FCA FIAT CHRYSLER AUTOMOBILES | CRF

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Automated Driving Applications and Technologies for Intelligent Vehicles

Vehicle automation in urban scenario

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Aachen, Germany
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// Partners

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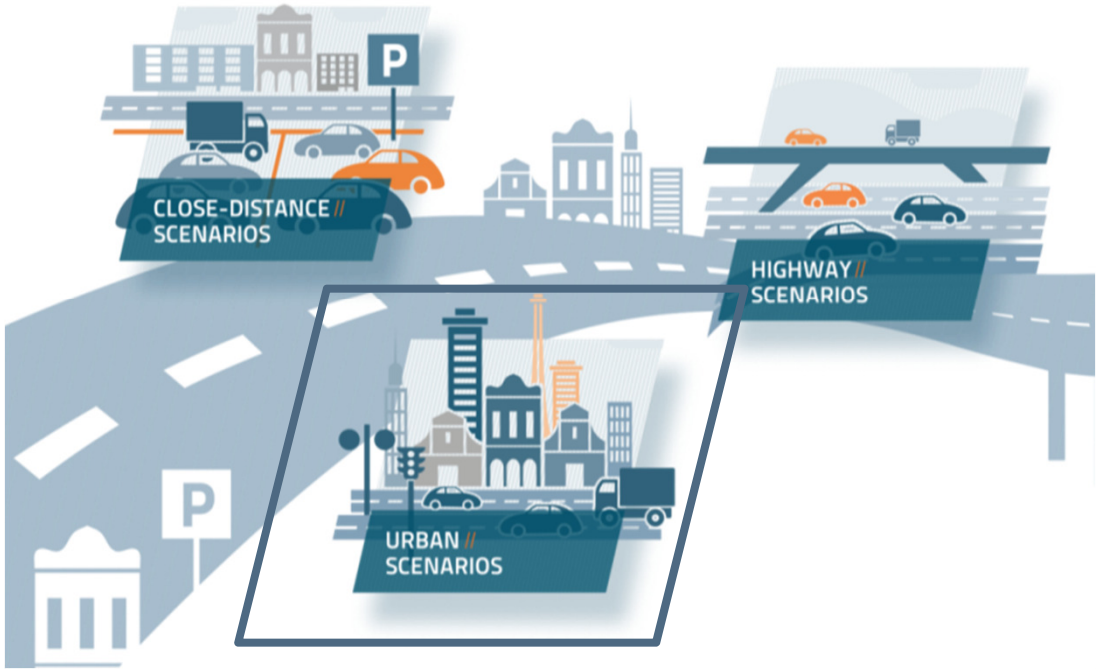


//Challenges

Traffic conditions' variety

Human failures

Demanding and repetitive tasks

// Perception and Action: scenario variables

RESILIENT PERCEPTION & ACTION

- **CONDITIONS RAPIDLY VARYING** within one automatic maneuver … traffic density
- **CONDITIONS SLOWLY VARYING** between two automated maneuvers … visibility, road conditions
- **INVARIABLE TRANSITIONS** geo-referenced area characteristic… a crossing, a roundabout
- **HUMAN INTERACTIONS** … driving behaviours, drivers' inattention
- **ROAD USERS** … cars, motorbikes, trucks, pedestrians, cyclists

//Technology: co-driver agent

SUBSUMPTIVE APPROACH "mirroring" human motion control and decision making

SAE level #3 "City Chauffeur" … lane change, lane following, speed adaptation, vehicle following:

- when any "subsumed function" is missing perception the function drops to SAE level #2

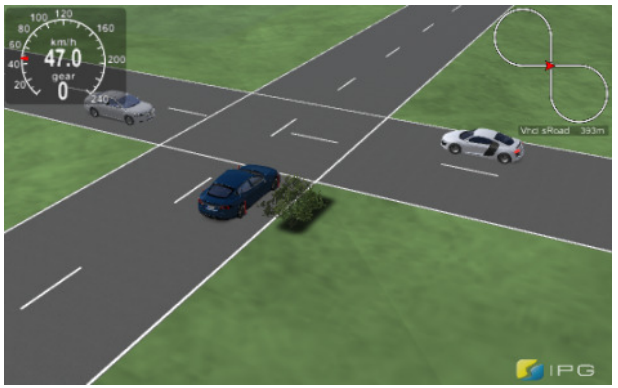
CO-DRIVING AGENT designed in "CarMaker simulator" and tested in demo vehicle

//Technology: trajectory planning and control

TRAJECTORY GENERATION AND CONTROL for real-time execution in mixed traffic and complex maneuvers: … overtaking, lane change, merging, crossings

Model Predictive Control for safe & comfortable driving

- Vehicle dynamic flexible to different vehicles
- Near future trajectories real-time updated



