Vision Based LABCAR Testing
Camera Based Testing of HMI
Vision Based LABCAR Testing
A Global and Growing Company

Our motivation
Driving embedded excellence

Our mission
With our solutions and services we increase the quality and efficiency for the development and maintenance of embedded systems

Our roots
Engineering Tools and Application Services
Vision Based LABCAR Testing
A Global and Growing Company

Leading Provider of Solutions and Services for Embedded Systems

- ETAS with over 850 associates is part of the Bosch Group
- Revenue: 149 million EUR in 2013
- ETAS subsidiary ESCRYPT is a specialist for embedded systems security

ETAS Customers and Domains

Trusted by OEMs, tier one and ECU suppliers, as well as engineering service providers:

- Commercial Vehicles
  - Automotive
  - Heavy Duty Engines
  - Railway
  - Construction Machines
  - Consumer Electronics
  - Off-Highway

ESCRYPT Customers and Domains

The ESCRYPT customer base includes:

- Automotive
- Mobile Machines & Transportation
- Energy
- Consumer Electronics
- Industrial Automation
- Financial & Government Logistics
- Mobile Devices
- Health Care
Truly International – ETAS is present in 13 countries

Germany Headquarters)
Stuttgart

USA
Ann Arbor

Brazil
São Paulo

France
Saint-Ouen

Italy
Turin

Sweden
Göteborg

United Kingdom
Derby
York

Russian Federation
Moscow
Togliatti

P.R. China
Beijing
Changchun
Chongqing
Guangzhou
Shanghai
Wuhan

India
Bangalore
Pune

Japan
Nagoya
Utsunomiya
Yokohama

Korea
Seoul
Thailand

Bangkok

Headquarters of the region
# ETAS Portfolio

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<tr>
<th>Software Engineering</th>
<th>Test and Validation</th>
<th>Measurement, Calibration, Diagnostic</th>
<th>Embedded Security</th>
<th>Real Time Application</th>
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**ETAS Product**

**Consulting with Engineering Services**

**Virtualization Technology**
Vision Based LABCAR Testing
ETAS Products within the V-Model

EHOOKS
ASCET-SE
Virtual Validation Platform
ISOLAR CODER
RTA-OS, -RTE, COMASO

INCA FLOW
INCA
ASCMO

LABCAR HiL
Integration

Software Integration
Vision Based LABCAR Testing
LABCAR HiL within the V-Model
# Vision Based LABCAR Testing

## Agenda

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Growing Complexity in HMI

- Instantaneous data on HMI difficult to verify manually
- Multiple screen and options in HMI make it difficult to verify manually
- High number of variants: time consuming to do manually
- Tedious to do manually testing
## Vision Based LABCAR Testing

### Agenda

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Components for Vision Based Testing

Main Hardware Components: | Main Software Components:
---|---
Desk LABCAR | LABCAR Operator
Camera (3rd Party) | LABCAR Automation
Camera SW | Camera Software (integrated in LABCAR Software environment)

LCO & LCA
## Vision Based LABCAR Testing

### Agenda

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Vision Based LABCAR Testing
Sequence of Events and Benefits of Vision Based System

Steps Involved in Automated Vision Based Testing

1. Camera(s) System
   - Camera configured for image capture (explained in next slides)

2. Communication
   - Power/IO

3. Triger
   - Result from Camera

4. LABCAR
   - Classifies as Pass/Fail

5. LABCAR
   - Classifies as Pass/Fail

6. Camera SW
   - Save captured images in test report

- Real time simulation and capture - accurate results
- Capture results not possible by manual testing (instantaneous speed, color intensity)
- Automated:
  - Low errors
  - Time saving
  - Repeatable
- All scenarios generation:
  LABCAR powerful architecture simulates all inputs for HMI testing
## Agenda

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Smart Vision Camera

- Camera chosen based on vision basics (Resolution, Focal Length, Distance to Object, Lighting of Unit Under Test etc.)

- **Smart camera** with ready to use post processing vision tools such as:
  - Pattern match
  - Color
  - Edge
  - OCR / OCV

- Includes easy to use software to define the different jobs for testing
Configuring the Camera

1. Identify the regions of interest (LED’s, Gauges, Text etc.) in the Unit under test (can also be trained with images available during design/prototype stage)

2. Select the correct post processing vision tool for the different regions of interest (for example: Text on HMI -> OCR/OCV tool, Color of LED -> Color vision tool)

3. When camera is triggered, the camera returns the results for the defined jobs
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Vision Based LABCAR Testing
Main Components: Desk LABCAR

Desk LABCAR

- LABCAR to simulate Inputs and Communication signals required for unit under test
- Can generate any type of signal required: PWM, Digital, Analogue, CAN

