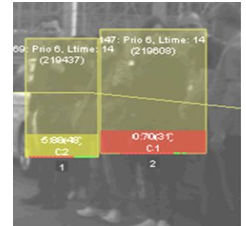
Light Sensing



Traffic Sign Recognition



Vehicle Detection



Pedestrian Detection

# Challenges – Getting confused?





# Challenges – Sign Set

## › Recognized sign types with and without navigation input (with examples)

### › Speed limits



### › No-passing



### › Directional / No Entry



### › Stop / Yield



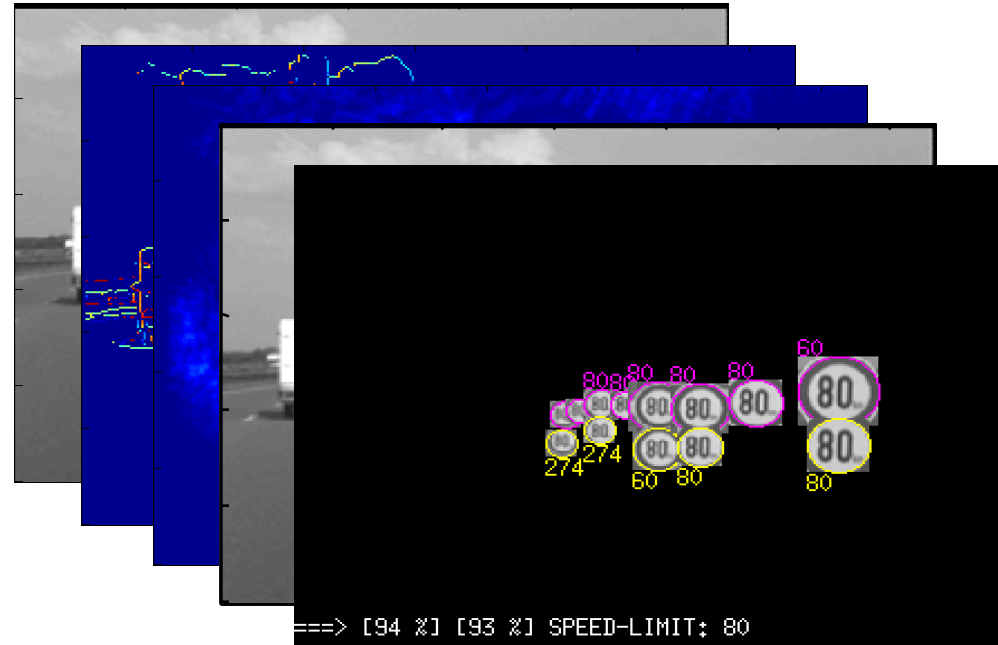
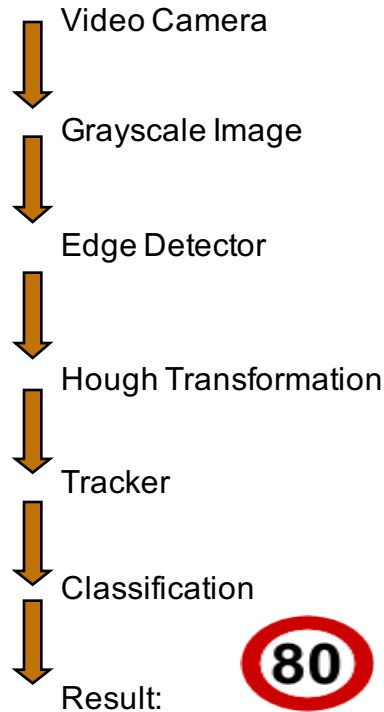
### › Implicit



