

W1. Objectives, Challenges, State of the Art, Technologies

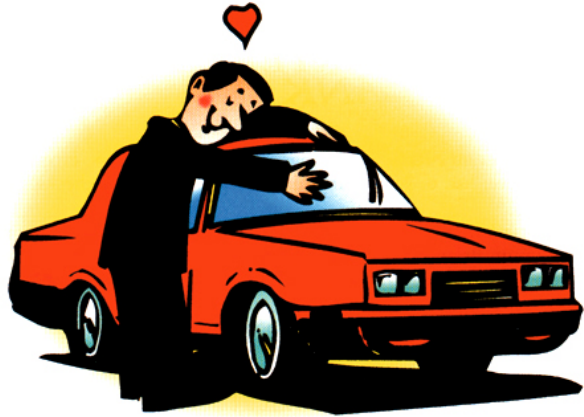
- Socio-economic context
- Technological evolution of Robotics & State of the Art
- New challenges for Robotics in Human Environments
- Decisional & Control Architecture for Autonomous Mobile Robots & IV
- Sensing technologies: Object Detection
- Sensing technologies: Robot Control & HRI
- Basic technologies for Navigation in Dynamic Human Environments
- **Intelligent Vehicles: Context & State of the Art**
- Intelligent Vehicles: Technical Challenges & Driving Skills

Place & Role of automobile in our human society

Automobile => Social & Industrial revolution in the 20th century !

The car today

Supposed to be a technological machine designed for enhancing individual Mobility



For most car owners it's more than that !

- ✓ *Synonymous to **motion freedom***
- ✓ *Often considered as a **Precious Personal Goods** & Showing a particular **Social Position***
- ✓ *Also often synonymous to **Driving Pleasure** (including speed feeling)*
- ✓ ***Look / Performances & Comfort / Safety** are important choice criteria*
- ...*

But the reality is somewhat different !

(in particular in cities)

Traffic congestion



Parking problems



Pollution



Accidents



A Drastic Future Social & Economic Change

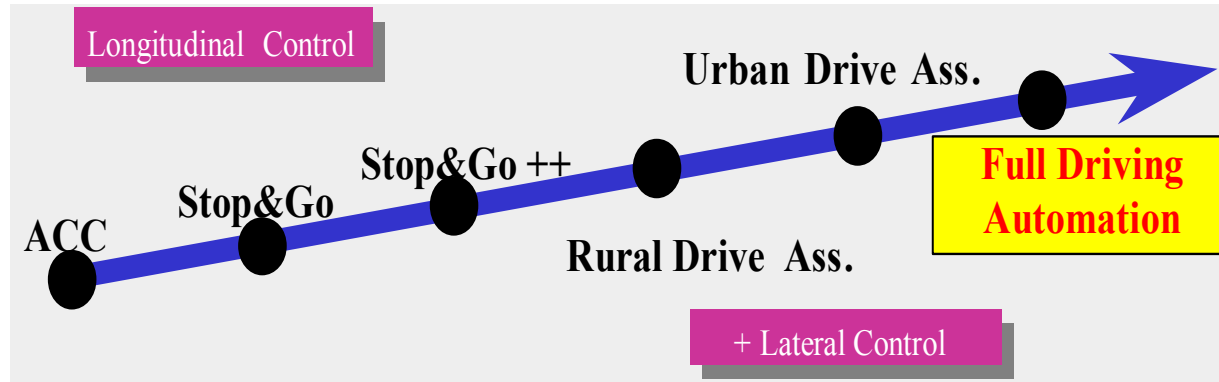
- Huge expected growth of the **number of vehicles** (*3 Billions in 2050*) & number of **people in cities** (*75% of population in 2050*)
- Human society is **no more accepting** the **nuisances** & the incredible socio-economic cost of **traffic accidents** (*~ 1.2 million fatalities / year in the world*)
- **Driving Safety** is now becoming a major issue for both **Governments** (*Regulation + Supporting plans*) & Automotive Industry (*Technology + commercial issues*)
- **New Technologies** can strongly help for:
 - ✓ Constructing **Cleaner & More Intelligent Cars**
=> *Next cars generation*
 - ✓ Developing **Sustainable Mobility** solutions for smart cities
=> *Cybercars*

The good news

- Thanks to the last decade advances in the fields of *Robotics & ICT*, **Smart Cars & ITS** are gradually becoming a reality
 - *Driving assistance & Autonomous driving, Passive & Active Safety systems, V2V & V2I communications, Green technologies for reducing fuel consumption & pollution... and also significant advances for **Embedded Perception & Decisional systems***
- **Legal issue** is also progressively addressed by Governmental authorities
 - *June 22, 2011: Law Authorizing Driverless Cars on **Nevada** roads ... Law also adopted later on by **California** and **some other states in USA***
 - *Some other countries (including Europe, Japan...) are also currently analyzing the **way to adapt the legislation** to this new generation of cars*

Steps towards “Automated Road”

The Automotive approach (*Advanced Driver Assistance Systems*)

