Automatized vehicle @ Toulouse from “PROMETHEUS to EasyMile”

A storytelling by Jean-Luc MATE

LAAS 23 March 2017
Chapter 1

Genesis

The world before LAAS
1925 Houdina remote Radio controlled car
1939 New York FUTURAMA Exhibition

• An early representation of the autonomous car was Norman Bel Geddes ‘s Futurama exhibit sponsored by General Motors at the 1939 World’s fair, which depicted:

• electric cars powered by circuits embedded in the roadway and controlled by radio.
1939 New York FUTURAMA Exhibition
1950 RCA LAB’S Radio controlled car

The RCA radio-controlled car. (Credit: Wikimedia Commons)
1950 First Radio Transistor

TRANSISTORS—first family of electronics
1956 the American autonomous car dream
1958 GM firebird II

A sophisticated guidance system intended for use with "the highway of the future," where an electrical wire embedded in the roadway would send signals that would help guide future cars and avoid accidents.
1958 the first cruise control on Chrysler Imperial
1960 first integrated circuit
Chapter 2 :
The world with LAAS in Toulouse
Charismatic electronic engineer with teaching talent and strong entrepreneur profile
1967 Jean Lagasse contribute to attract Motorola

C'était, raconte Jean-Etienne Cassignol en 1966 à Toulouse. Motorola, le leader mondial dans les semi-conducteurs, cherchait à s'implanter en Europe. Une délégation conduite par le grand patron avait entrepris un tour de France pour choisir le site du nouveau centre de fabrication destiné aux besoins européens.

Nous étions avec Jean à Toulouse, très intéressés par cette implantation. C'était mon premier contact avec Lester Hogan, le grand patron des semi-conducteurs chez Motorola, qui allait faire basculer toute ma carrière.
1968: The LAAS Founder .... again a builder

MAY 1968 Another anniversary in PARIS
1968 : The LAAS Founder ...... select his deputy
1971 we can start on computing miniaturization
Georges Giralt French pionner in Mobile Robotics

1977-1992  The Hilare Family
LAAS - France

1977 - Hilare I

Wheels: 2 driving wheels and a free wheel
Batteries: 24V
Bus: Multibus
Processors: 4 x Intel 80286
Operating system: none
Communication: serial radio modem (9600 bauds)
Sensors: Odometer, 16 US sensors, a Laser Range Finder
Dimensions (LxWxH): 80cm x 80cm x 60 cm
Weight: 400kg
Robotics and Artificial intelligence RIA french foundation

1990 - Hilare II

1992 - Hilare IIbis

Wheels: 2 driving wheels + 4 free wheels
Batteries: 48V
Bus: 1 VME Rack
Processors: 4 x Motorola 68040 + 1 Motorola PPC 604
Operating system: VxWorks 5.3.1
Communication: Ethernet radio modem (3 Mbit/s)
Sensors: odometry,
32 Sonar range sensors,
2D Laser Range Finder,
1B&W camera
Dimensions (LxWxH): 130cm x 80cm x 80cm
Weight: 400kg
1977 - 87 Jean Lagasse enter the industry!

After having been director of scientific and technical affairs (DRAST) at Renault, he was promoted director of research and president of REGIENOV (Renault innovation)
1978: Jean Lagasse brings to Toulouse the French Automotive Electronics foundation.
80’s German car makers are leading Automated Driving

https://www.youtube.com/watch?v=I39sxwYKlEE
Chapter 3:
French German EUREKA Initiative
Prometheus: the largest R&D program for the vehicle of the future
PROMETHEUS

PROgraMme for a European Traffic of Highest Efficiency and Unprecedented Safety, 1987-1995 - 749M€

Defined the state of the art of “autonomous” vehicles.