### › Supplementary



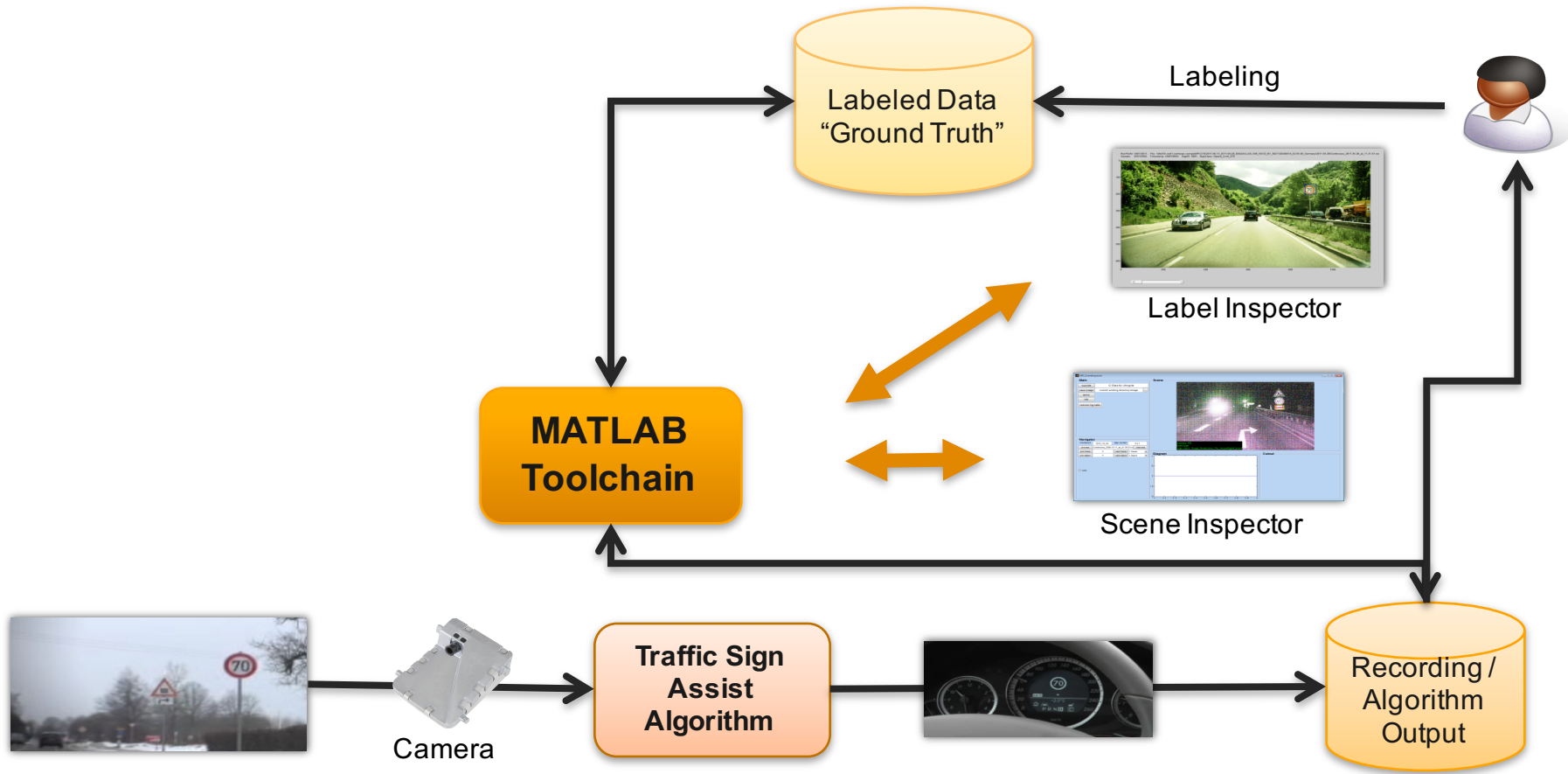
# Circular Sign Recognition Algorithm



# MATLAB Tooling

## Example: Traffic Sign Recognition - Classifier Training

- › MATLAB Tools are developed and used for
  - › Development / training, analysis, review, evaluation
  - › Interaction with different databases
- › Advantages
  - › Easy and fast pre-development
  - › Evaluation and generation of key performance indicators
  - › GUI and user friendly interfaces
- › Example: Classifier Training
  - › Training of classifiers for Traffic Sign Recognition is data driven
  - › Automated training
  - › Handling of large databases
  - › Evaluation and analysis





# Scene Inspector

The screenshot displays the SRG\_SceneInspector application interface. The main window is titled "SRG\_SceneInspector" and contains several panels:

- Main:** Contains buttons for "make query", "save image" (with a file path "D:\projects\SR\_SignRecognition\_..."), and "dump to console".
- Navigator:** Includes dropdown menus for "checkpoint" (2013\_11\_29) and "algo version" (10.7.2). Below these are fields for "Continuous\_2011.10.23\_at\_15.12.05.rec" and "1052745144". There are also buttons for "pre seq", "next seq", "pre object", "next object", "pre frame", and "next frame" with associated numerical values.
- Scene:** The central area shows a highway scene with a white bus on the left and several cars in the distance. Two speed limit signs (110) are visible on the right side of the road. A small text box in the bottom-left corner of the scene area displays metadata: "country: PL", "road type: Motorway", "sign class: Speed\_Limit\_110", "sign id: 16", "partly: false", "invisible: None". A "decision: HACK\_ome\_loss" is shown in the bottom-right corner.
- Statistic:** A panel below the scene area, currently empty.
- Cutout:** A panel on the right side showing a grid of 20 circular cutouts of the speed limit sign. The cutouts are arranged in two rows of ten. The third cutout in both rows is highlighted with a red border.
- Eval:** Contains buttons for "load evaluation", "show selected", "new RLT entry" (with a dropdown menu "select request issues ..."), "reopen RLT entry", and "approve RLT entry".

