Safe and Dynamic Driving

towards Vision Zero

SensePlanAct
Chassis & Safety

Continental

Continental
The Future in Motion

Senses for Safety.

Driver assistance systems help save lives.

MathWorks Automotive Conference 2015

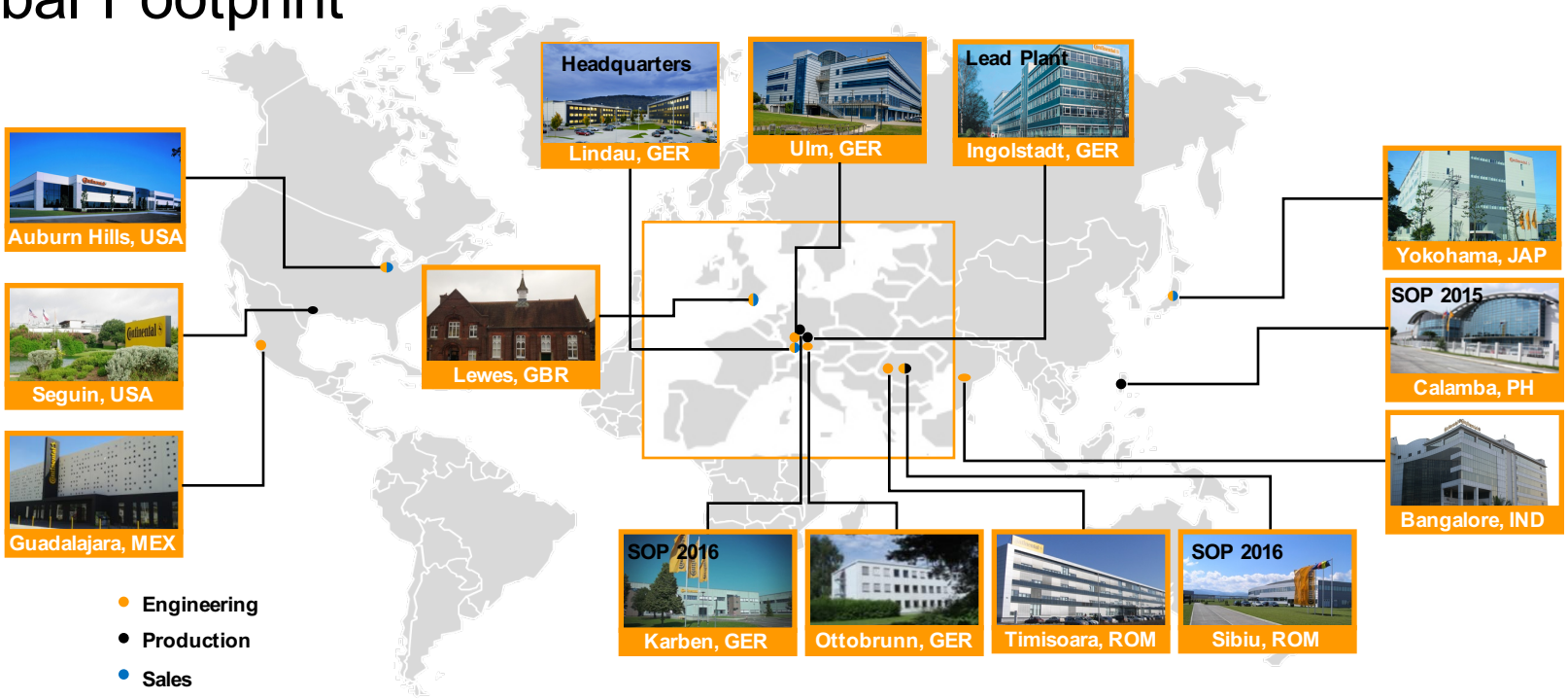
Verkehrszeichenerkennung in Fahrerassistenzsystemen
– MATLAB @ Continental –