// Functions: vehicle automated driving

SAE Level		
-	SAFE STOP	DRIVER is not responding SYSTEM slows down the vehicle and stops
3 - Conditional Automation	CITY CHAUFFEUR	DRIVER performs fallback manoeuvres SYSTEM monitors driving environment & supports overtaking, crossings, roundabouts, traffic lights
2 - Partial Automation	SUPERVISED CITY CONTROL	DRIVER monitors driving environment SYSTEM takes longitudinal and lateral controls
1 – Assisted	CITY CRUISE	DRIVER monitors driving environment & takes lateral control SYSTEM takes longitudinal control

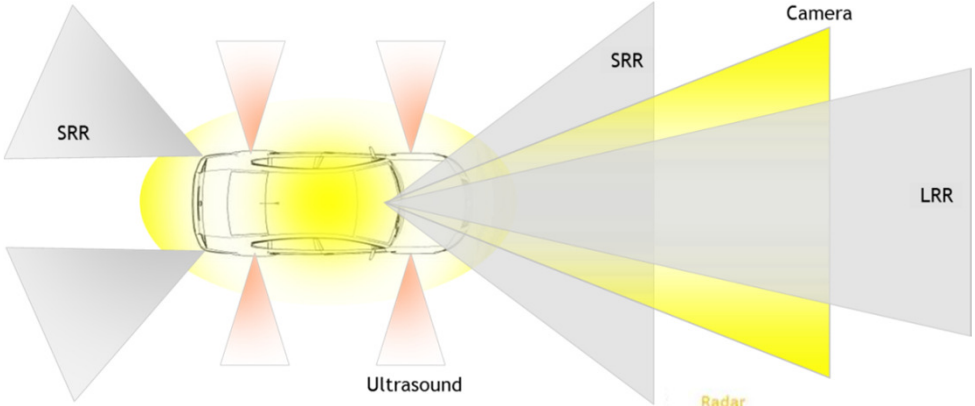
//Vehicle demonstrators: sensor setup

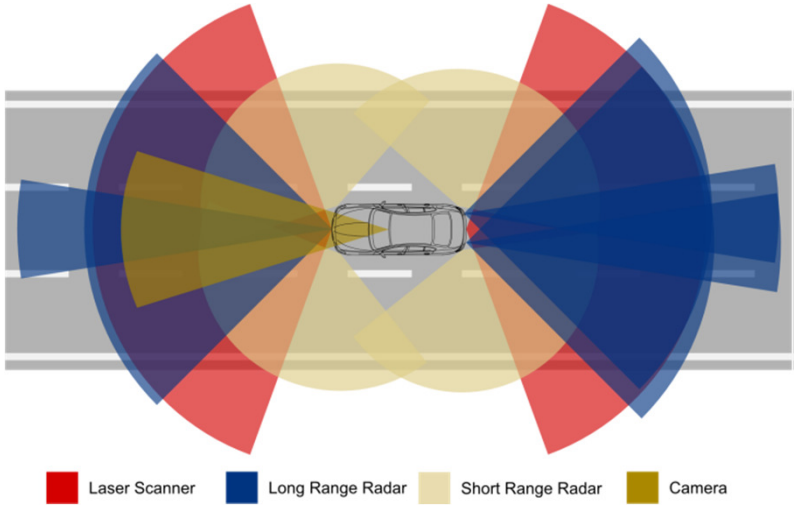
Front Radar & Camera
Electronic Horizon
Rear blind-spot radar
Side Ultrasound
V2X via G5
GNSS

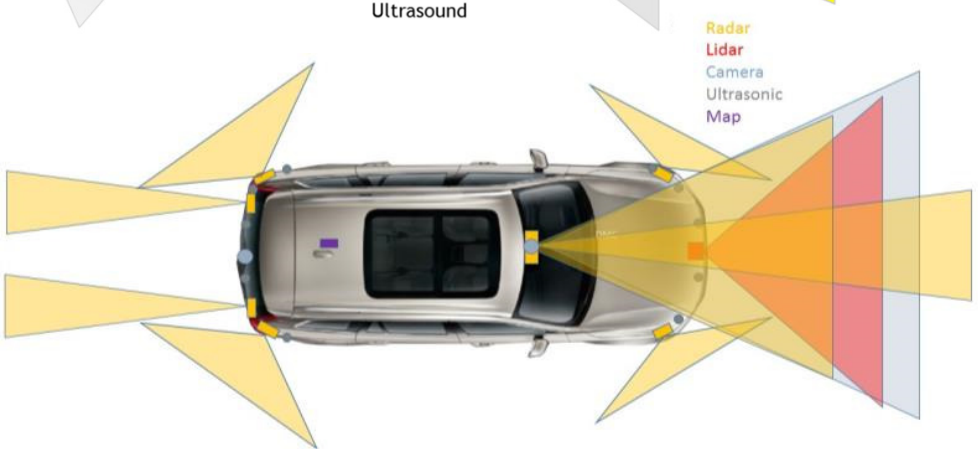
Laser Scanner
Long Range Radar
Short Range Radar
Camera
GNSS

