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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



C. LAUGIER – Autonomous Vehicles : Societal & Technological evolution

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



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*



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

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

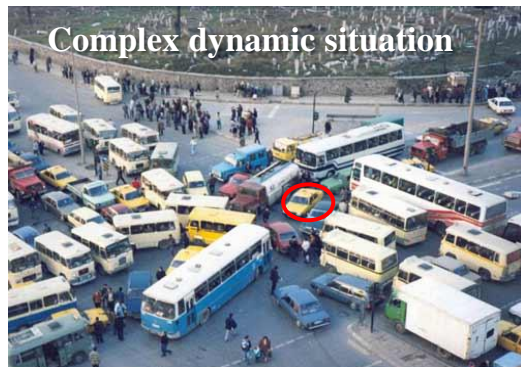
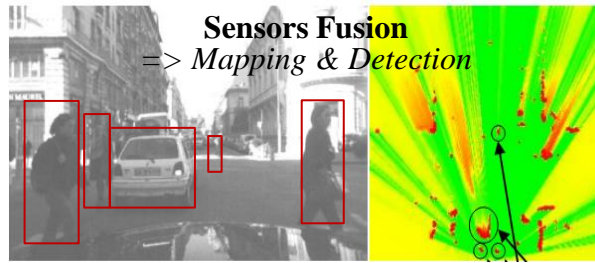


Key Technologies: Embedded Perception & Decision

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



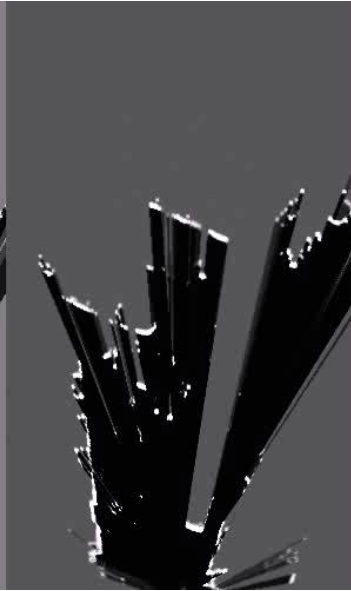
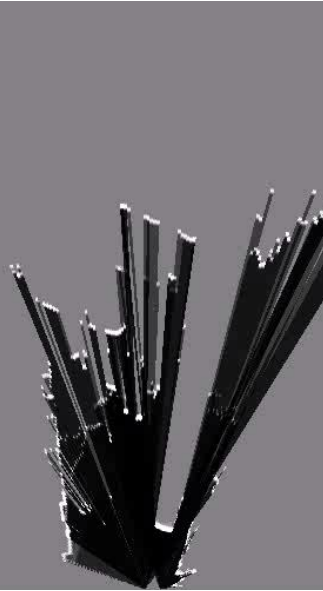
Embedded Multi-Sensors Perception
=> Continuous monitoring the dynamic environment



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



Urban street experiments

=> Almost no false alarm (car, pedestrians ...)

2015



Other Vehicle

Mobile Dummy

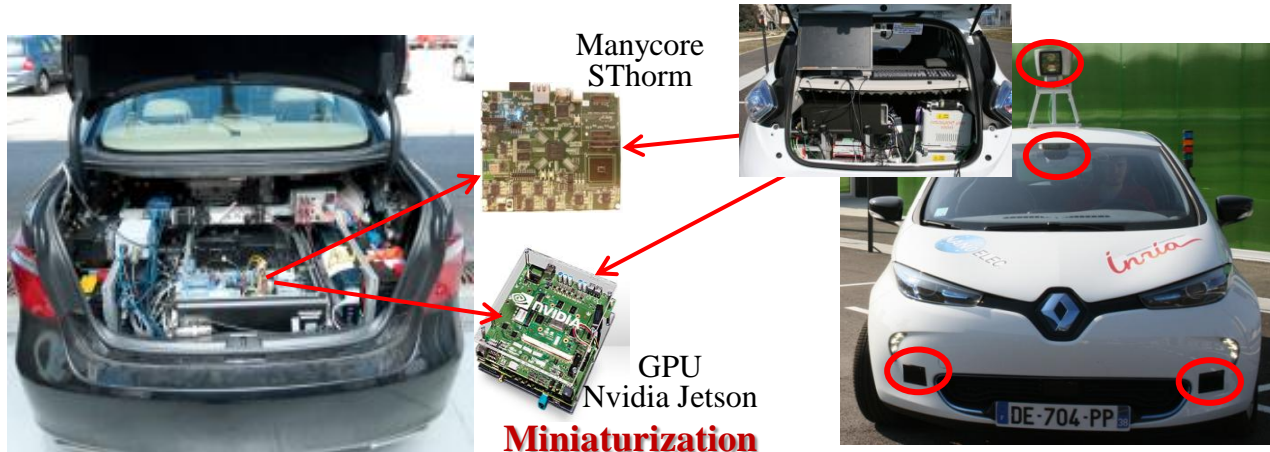
Ego Vehicle

Crash scenario on test track

=> Almost all collisions predicted before the crash 0.5 – 3 s before)

Embedded perception & V2X Communication

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



Toyota Lexus

Renault Zoé



Integrated Perception Box
Movable & Connected