Continental Corporation
Five Strong Divisions

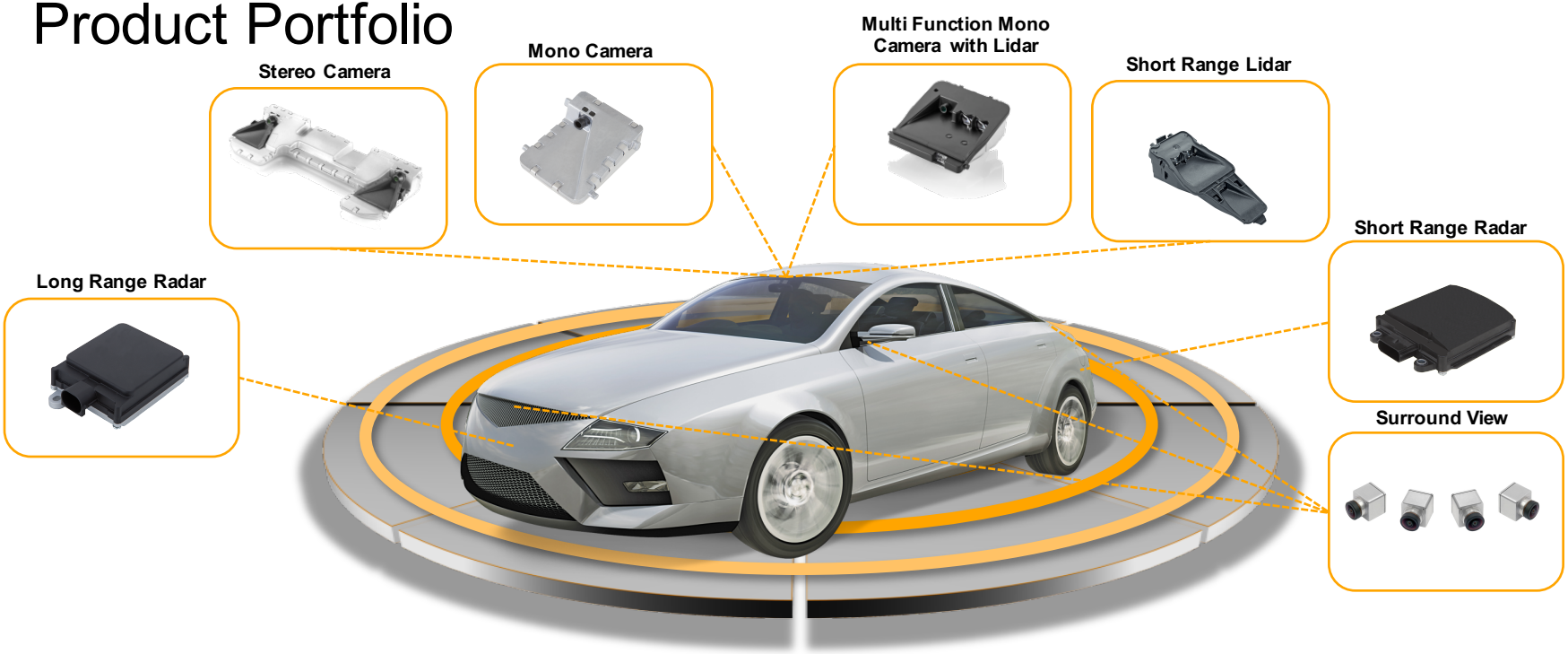
Chassis & Safety	Powertrain	Interior	Tires	ContiTech
Vehicle Dynamics	Engine Systems	Instrumentation & Driver HMI	PLT, Original Equipment	Air Spring Systems
Hydraulic Brake Systems	Transmission	Infotainment & Connectivity	PLT, Repl. Business, EMEA	Benecke-Kaliko Group
Passive Safety & Sensorics	Hybrid Electric Vehicle	Intelligent Transportation Systems	PLT, Repl. Business, The Americas	Compounding Technology
Advanced Driver Assistance Systems (ADAS)	Sensors & Actuators	Body & Security	PLT, Repl. Business, APAC	Conveyor Belt Group
	Fuel & Exhaust Management	Commercial Vehicles & Aftermarket	Commercial Vehicle Tires	Elastomer Coatings
			Two Wheel Tires	Fluid Technology
				Power Transmission Group
				Vibration Control