Compact size

Open and scalable architecture

Excellent price performance ratio

Reliable, proven technology
### Components of Desk LABCAR

**RTPC**  
- Linux-based high-performance simulation target running with a cycle time of 200ms  
- Outstanding investment protection and an excellent price/performance ratio

**Hardware (Signal I/O)**  
- PCI Express interface  
- High precision and software controlled signal simulation  
- 40 channels multi I/O: analog outputs (8 channels), digital outputs (8 channels), analog inputs (4 channels), digital inputs (20 channels)

**ETAS LABCAR-OPERATOR**: Experiment Software  
- System stimulation  
- Signal measurement and logging  
- Requires separate Windows PC (not part of package)
# Vision Based LABCAR Testing

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Vision Based LABCAR Testing
Main Components: LABCAR Software

LABCAR Operator

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<tr>
<th>Integration Platform</th>
<th>Experiment Environment</th>
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<tr>
<td>− Integration of Models (ASCET, Matlab, C-Code)</td>
<td>− User interface for test execution</td>
</tr>
<tr>
<td>− Connection of Signals</td>
<td>− Parameter management</td>
</tr>
<tr>
<td>− Configuration of Real-Time OS</td>
<td>− Real-time signal generation and data recording</td>
</tr>
<tr>
<td>− Configuration of CAN/LIN/FlexRay Bus</td>
<td>− Furnishes test automation interface to LABCAR Automation, INCA</td>
</tr>
<tr>
<td>− Code generation for LABCAR-RTPC</td>
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![Integration Platform](image1.png)

![Experiment Environment](image2.png)
Vision Based LABCAR Testing
Main Components: LABCAR Software

LABCAR Automation (LCA)

- Development, management, and automated execution of test cases using C# scripting
- Includes ASB (Automation Sequence Builder) that allows creation of test scripts in a flow chart manner. Features include:
  - Each action with an associated with a stencil
  - Define own stencils with your favorite sequences
  - Extend own function library
  - Functionality scope from ATCL is used
- Automatic Report generated that also stores picture of image captured
Vision Based LABCAR Testing
Main Components: LABCAR Software

LABCAR Automation: Automatic Report Generation

Benefits

- HTML representation of the xml reports
- Powerful filter to customize the view and content of reports
- Storable report configurations quickly generate different report views
- Hierarchy elements allow convenient browsing within reports
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<td>4. Main Components:</td>
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<td>4.1. Camera</td>
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<td>4.2. LABCAR Hardware</td>
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<td>4.3. LABCAR Software</td>
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<td><strong>5. Features of Vision Based Testing</strong></td>
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<td>6. Summary</td>
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Feature: Quick and Easy Camera Alignment

1. Select alignment job
2. Move the camera to align the 2 reference points
3. Live feedback shows if camera is aligned
4. Once both referenced points are aligned, the automated tests can be executed
Vision Based LABCAR Testing

Features

Features: Real Time Capture

* Real time generation of inputs and trigger of camera – X1 can be defined
** Real time response from camera – X2 can be defined
**Vision Based LABCAR Testing**

**Features**

### Features: Gauge Detection

1. Camera will be triggered multiple times to capture movement of needle

2. Camera tracks needle and returns angle of movement

3. LABCAR will calculate speed displayed based on angle returned by camera

4. Can check response times of HMI, validate correctness of speed displayed
Features: Verify Colors

1. Select area and specify expected color
2. Set the minimum number of pixels expected with the specified color (5700)
3. Camera Software will report the number of pixels with the expected color within the selected area (5907)
4. Camera classifies as pass if number of pixels with correct color (5907) is exceeding the minimum limit (5700)
5. Camera classifies as fail if the number of pixels with correct color (5530) is below the minimum limit (5700)
Vision Based LABCAR Testing

Features

Features: Telltale Detection

1. Define search area and model area
2. Trained image is shown in configuration software
3. If telltale is detected, camera will classify test as passed in real-time. (46.1ms for this telltale)
Vision Based LABCAR Testing

Features

**Features: Telltale Detection cont...**

4. Telltale is partially detected

5. Camera will classify test as passed, if the result is above the accept threshold

6. Camera will classify test as failed, if the result is below the accept threshold

7. Job file can be saved to a file and triggered from LCA test automation script
Feature: Optical Character Recognition (OCR)

1. Select text and train each character once

2. Camera converts the image to a text string, which can be evaluated in automation scripts

3. If parts of the expected string are not found, the camera reports failed and only the detected substring (8?)
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Why ETAS Vision Based LABCAR Testing

- Difficulties of manual testing eliminated
- Automation
  - Time saving
  - Less Errors
  - Repeatable
- Real time
- Smart Camera with easy configuration Software