

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

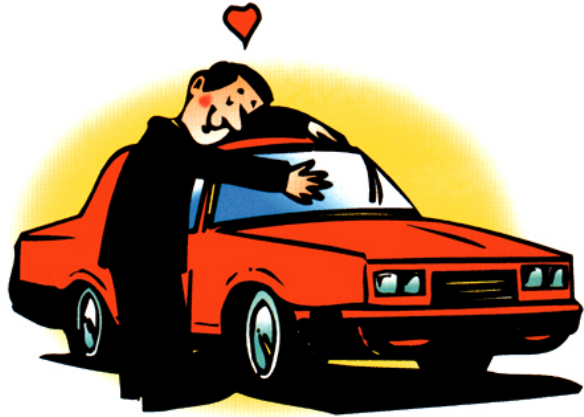
- Socio-economic context
- Technological evolution of Robotics & State of the Art
- New challenges for Robotics in Human Environments
- Decisional & Control Architecture for Autonomous Mobile Robots & IV
- Sensing technologies: Object Detection
- Sensing technologies: Robot Control & HRI
- Basic technologies 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 20<sup>th</sup> 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

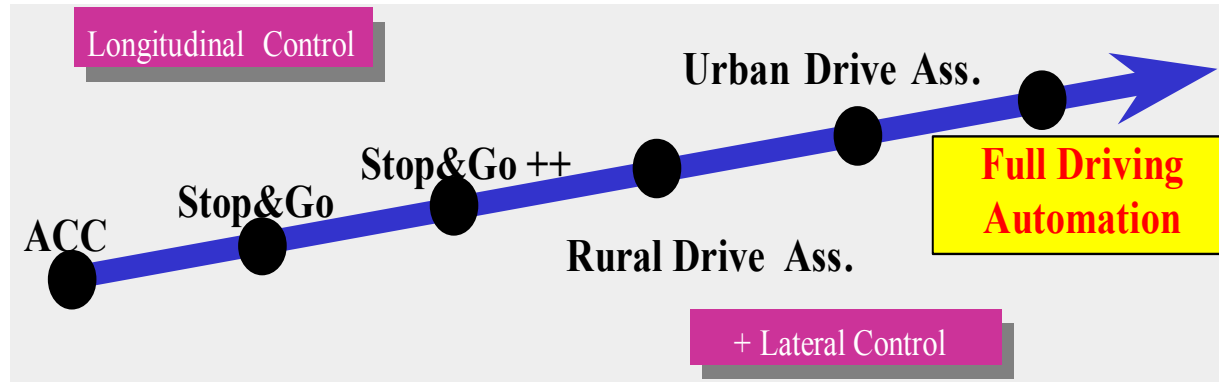
- Huge expected growth of the **number of vehicles** (*3 Billions in 2050*) & number of **people in cities** (*75% of population in 2050*)
- Human society is **no more accepting** the **nuisances** & the incredible socio-economic cost of **traffic accidents** (*~ 1.2 million fatalities / year in the 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*)

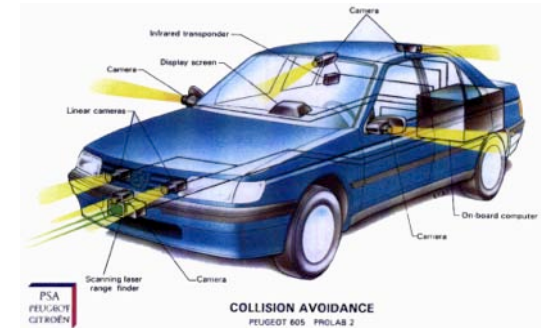


- Normal roads & High speed
- From ADAS to Fully Autonomous Driving

**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*)



- Medium speed (e.g. 4m/s, 4 times average speed of classical mobile robots)
- From protected areas to progressively more open 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)*



29/08/2013



*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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