interactIVe

Accident avoidance by active intervention for Intelligent Vehicles

interactIVe IP: Perception platform and modules

Angelos Amditis, ICCS
19th ITS-WC-SIS76: *Advanced integrated safety applications based on enhanced perception, active interventions and new advanced sensors*

Vienna, October, 26 2012

Agenda

1. Introduction
    1.1. interactIVe project
    1.2. Environment perception in interactIVe

2. Perception Platform
    2.1. System architecture
    2.2. Perception Horizon
    2.3. Perception Modules (+ short duration demos)

3. Conclusions & future work

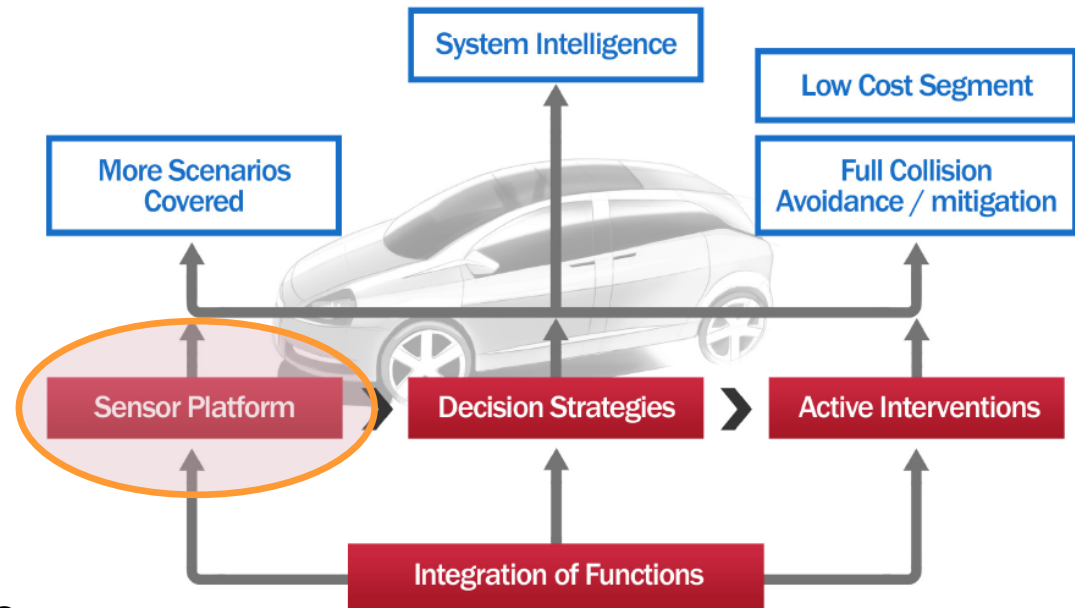**interactive**

interactIVe project

- *Development & evaluation of next generation safety systems providing continuous support and utilizing active intervention*

Current systems:
- independent functions
- multiple expensive sensors
- unnecessary redundancy

interactIVe:
- vehicle components shared among various safety systems
- integrating applications upon a common perception framework
- discrete architectural layers common to all applications

System Intelligence

Low Cost Segment

More Scenarios Covered

Full Collision Avoidance / mitigation

Sensor Platform   Decision Strategies   Active Interventions

Integration of Functions

interactive

Environment perception in interactIVe

- Fusion of information from heterogeneous sources **to provide a holistic environment perception**
    - Perception sensors: radars, cameras, laserscanners etc.
    - Digital maps
    - Wireless communication (V2X)

