



Autonomous Vehicles: Societal and Technological Evolution (Invited Contribution)

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Véhicule autonome et ville de demain

Technologie, business et société : quels enjeux ?

Nextdoor Issy Village

41-43 rue Camille Desmoulins

92130 Issy-les-Moulineaux

Mercredi 14 décembre 18h30 - 21h00

Comment le véhicule va-t-il s'adapter à la ville de demain ?
Et comment les villes vont-elles s'adapter au véhicule de demain ?

Pour appréhender le sujet dans son ensemble et
entrevoir les risques et opportunités induits par cette « nouvelle » révolution,
nous vous invitons à une table ronde animée par **Jean-Michel Normand**,
journaliste au Monde, avec :



Vincent Abadie.
Responsable Innovation et
Technologies avancées,
Aide à la Conduite,
Maître-expert, **Groupe PSA**



François Nédey.
Directeur technique
Assurance Biens
et Responsabilités, **Allianz**



Didier Marginedes.
Senior Vice President,
Blue Solutions, **Bolloré**



Eric Legale.
Directeur de **Issy Media**,
Société d'Economie Mixte
chargée de la communication
et des Technologies de l'Information
de la ville d'**Issy-les-Moulineaux**.



Emmanuel François.
Président,
Smart Building Alliance
for Smart Cities



Christian Laugier.
First Class Research Director,
INRIA CHROMA -
Cooperative & Human-aware
Robot Navigation
in Dynamic Environments



Olivier Babeau.
Economiste, Professeur des
sciences de gestion,
Université de Bordeaux et spécialiste
des transitions numériques



Cars & Human Mobility

A Psychological & Technological evolution

On-going change of the role & concept of **private car** in human society



*Ownership & Feeling of Freedom
Affective behaviors & Social position
Driving pleasure ... but less and less true !*



*Next cars generation => Focus on **Technologies** for
Safety & Comfort & Reduced Pollution
Driving Assistance v/s Autonomous Driving*

- ❖ Context
 - ⇒ Expected 3 Billions vehicles & 75% population in cities in 2050 (current model not scalable)
 - ⇒ Accidents: ~1.2 Million fatalities/Year in the world
 - ⇒ Driving safety & Nuisance issues (pollution, noise, traffic jam, parking ...) are becoming a major issue for both **Governments & Industry**
- ❖ Technology & Internet progressively change de **mobility habits** of people
 - => Shared mobility systems, more carpooling, more ADAS ...
e.g. Uber, BlaBlaCar, Tesla Autopilot ...
- ❖ A Huge ADAS market for Automotive Industry
 - => **\$16 billions** in 2012 & **Expected \$261 billions** in 2020 ^(f)

^(f) Forecasted US\$ 260 Billion Global Market for ADAS Systems by 2020. ABI Research. 2013.

Autonomous Vehicles: 30 years R&D

Pioneer work at INRIA in the 90's : Autonomous parking, Platooning in cities, People mover (Cycab)



1986 VaMors (Dickmann Munich U)
First autonomous vehicle on a road,
Followed by EU project Prometheus



2011 Google Car project
Fleet of 6 automated Toyota Prius
140 000 miles covered on California roads
with occasional human interventions



2004 Darpa Grand Challenge
Significant step towards Motion Autonomy
... But still some uncontrolled behaviors

2007 Darpa Urban Challenge
97 km, 50 manned & unmanned
vehicles, 35 teams

Numerous real-life experiments ...but Safety is still insufficient => Some benign & serious accidents in the past few months (Google, Tesla ..)