PLT – Passenger and Light Truck Tires

ADAS Business Unit
Global Footprint



ADAS
Product Portfolio



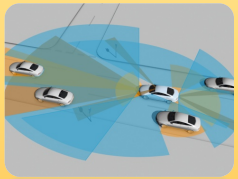
ADAS Functions
Overview & Motivation


Traffic Sign Assist

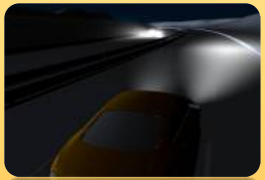

Emergency Brake Assist


Lane Departure Warning


Adaptive Cruise Control


Surround View


Blind Spot Detection

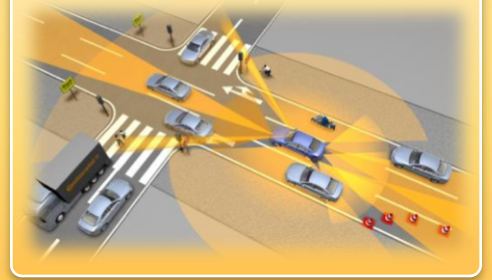

Intelligent Headlamp Control


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!

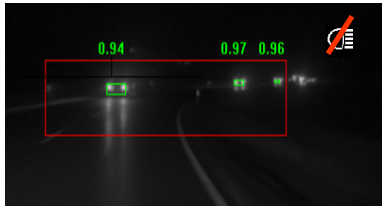


* Directorate General Information Society and Media, Informal document No.: ITS-13-07

Multi Function Mono Camera

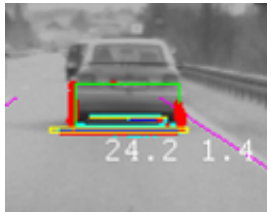
One Camera for Multiple Functions

Lane Recognition

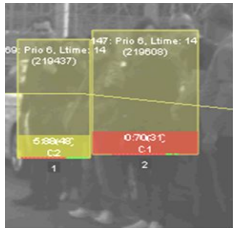


Light Sensing

Traffic Sign Recognition



Vehicle Detection



Pedestrian Detection

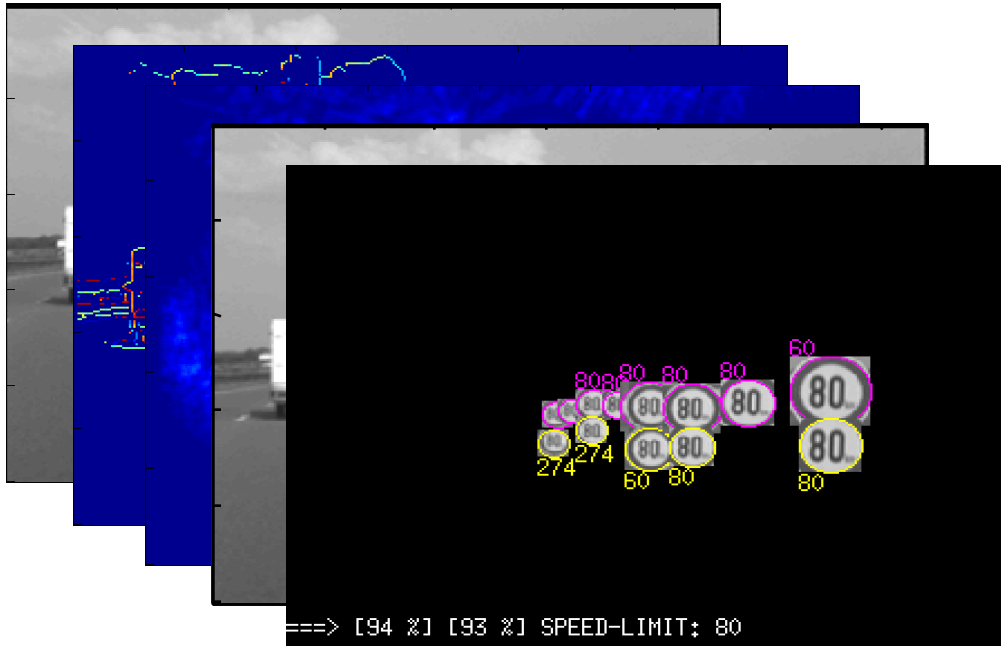
Challenges – Getting confused?