- Design of a common perception framework for multiple safety applications

- Advanced research on enhancing the electronic safety zone surrounding vehicles:
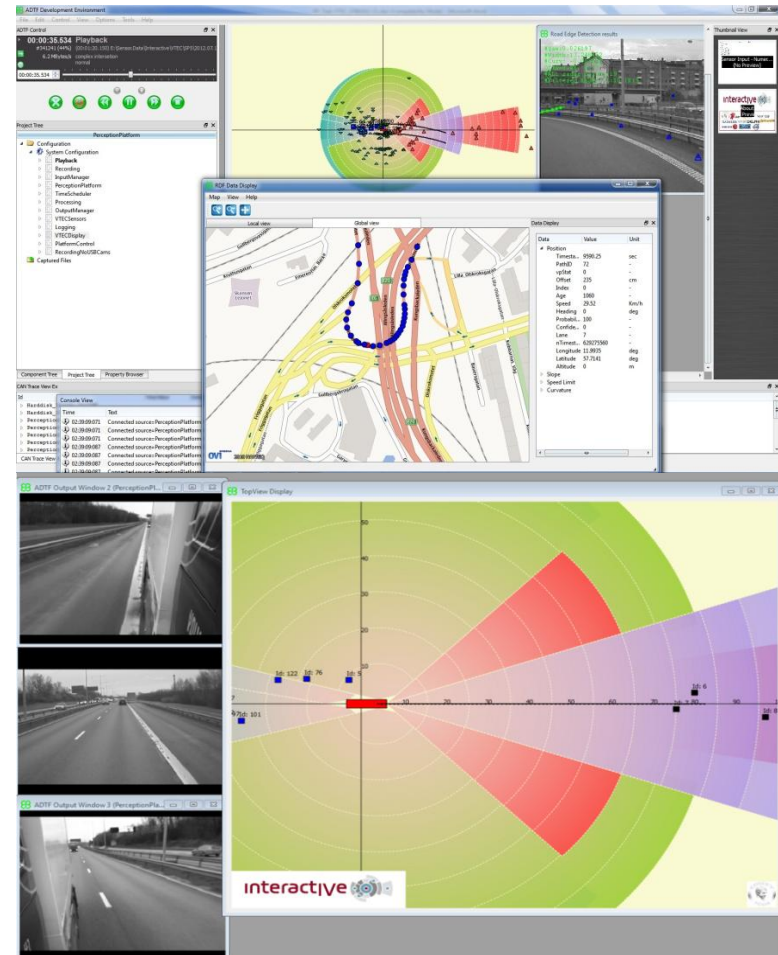- Sensor refinement
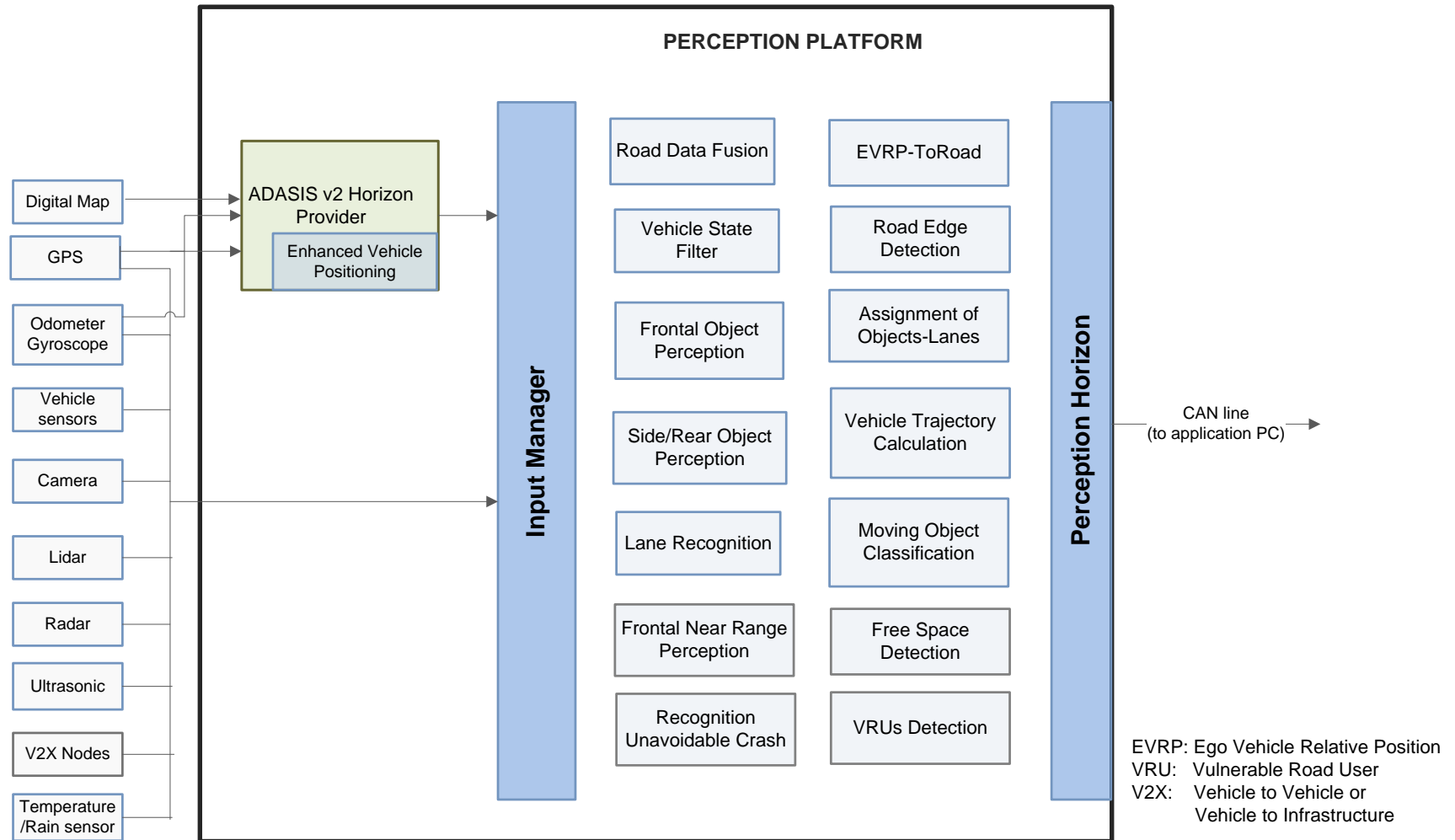- Object refinement
- Situation refinement