The status bar at the bottom left of the application window displays "Ready".

# Scene Inspector



Cutout

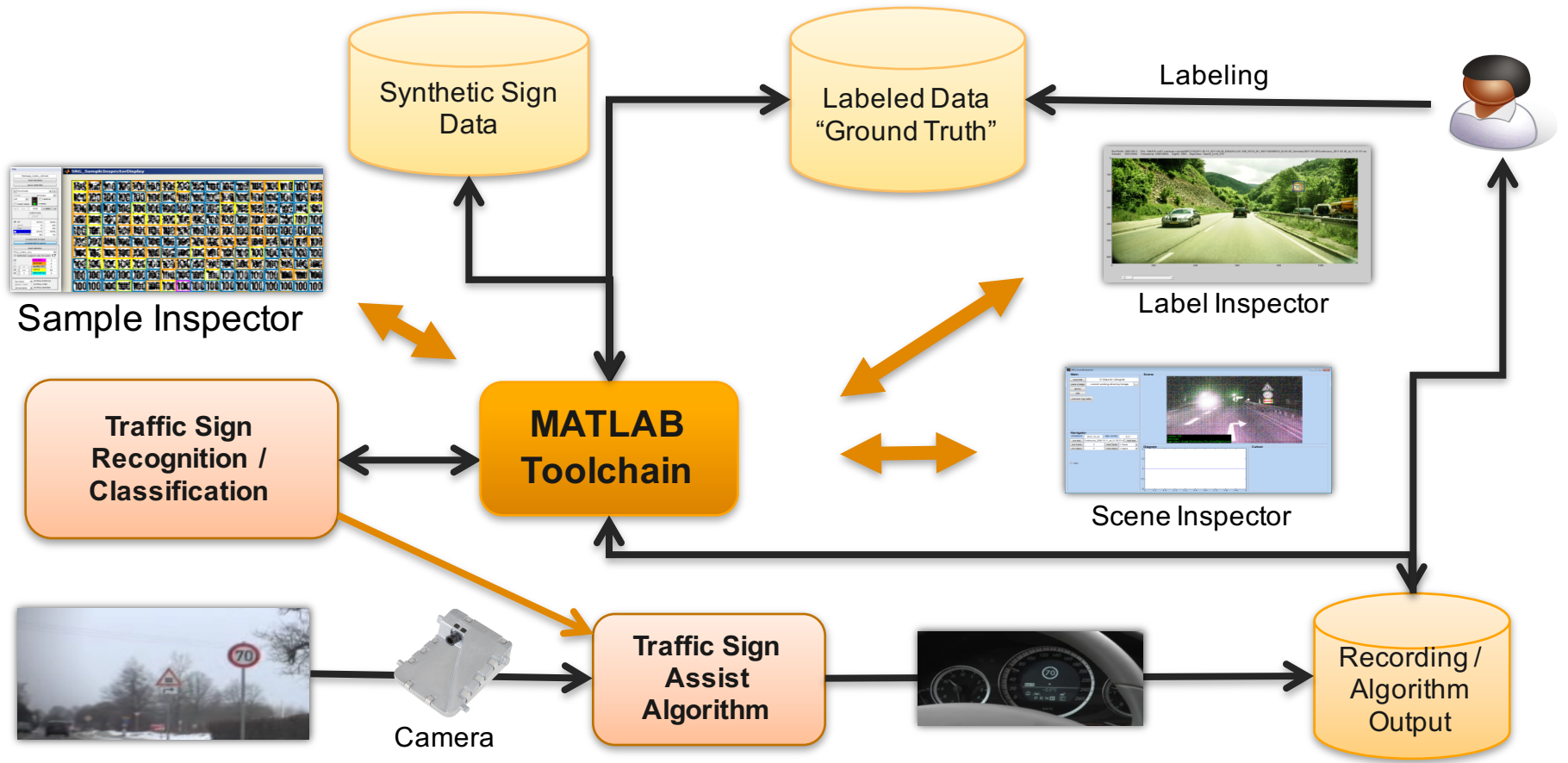
show cutout



Cutout

show cutout

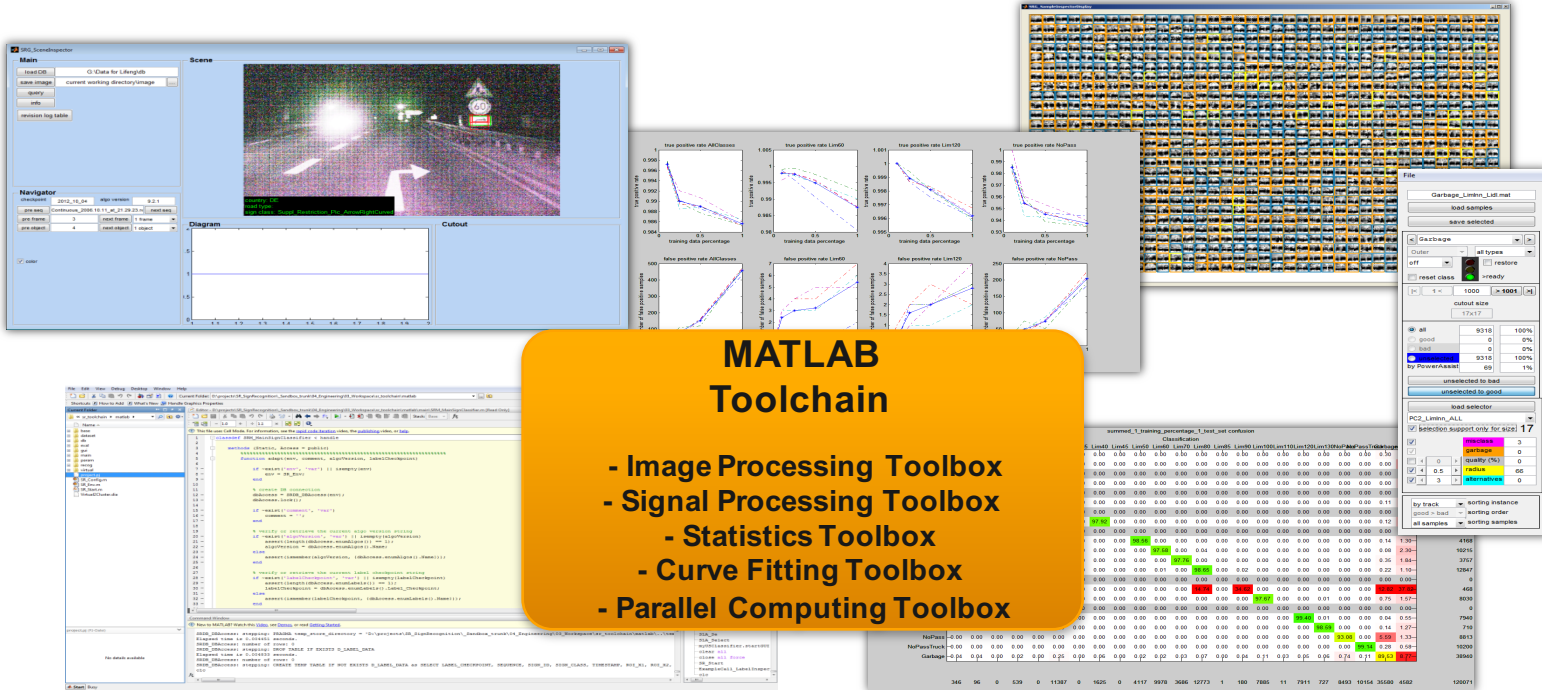








# Evaluation



**MATLAB Toolchain**

- Image Processing Toolbox
- Signal Processing Toolbox
- Statistics Toolbox
- Curve Fitting Toolbox
- Parallel Computing Toolbox

# Summary

- › MATLAB is used in daily work for development and evaluation of driver assistance functions
- › Prototypes are designed with MATLAB for predevelopment and proof of concept
- › Data management, evaluation, and interactive analysis are supported by MATLAB tools and GUIs
- › Traffic Sign Recognition and other functions make high use of MATLAB tools
- › MATLAB and its established features
  - › reduces our tool development efforts,
  - › accelerates our simulation cost,
  - › and allows reliable, repeatable and accurate parameter optimizations

**Thank you**  
for your attention!

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