Front Radar & Camera
Corner Radars
Front, side & rear Ultrasounds
Front Lidar
V2X via 3-4G
GNSS

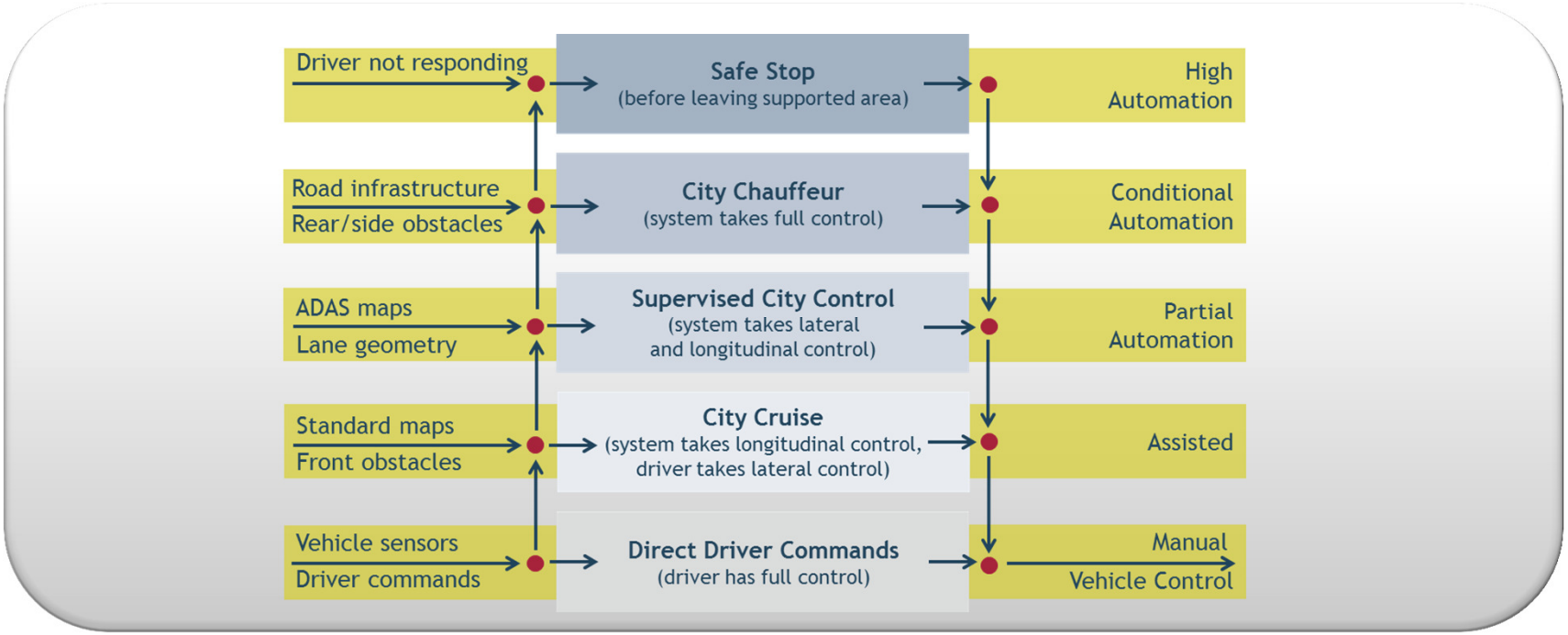
//Vehicle demonstrators: fields of view







// Functions


Driver not responding
Road infrastructure
Rear/side obstacles
ADAS maps
Lane geometry
Standard maps
Front obstacles
Vehicle sensors
Driver commands
Safe Stop
(before leaving supported area)
City Chauffeur
(system takes full control)
Supervised City Control
(system takes lateral
and longitudinal control)
City Cruise
(system takes longitudinal control,
driver takes lateral control)
Direct Driver Commands
(driver has full control)
High
Automation
Conditional
Automation
Partial
Automation
Assisted
Manual
Vehicle Control

//Vehicle automation in urban scenario: now & next

AWARENESS and selection of «operational design domains» with:

- **RESILIENCY** in perception & action
- **REDUNDANCIES** multi-sensor technologies

- **SENSING TECH** for all traffic participants including also connectivity
- **POSITIONING** vs urban canyoning effect
- **ADDRESS** long terms effects in urban mobility

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Technologies for Intelligent Vehicles

Thank you.

Luisa Andreone
FCA-CRF
Vehicle Innovation
Collaboration & Public Funding
"Safe & Integrated Mobility"

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