➢ Active intervention poses "hard" real-time requirements for data processing & fusion modules

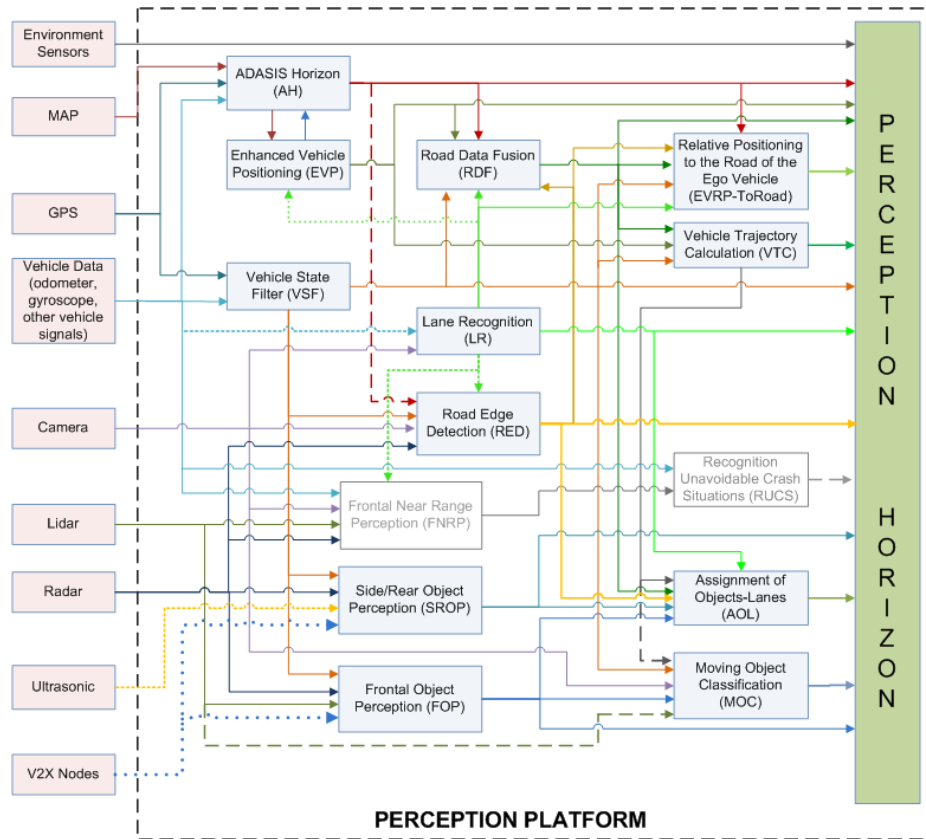interactIVe

Perception Platform - the concept

- Reference implementation

- Common *interface structure* for every sensor type or information source
- Different sensor types and products attached based on the *plug-in concept*

