Autonomous Vehicle
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Building a Relevant Validation Database for Camera-Based ADAS

Author: Gérard YAHIAOUI, NEXYAD
Presentation shows a methodology and tools of the companies NEXYAD and INTEMPORA
NEXYAD and INTEMPORA are member of the MOV’EO Groupement ADAS
1 - The AGENDA methodology

Reducing the number of km to be driven while still ensure extensive coverage of situations.

Complexity and validation of a camera-based ADAS module

Example: road detection using RoadNex

Case of 24 bit color image, HD

- number of possible value for every pixel: \( N_v > 65\,000 \)
- number of pixels: \( N_p > 2\,000\,000 \)
- number of messages: \( N_m > (65\,000) \)

If you drive 1,000,000 km (100 km/h) the number of images does not exceed 9,000,000,000 images.

\[ K = o(N_m) \quad (\text{Landau notation}) \]

Then it is NOT possible to randomly sample and test: it simply makes NO SENSE

We propose to USE KNOWLEDGE about road scenes variability, in a DETERMINISTIC scheme: this is the AGENDA methodology.
. Issues of the methodology AGENDA

**Methodology AGENDA**

. Description of a system with its factors of variability: Functional specification variant/invariant
. Technical choices linked to this functional specification: traceability
. Unitary Testing
. Specification of the two databases: tuning and validation
. Closure of the open world and onboard real time reliability estimation

**Advantages**

. Easiest team work
. Maintenance and evolution of system are natively possible
. Reliable and robust system
. Copy Paste solutions from a project to another
. Increasing team knowledge
Example for pedestrian detection: Factors of variability

Sensor:
- sharpness
- continuity
- dynamic
- Size of the smallest detectable object
- Noise

Car where the sensors are installed:
- speed
- vibrations
- rotations (roll pitch yaw)

Road scene:
- Type of coating
- Presence / absence of markings
- Presence / absence of vertical road signs
- Track curvature

Weather condition:
- Ambient light
- Presence of shadows
- atmospheric disturbance

Target (to be detected):
- Contrast
- landmark ground speed
- Height
- width
Factors of variability and Functional Specification

Sensor:
- sharpness
- continuity
- dynamic
- Size of the smallest detectable object
- Noise

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Factors of variability + Functional Specification + Solutions

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Choice of camera
Optics
shutter speed +
no integration (CMOS)?
Log
spatial resolution
Sensor
Renormalizations
Denoising
Stabilization of Image
measuring
Algorithm of detection

Note: 13 arrows on « Algorithm of detection »
2 - The validation database

NEXYAD recorded a database for computer vision-based ADAS validation:
road situations are samples via scenarios designed with the methodology AGENDA
Soon available (for FREE) : http://www.nexyad.com/Automotive-Transportation
3 - Test automation tools

AGENDA methodology

MaTeLo

Web services

Web clients

Resources upload
Test cases definition
Execution reports lookup

Resources storage
Test cases and execution results management

Pro-SIVIC

RTMaps

Sensors datasets

Distributed automated test cases execution

I-DEEP
(tool of INTEMPORA)

RT-MAPS
(tool of INTEMPORA)

Non regression testing every time one chance the solution.
Thanks for your attention