AUTOMATED VERIFICATION OF AUTOMOTIVE INFOTAINMENT

BMW GROUP

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AGENDA

1. BMW Autonomous Driving
2. Assisted Driving View (ADV)
3. Conventional Testing
4. Lab Verification Methods
5. Future Strategy
6. MATLAB Demonstration
7. Questions & Answers
Visualise Real-Time Traffic

Secure Driver Trust
SIMULATION VERIFICATION

Test Rack 1: Ground Truth Data

Test Rack 2: Experimental Data

End to End

Code Ground Truth

Create Animated Scenario

Compare Instrument Clusters
1. Camera based driver support systems (KAFAS)
2. Radar and Ultrasound Sensors
3. Body Domain Controller (BDC)
4. Optional Equipment System (SAS)
5. Head Unit (HU)
6. Instrument Cluster (KOMBI)
VERSION VERIFICATION

Version 1: Verified Scene

Version 2: Hypothetical Scene

Version to Version

Test new software version

Play same vehicle signals

Detect differences
Real Traffic vs Assisted Driving View
Deep Learning Implementation
MATLAB DEMONSTRATION

Object Detection

Image Registration

Simplified Machine Learning Workflow

Register Images

Label Objects

Train, Deploy & Evaluate Detector
STEP 1: PRE-PROCESS IMAGES

Apply exported transformation to entire image set:

\[ tform = \text{registerImages(moving, fixed).Transformation}; \]
\[ \text{imwarp(moving, tform);} \]
Train detector from exported labels:

```matlab
trainingData = objectDetectorTrainingData(gTruth);
detector = trainACFObjectDetector(trainingData);
```
Deploy detector on independent image set:

\[
[bboxes, scores] = \text{detect}(\text{detector});
\]

\[
\text{evaluateDetectionPrecision}(\text{detectionResults}, \text{gTruthData});
\]
STEP 4: UNIT TESTING

Computer bounding box overlap ratio:

\[
\text{overlapRatio} = \text{bboxOverlapRatio}(\text{bboxA}, \text{bboxB}, \text{ratioType})
\]

Class Based Unit Testing:

\text{matlab.unittest.qualifications.Verifiable class}
STEP 5: MOBILE INTEGRATION

**Hardware Package Support**

Simulink → Android Mobile
1. **Computer Vision** offers improved speed, accuracy and reliability.

2. **Lab Simulations** facilitate controlled, reproducible data collection.

3. **Machine Learning** Workflow:
   a. Collecting, Preprocessing & Labelling **Data**
   b. Training, Deploying, & Evaluating **Model**
Q&A

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Integration and Validation
Onboard Platform

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