- Development of a variety of *perception modules*, e.g.
  - object perception & classification
  - lane detection & road geometry extraction
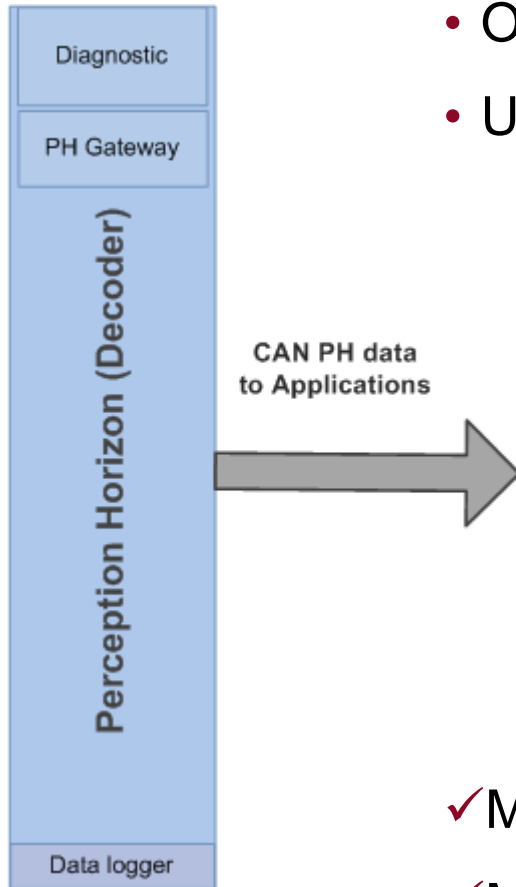- Unified Output: *Perception Horizon*

interactive

Perception Platform - architecture overview

PERCEPTION PLATFORM

Inputs (left side):
- Digital Map
- GPS
- Odometer Gyroscope
- Vehicle sensors
- Camera
- Lidar
- Radar
- Ultrasonic
- V2X Nodes
- Temperature /Rain sensor

ADASIS v2 Horizon Provider
- Enhanced Vehicle Positioning

Input Manager

Processing modules:
- Road Data Fusion
- Vehicle State Filter
- Frontal Object Perception
- Side/Rear Object Perception
- Lane Recognition
- Frontal Near Range Perception
- Recognition Unavoidable Crash
- EVRP-ToRoad
- Road Edge Detection
- Assignment of Objects-Lanes
- Vehicle Trajectory Calculation
- Moving Object Classification
- Free Space Detection
- VRUs Detection

Perception Horizon

CAN line (to application PC)