CED 1: Vision Enhancement
CED 2-1: Friction Monitoring and Vehicle Dynamics
CED 2-2: Lane Keeping Support
CED 2-3: Visibility Range Monitoring
CED 2-4: Driver Status Monitoring
CED 3: Collision Avoidance
CED 4: Cooperative Driving
CED 5: Autonomous Intelligent Cruise Control
CED 6: Automatic Emergency Call
CED 7: Fleet Management
CED 9: Dual Mode Route Guidance
CED 10: Travel and Traffic Information Systems
Strategic Approach: From the product “Vehicle” to the product “traffic”. Considering the high complexity of the program, it had been started and planned carefully and installed a new form of cooperation between industry, basic research entities and governments in order to integrate all relevant partner just from the beginning.
The Key people @ Renault - PSA & LAAS

D. Angello
- Directeur de la Recherche
  RENAULT S.A. • Chef de
  Projet PROMETHEUS,
  • Représentant RENAULT au
    Steering Committee du
    Programme.
  (Avant propos).
  (R.N.U.R.
  9/11, Avenue du 18 Juin 1940
  92500 Rueil Malmaison)

A. Raul
- Direction des Recherches et
  Affaires Scientifiques.
  • Représentant PSA à
    PROMETHEUS.
  (Avant-Propos).
  (Peugeot S.A. - Centre
    Technique Citroën - D.R.,A.S. -
    Route de Gisy
    78140 Velizy-Villacoublay)

D. Estève
- Directeur de Recherche au
  LAAS/CNRS.
  • Responsable Scientifique du
    Programme PROCHIPFRANCE
  Spécialiste des questions
    d’intégration de systèmes et
    microsystèmes (Introduction
générale Chap. 1, Parag. 1 et 2).
  (LAAS-CNRS
  7, avenue du Colonel Roche
  31077 Toulouse cedex)
Pro-Chip: Development of the integrated microelectronics required for a Prometheus vehicle with advanced on-board automotive electronics

Pro-Art: Methodological investigations of applications of Artificial Intelligence for signal processing and decision making processes.

L’intégration des systèmes électroniques dans l’automobile du XXIᵉ siècle

XM Alto : véhicule de synthèse de PSA Peugeot Citroën
Prometheus – MMI and Safety concepts in Pro-Car

Pro-Car: Development of
- Computer-assisted systems in vehicles to assist and relieve the driver
- MMI- concepts to support safe interactions between driver and computer-assisted systems.
- Reliable, safe and high quality Hard- and Software and concepts for diagnosis, service and maintenance.
1990 - 1994 First French common research – Industry Laboratory

Automotive systems focused

**Siemens Automotive**

4 laboratories CNRS/INPT :

**LAAS**, LEEI, LEN7, IMFT

Midi-Pyrénées region funding

10 industry/research projects
L'automatisme s'adapte au style de conduite

La nouvelle boîte de vitesses automatique DPO développée en commun par Renault et PSA fait appel à la logique floue pour calquer son comportement sur celui d'une transmission mécanique classique.

réagit comme une boîte mécanique. Cela grâce à son système de gestion électronique par logique floue, développé avec Siemens. Ainsi, la DPO intègre neuf lois de passage auto-adaptatives, alors que la plupart de ses concurrentes n’en possèdent que deux. Le calculateur 8
1996 - 2005 Institute for Embedded Systems for transportation

Strong focus in Automotive driven by visionary managers and Toulouse city

25 funded projects with active participation of Renault and PSA (PREDIT)
IERSET in the top of ADAS R&D projects
DRIVER VIGILANCE MONITORING - NEW DEVELOPMENTS

S. Boverie\textsuperscript{a}, D. Daurenjou\textsuperscript{a}, D. Estève\textsuperscript{b}, H. Poulard\textsuperscript{c}, J Thomas\textsuperscript{c}

\textsuperscript{a} Siemens VDO Automotive SAS - B.P.1149 av. Paul Ourliac 31036 TOULOUSE Cedex France.  
\textsuperscript{b} Laboratoire L.A.A.S./C.N.R.S. - 7, av. du Colonel Roche 31077 TOULOUSE France.  
\textsuperscript{c} ACTIA – 25, Chemin de Pouvoirville 31400 TOULOUSE France

Abstract: Driver drowsiness is a major cause of traffic crashes all over the world. The real time detection and assessment of driver impairment through non-intrusive driver drowsiness detection system is a real challenge. Within this paper a quick overview of former development related with driver monitoring system is given. Then latest developments and results concerning sensing capabilities and diagnostic are presented. Finally some promising results are presented. Copyright © 2002 IFAC