Challenges – Sign Set

- Recognized sign types with and without navigation input (with examples)
  - Speed limits
  - No-passing
  - Directional / No Entry
  - Stop / Yield
  - Implicit
  - Supplementary

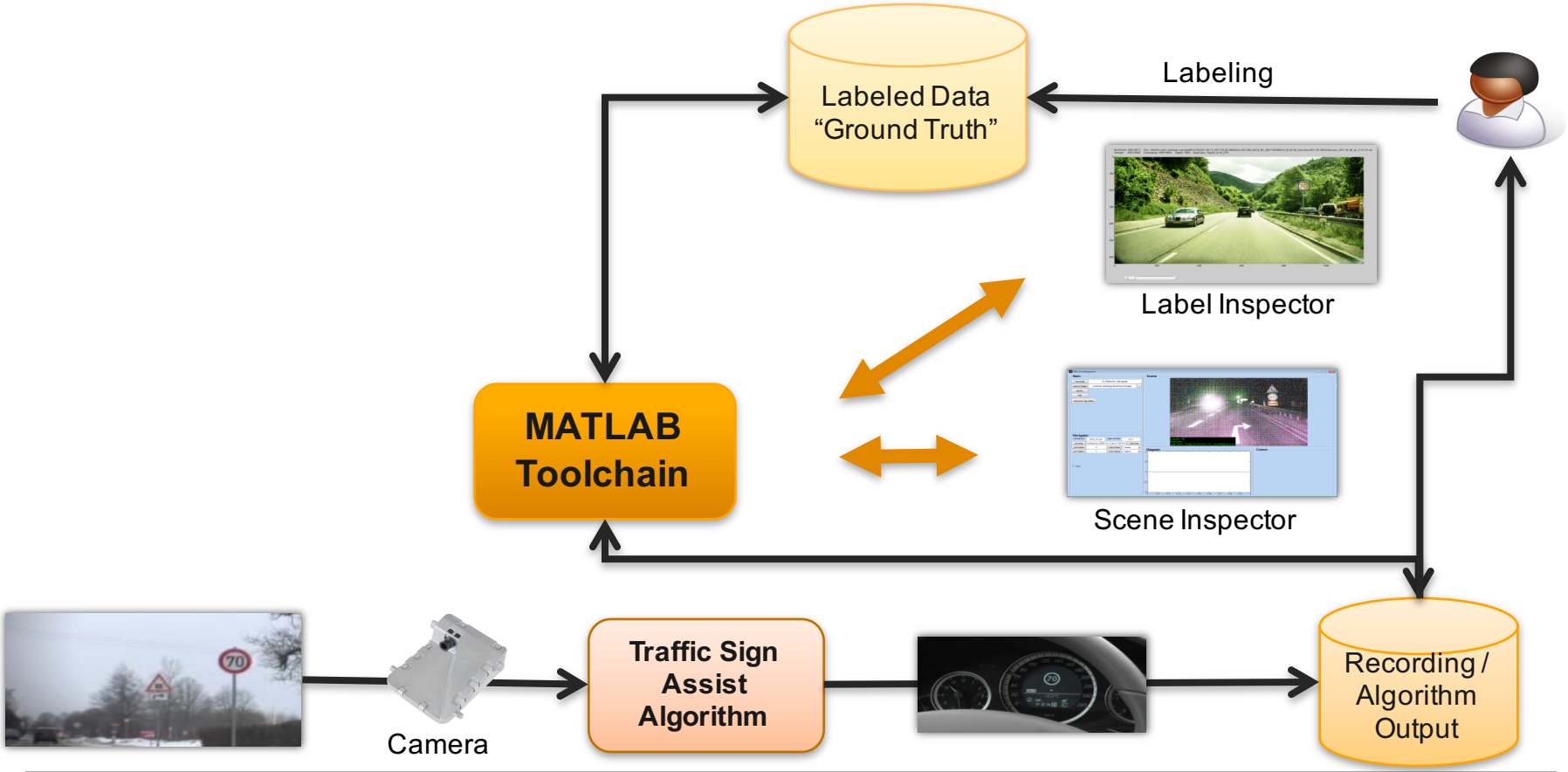
Circular Sign Recognition Algorithm

- Video Camera
- Grayscale Image
- Edge Detector
- Hough Transformation
- Tracker
- Classification
- Result:

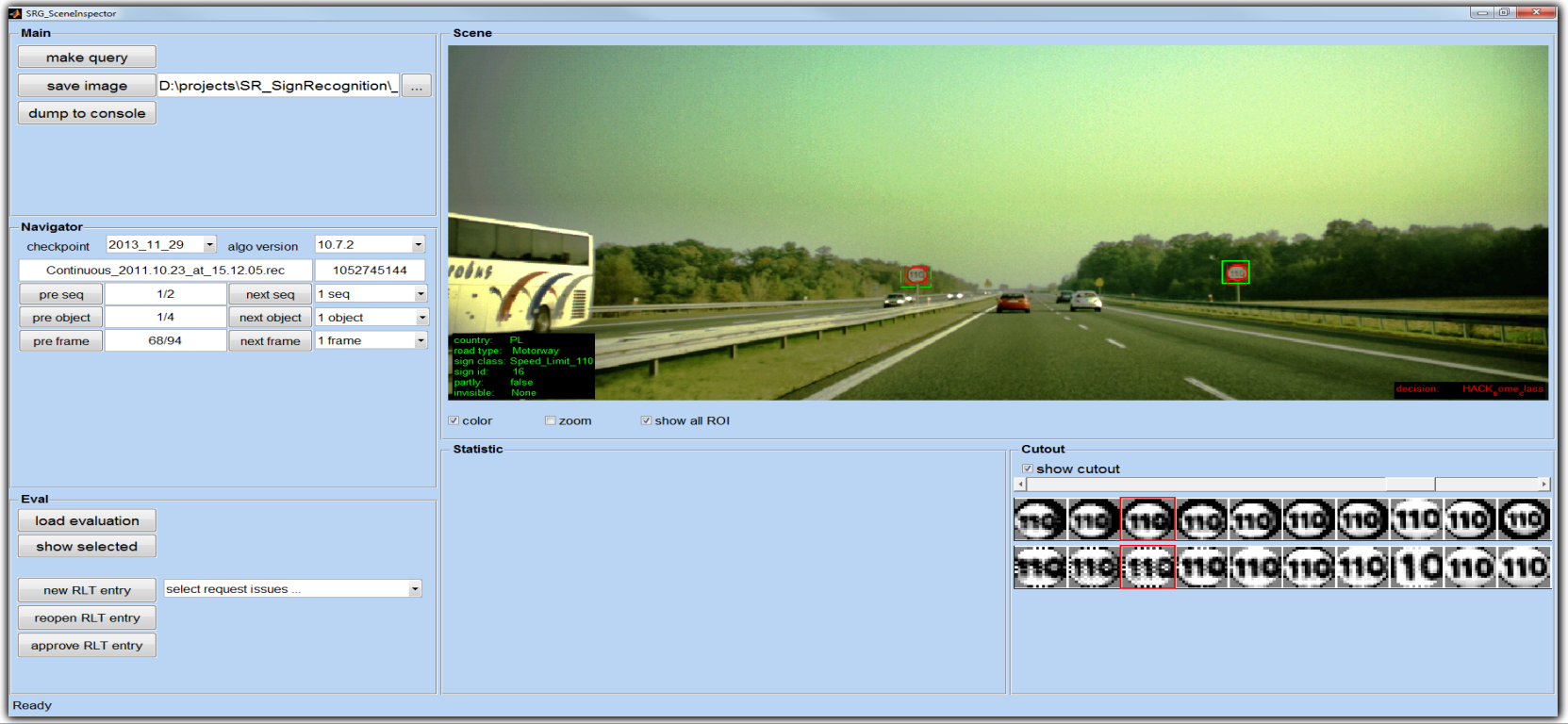


MATLAB Tooling
Example: Traffic Sign Recognition - Classifier Training

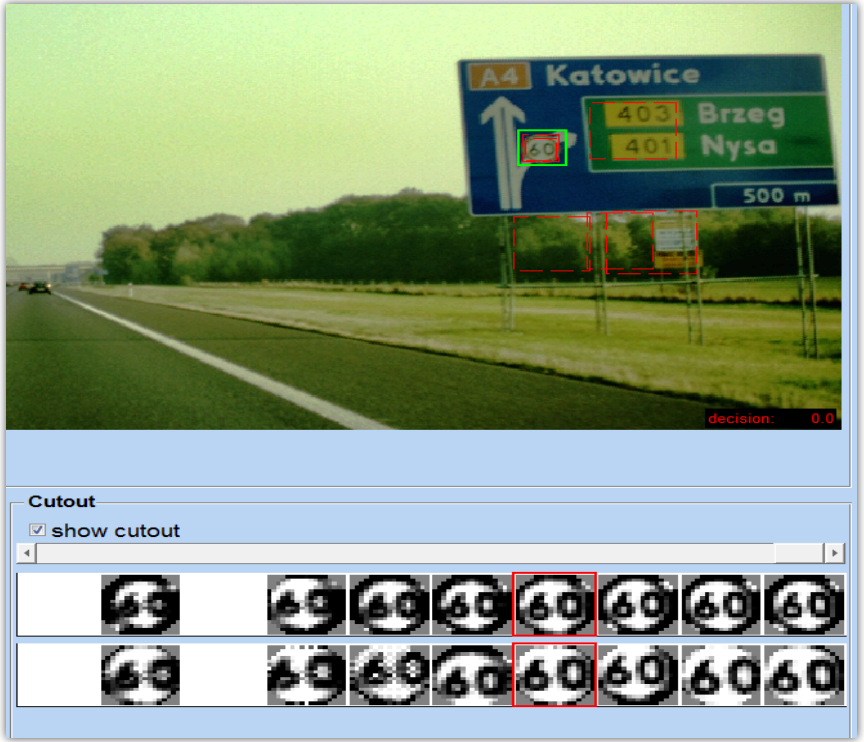
- MATLAB Tools are developed and used for
  - Development / training, analysis, review, evaluation
  - Interaction with different databases
- Advantages
  - Easy and fast pre-development
  - Evaluation and generation of key performance indicators
  - GUI and user friendly interfaces
- Example: Classifier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