EVRP: Ego Vehicle Relative Position
VRU: Vulnerable Road User
V2X: Vehicle to Vehicle or Vehicle to Infrastructure
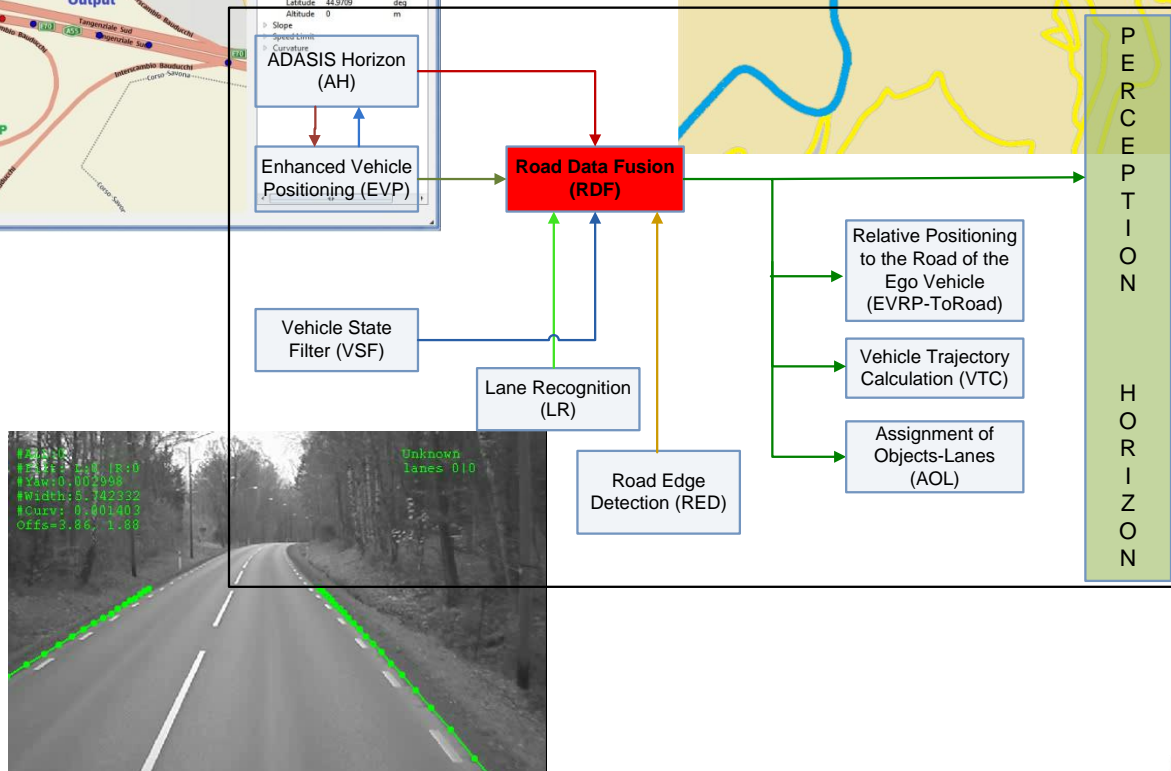
interactive
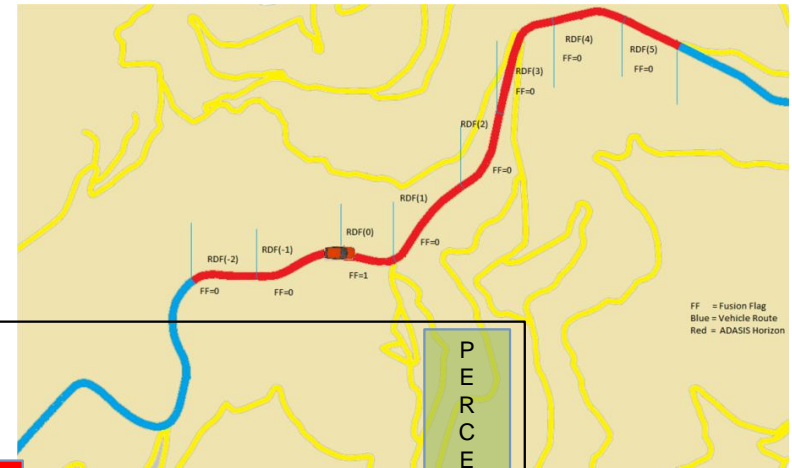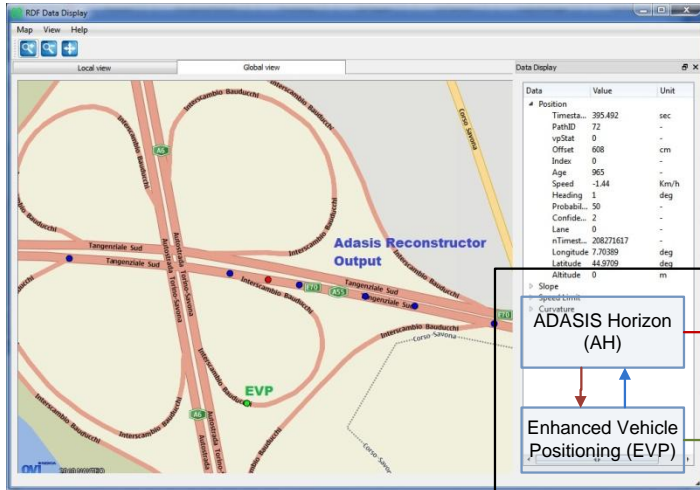
Functional architecture