Autonomous Car: Next generation technology & Expected market of 500 B€ in 2035



Tesla Autopilot based on Radar & Mobileye

- Partnership with Mobileye uncertain
- Commercial option : 3400 € in France



Costly 3D Lidar & Dense 3D mapping



Cybus experiment, La Rochelle 2012
(CityMobil Project & Inria)



Drive Me trials

- 100 Test Vehicles in Göteborg, 80 km, 70km/h
- No pedestrians & Plenty of separations between lanes



Driverless Taxi testing in Pittsburgh (Uber) & Singapore (nuTonomy)
=> Numerous Sensors & Engineer in the car during testing

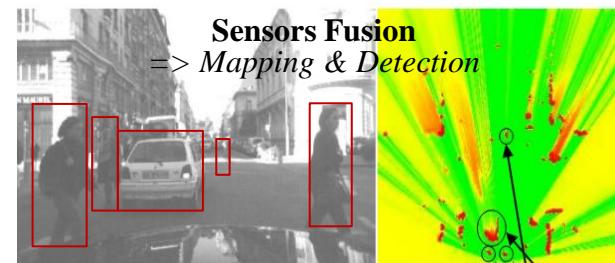


Key Technologies: Embedded Perception & Decision

=> Decision-making for navigation while avoiding pending & future collisions



Embedded Multi-Sensors Perception
=> Continuous monitoring the dynamic environment



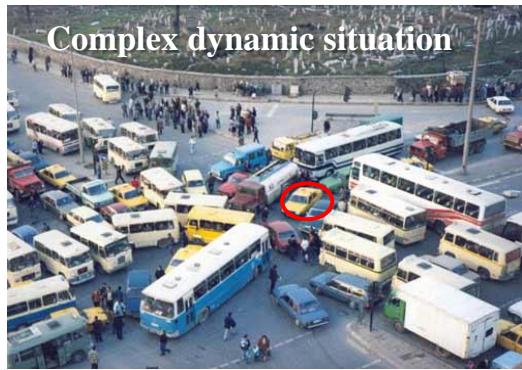
Sensors Fusion
=> Mapping & Detection



Scene interpretation
=> Using Context & Semantics



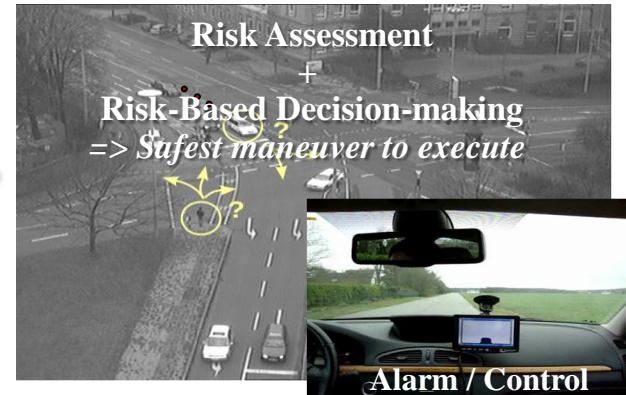
Characterization of the Safe navigable space (local)



Complex dynamic situation



Human Aware Situation Assessment



Risk Assessment

+
Risk-Based Decision-making
=> Safest maneuver to execute

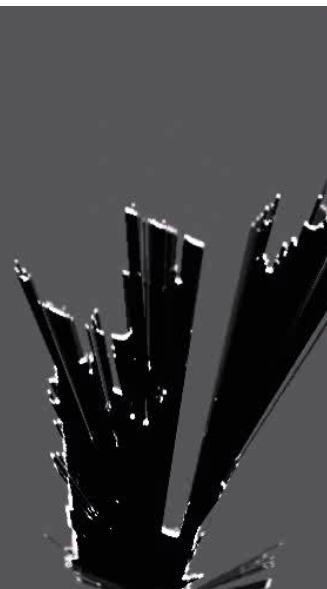
Alarm / Control

Main features

Noisy data, Incompleteness, Dynamicity, Discrete measurements + Real time
Human in the loop & Environment change prediction required

=> Situation Awareness, Prediction & Risk assessment, Human-Vehicle Interactions

Exploiting dynamics for Scene Understanding



Motion Prediction for collision avoidance (Risk)

=> Detect future collision & Avoid false alarms

Autonomous Vehicle (Cycab)



Parked Vehicle (occultation)

2005



2015



Embedded perception & V2X Communication

CPU+GPU+ROS / Stereo vision + Lidars + GPS + IMU + Odometry



Toyota Lexus