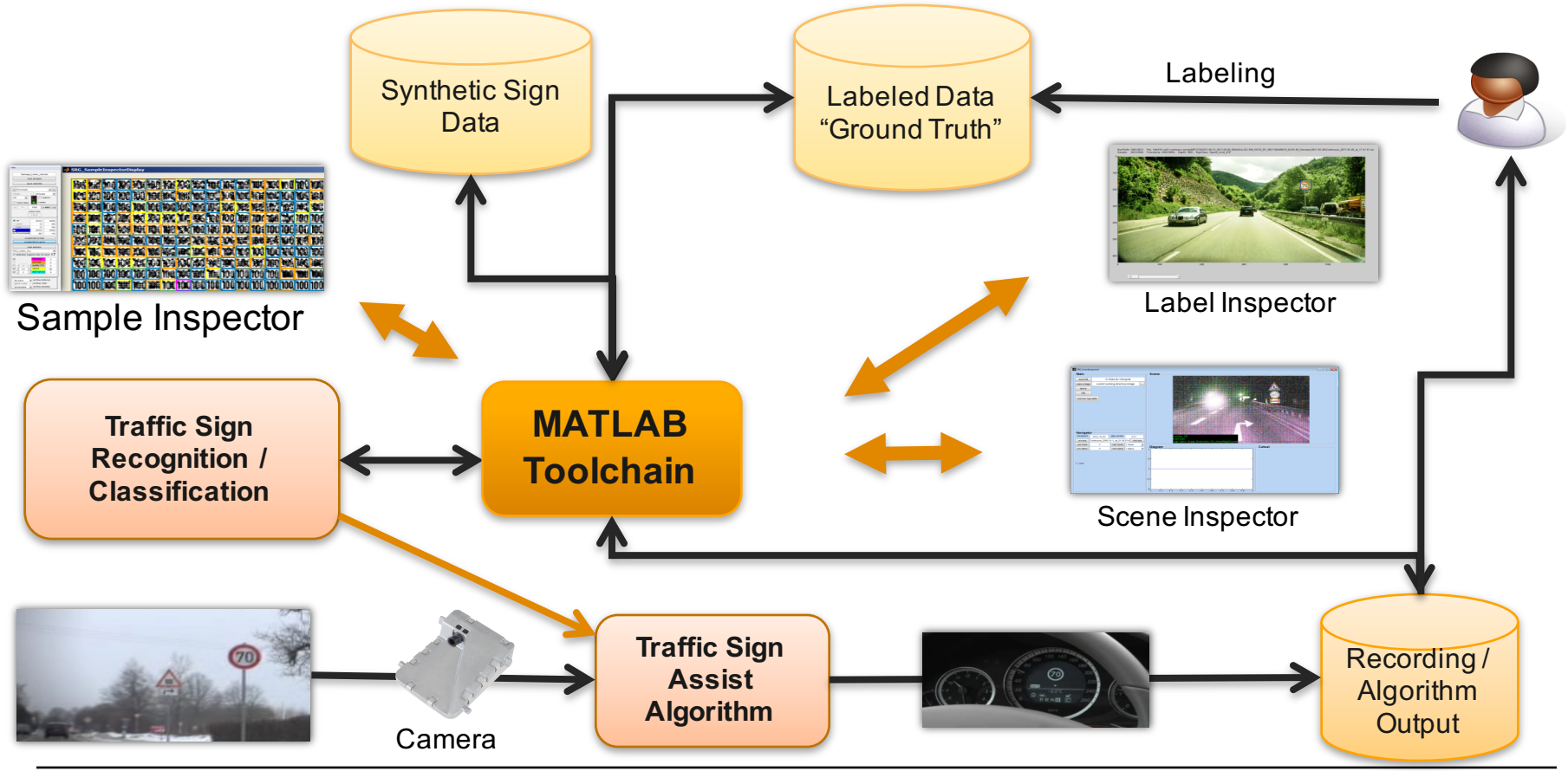

Labeled Data
“Ground Truth”
Labeling
Label Inspector
MATLAB
Toolchain
Scene Inspector
Camera
Traffic Sign
Assist
Algorithm
Recording /
Algorithm
Output