Perception Horizon

- Output interface of the perception platform
- Union of the following three elements:
  - **Synchronized subset** of the perception modules outputs
  - **Configuration files** for each demonstrator vehicle (available sensors, mounting position etc.)
  - **Output manager functionality** (software module translating Perception Horizon data to the communication line between perception platform and applications + diagnostics + logging)

✓Modular handling - avoiding duplicate structures

✓Minimization of low - level passing through information

Perception Modules (1- the road around)

Perception Modules (2 - the objects around)

interactive
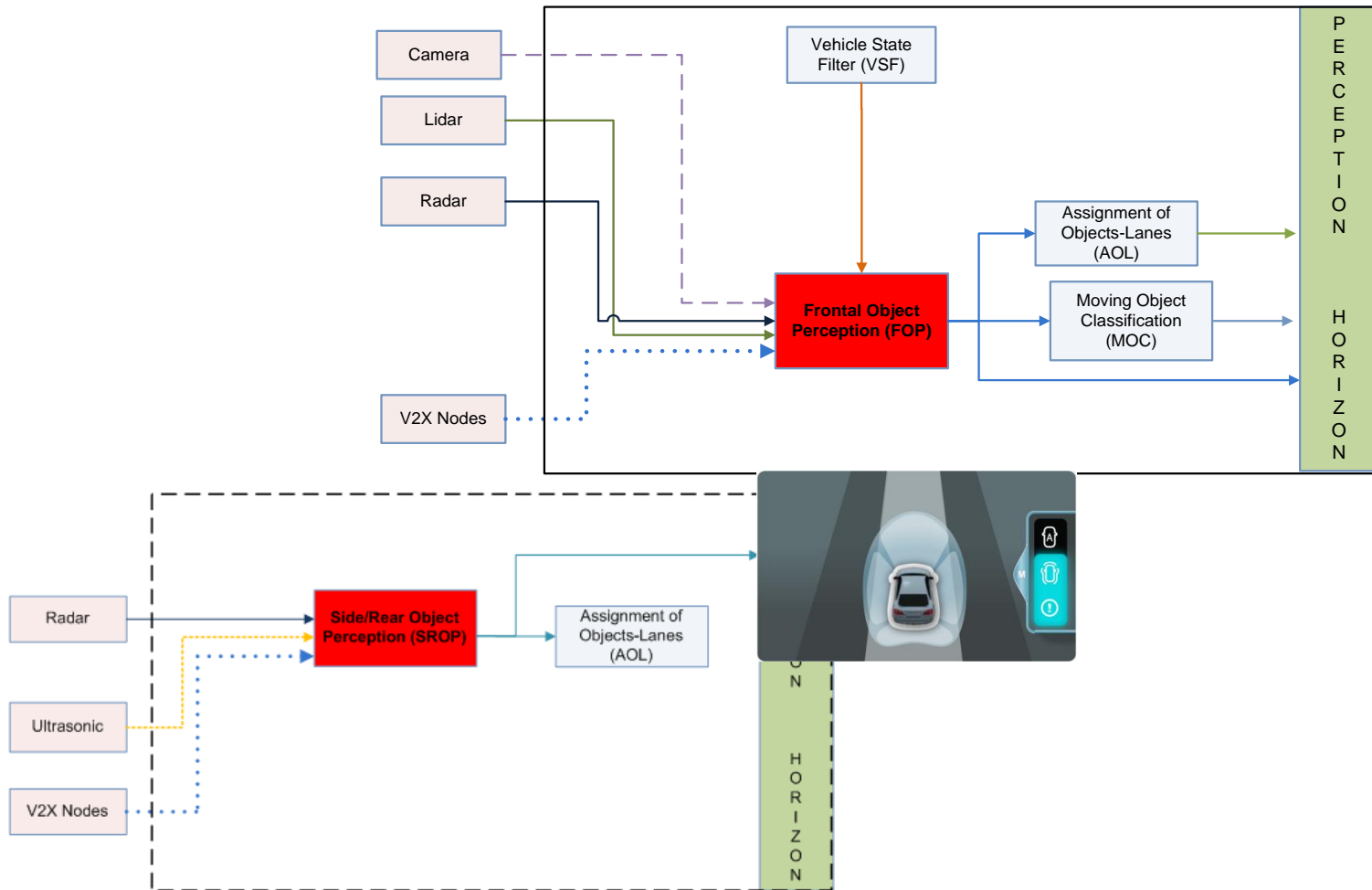
Perception Modules (2 - the objects around)