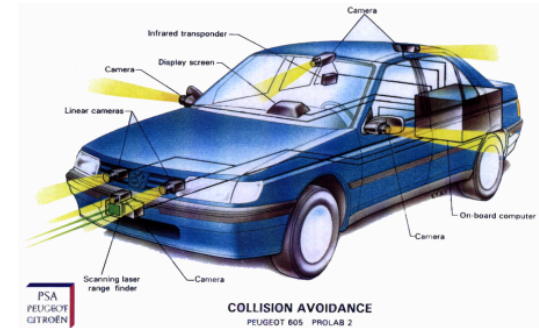


- Normal roads & High speed
- From ADAS to Fully Autonomous Driving

Numerous R&D projects in the world since about 30 years:

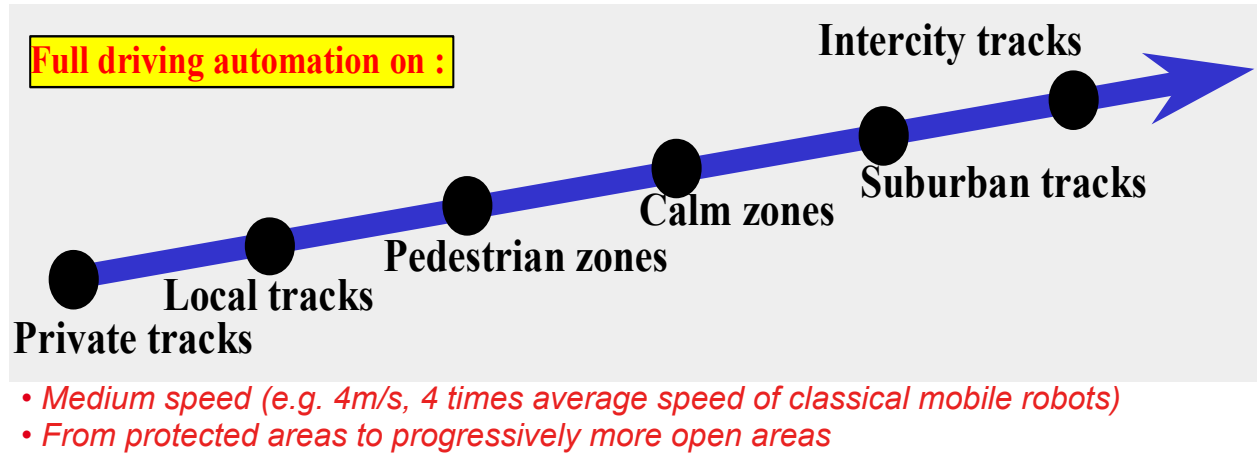
AHS in Japan; Path & IVI in USA;

Prometheus, Chauffeur, Carsense ... in Europe



Steps towards “Automated Road”

The “Cybercar” approach (*Autonomous Vehicles in protected areas*)



Several R&D projects since about 2 decades:

ICVS in Japan

Praxitele, Parkshuttle, Cybercars ... in Europe

State of the Art

Cybercar technologies for Sustainable Mobility

- **An EU driven concept since the 90's: “Cybercar”**
 - Autonomous Self Service **Urban & Green** Vehicles
 - Numerous R&D projects in Europe during more than 2 decades
 - Several European **cities involved**
 - Some **commercial products** already exist for protected areas (e.g. airports, amusement parks...), *SME Robosoft, 2GetThere ...*



Cycab (Inria /Robosoft)



Cybergo (Induct)



Parkshuttle
Schiphol Airport (1997)

State of the Art

Cybercar technologies for Sustainable Mobility

- Several early large scale public experiments in Europe



Cybus experiment, La Rochelle 2012, 3 months (CityMobil EU project & Inria)

State of the Art

Fully Autonomous Driving

- **More than 25 years of research, both for off-road & road Vehicles**
 - Significant recent steps towards fully autonomous driving
=> Partly pushed forward by events such as DARPA Grand & Urban Challenges ... and Google Car project
 - Fully Autonomous driving is gradually becoming a reality, for both the **Technical & Industrial & Legal** point of views
=> e.g. Car industry announcements & Recent Nevada law for driverless cars

State of the Art

Fully Autonomous Driving

- **Several major events & results**

- Darpa Grand Challenge 2004 & Urban Challenge 2007
- Intercontinental Autonomous Challenge 2010 (VIAC)
- Google car project



VIAC Challenge 2010 (Parma – Shanghai)
13 000 km covered, 3 months race, Leader + Followers
=> See Spring 2011 IEEE RAM issue



Junior – Stanford Racing team
Urban Challenge 2007

State of the Art

Advanced Driving Assistance Systems (ADAS)

- Increasing number of Products & Equipped commercial cars
- Traded by Automotive Constructors & Often developed by Car Suppliers



Intelligent Cars – Towards Driverless Cars?

Horizon 2025-30?

*Nissan promises a
driverless car for 2020*

LE FIGARO

29/08/2013



Autonomous car: An industrial challenge for tomorrow !

French Minister of Industry & Carlos Ghosn (PDG Renault-Nissan)



*Google Car 2011
140 000 miles covered*



Toyota Automated Highway Driving Assist

Demo Tokyo 2013, Product 2017 ?



**But also most of the
Automotive Constructors !**

e.g.

*Tesla (90% Autonomous in 2016),
Volvo, Mercedes Class S, BMW*

....

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