Scene Inspector

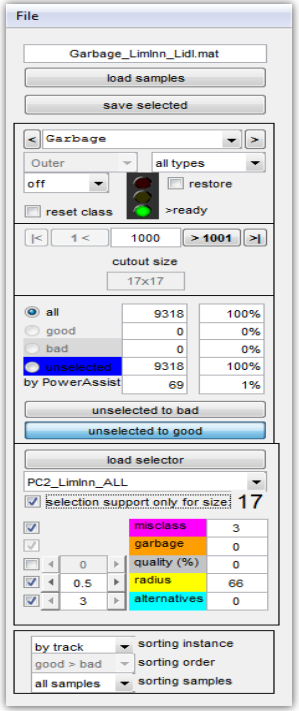


Scene Inspector

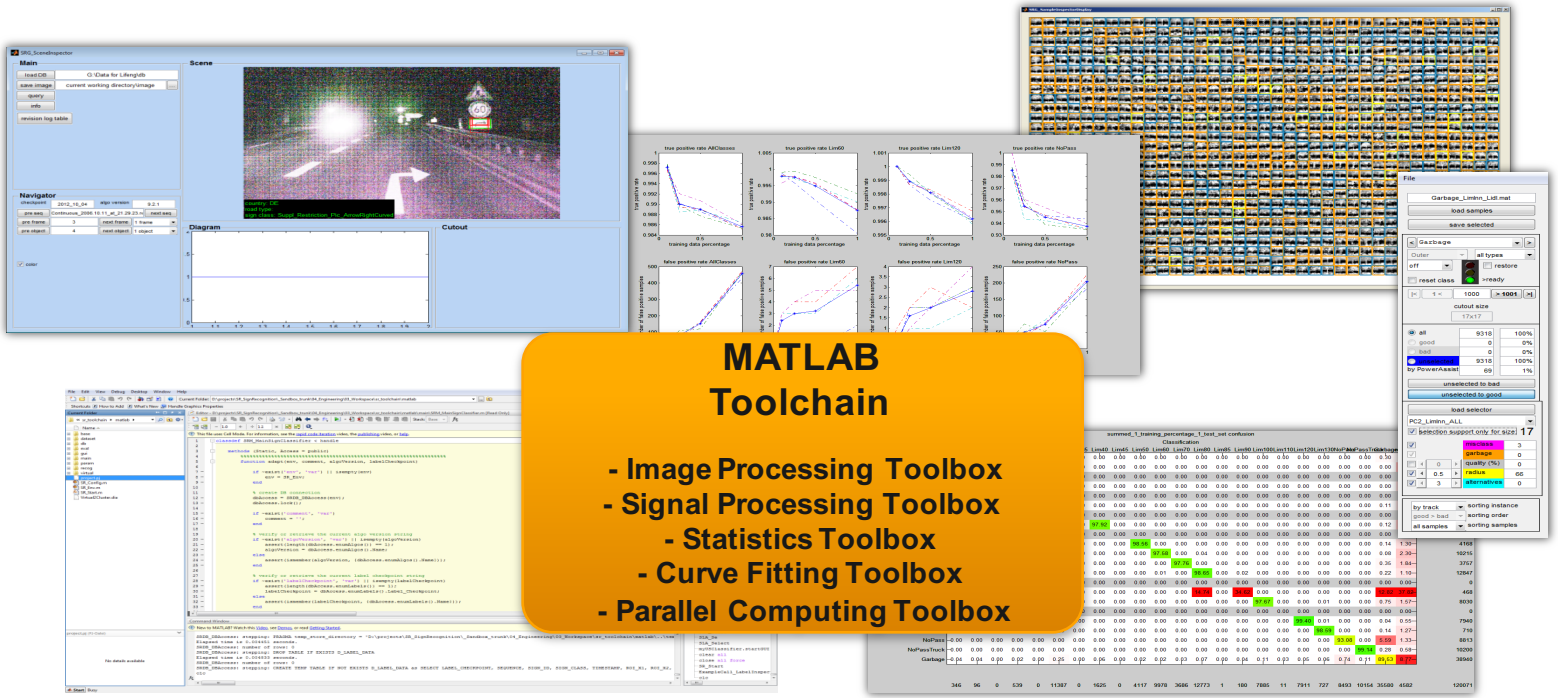



Synthetic Sign Data
Labeled Data "Ground Truth"
Labeling
Sample Inspector
Label Inspector
Traffic Sign Recognition / Classification
MATLAB Toolchain
Scene Inspector
Camera
Traffic Sign Assist Algorithm
Recording / Algorithm Output

Sample Inspector



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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towards Vision Zero

SensePlanAct
Chassis & Safety

Continental