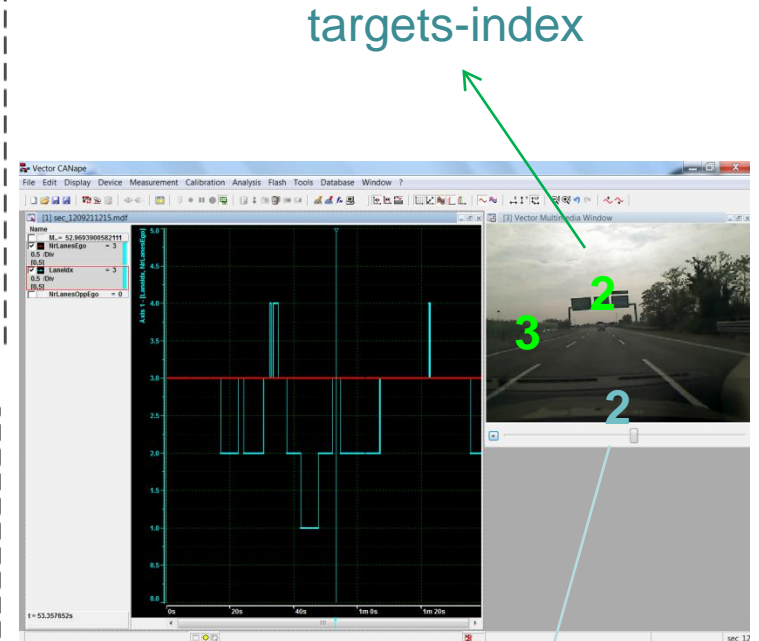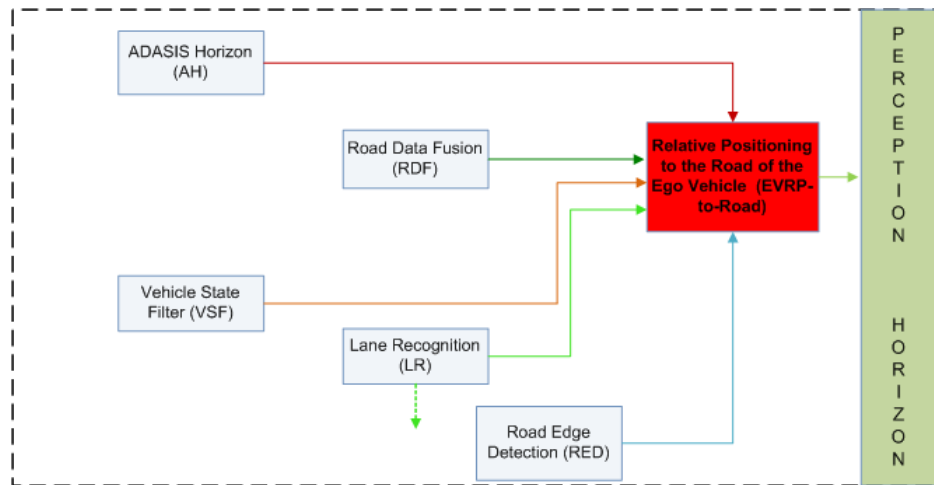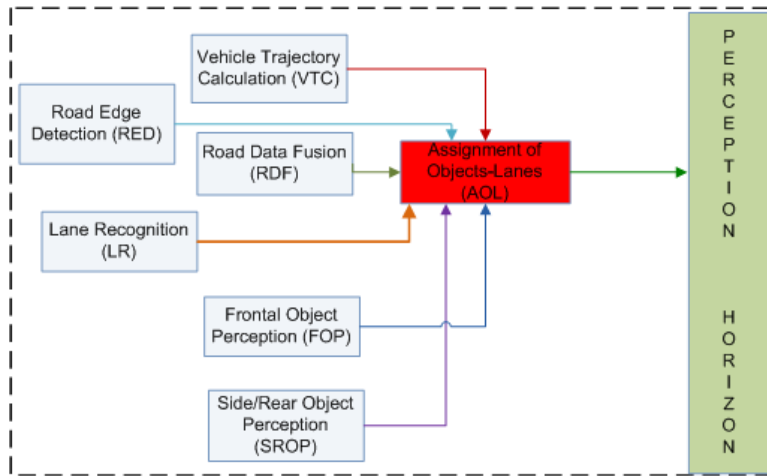- 1st video: LRR radar/camera object fusion approach

(highway scenario)

Perception Modules (2 - the objects around)

- 2nd video: Radar/Lidar/Vision fusion approach inc. object classification

TRW Conekt Moving Object Classification :
Trucks and Cars

(highway scenario)

interactive

Perception Modules (3 - the ego + the objects in the road)

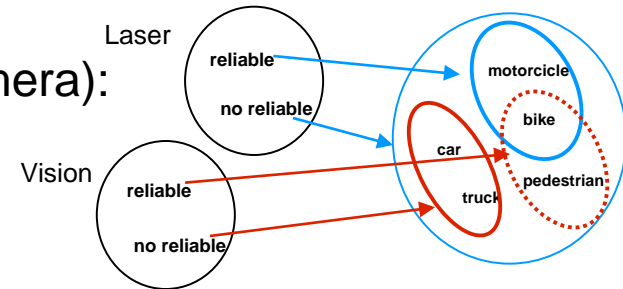targets-index

ego-index

ınteractıve

Perception research

Processing/Fusion algorithms (maps, radar, lidar, camera):

- Multi-sensor tracking in sensor networks
- Maintenance of Track ID @ rear-side-frontal
- Instantaneous fusion using Evidential occupancy grids
  (Degrees of belief for detection, tracking and classification)
- Efficient object classifier for pedestrian, cars and trucks
- Robust Road Boundary Detection + Adv. Lane Tracking
- Frontal Near Range Perception for collision avoidance

Laser — reliable / no reliable

Vision — reliable / no reliable

motorcicle, bike, car, pedestrian, truck

Lessons learned and future work

- Need for hard real-time & multitasking environment for the implementation of the platform
- Reduce complexity, increase scalability and interoperability, allow multiple implementations
- Need for common agreed (standardized?) input/output structures
- Need for massive ground truth data covering all scenarios
- Dynamic maps with advanced attributes & enhanced accurate positioning

Continuous driver support   **Collision avoidance**   **Collision mitigation**
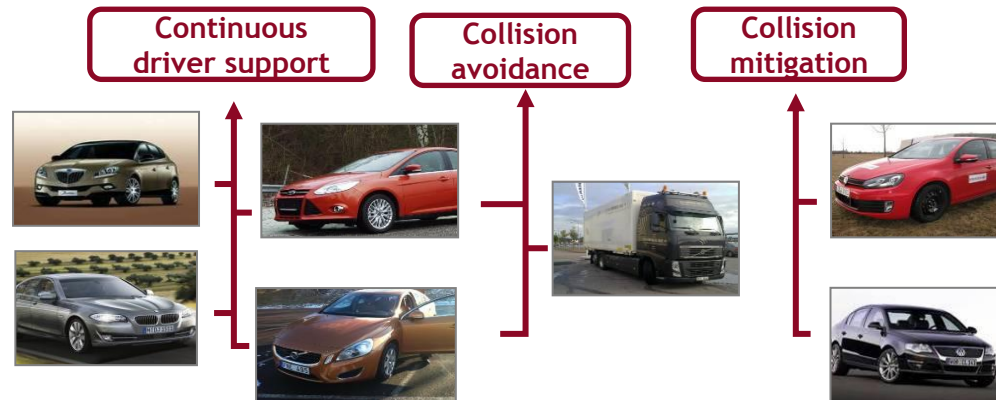
- Towards implementation in (distributed) embedded systems
- Plug & play concepts
- Early fusion or object level fusion?
- Global trackers & advanced world (environment & traffic) models
- New low cost high performance sensors & actuators
- Fault-tolerant perception architectures
- Need for verification-certification methods for perception

interactive

Accident avoidance by active intervention for Intelligent Vehicles

www.interactive-ip.eu

Thank you.

Dr. Angelos Amditis
Research Director,
Institute of Communication and
Computer Systems, Greece
a.amditis@iccs.gr

Co-funded and supported
by the European Commission

SEVENTH FRAMEWORK
PROGRAMME