Keywords: ADAS, Driver vigilance, diagnostic, image processing
PREDIT Research in Terrestrial transportation

New Active safety functions: ADAS

2001

French Research ministry award

Drowsiness driver Monitoring
Chapter 4

2010’s The IT world is changing the Automobile to more Connected & Automatized
The Internet Industry is Interested in the Connected Car

- 2.8 billion internet users x 20 min online per day = 933 million hours on the internet per day
- 1 billion vehicles x 60 min driving time per day = 1 billion hours driving per day

Internet consumer hours double with the car.
From manual driving to full automation

- **Level 0**: No automation
  - Driver must monitor the system at all the time

- **Level 1**: Assisted
  - ACC/lane keeping support
  - Only longitudinal or lateral control

- **Level 2**: Partial Automation
  - Integrated cruise assist
  - Partially automated longitudinal and lateral guidance in driving lane
  - Speed range: 0-130 kph

- **Level 3**: Conditional Automation
  - Highway assist
  - Partly automatic longitudinal and lateral guidance
  - Lane change after driver confirmation
  - Supervision of surrounding traffic (next lane, ahead, behind)

- **Level 4**: High Automation
  - Highway pilot
  - Highly automated longitudinal and lateral guidance with lane changing
  - Reliable environment recognition, including in complex driving situations
  - No permanent supervision by driver

- **Level 5**: Full Automation
  - Auto pilot
  - Door-to-door commuting (e.g. to work) in urban traffic
  - Stricter safety requirements
  - No supervision by driver

Driver is not required during defined cases.
Consolidated vehicle infrastructure architecture

- Smart Antenna
- UI Computing Cluster
- Gateway
- IO Concentrators, Actors, Sensors
- Smart Sensors
- Steering
- Braking
- Computing Cluster(s)
- Gigabit Ethernet
- Engine
- Battery
- Smart Sensors
- Back-end System
Back to USA Open road in Nevada
Self-Driving Vehicles, from Science-fiction to Reality
Automated Driving Roadmap

- Automated valet parking 2017
- Remote park assist 2015
- Evasive steering support 2015
- Automatic emergency braking since 2010
- Assisted driving Supports the driver
- Highway assist 2018
- Traffic jam assist 2015
- Partially automated driving Permanent driver supervision
- Auto pilot >2025
- Highway pilot 2020
- Traffic jam pilot 2018
- Urban Auto-Pilot Low speed (Pods) >2021
- Highly and fully automated driving Reduced driver supervision
Challenges to Highly Automated Driving - Level 3 to 4

• Environment models world wide!
• Vehicle E/E Architecture with robust OTA reprogramming & cybersecurity
• Functional Safety
• AI & Deep learning smart integration
• Driver monitoring: valid for all types of drivers world wide!
• Integration of third party information: connected & cooperative driving
• Legal aspects
• Add on cost in a given platform

• Safety, Security and Intuitive use for customer acceptance.
Chapter 5

2017 The Toulouse Automotive EcoSystem is booming
GUIDE
SCIC SA – Innovation in GNSS metrology

**Business**  Geolocation testing laboratory

**Mission**  Assess and validate the performances of geolocation critical functions, especially dedicated to *autonomous vehicles* and trains.

**President**  Marc POLLINA : CEO M3 Systems

**Workforce**  Full time engineers supported by the founding members and CNES (French Space Agency).

**Key-Projects**  ECOTAXE, PPP, JUPITER, GUEST, GPSTART, GEOFER, HISTB2,

**Know how**  Simulation tests based on GNSS signals and sensor measurements, previously collected in the field.
Geolocation performances
Accuracy – Integrity – Availability

GNSS, the sole sensor measuring absolute positions at any point, but requiring a system integration with relevant validation tests.

20m error caused by a "multi-path"

20 receiver measurements, simultaneously
Visionary manager with strong link with top company challenges can change the world

Renault reinforces its development in connected vehicles, with the acquisition of Intel's French embedded software R&D activity: Renault Software Labs

“This acquisition is right in line with Groupe Renault’s strategy of offering new connected services and improving the experience of its customers. The Intel employees joining Renault hold highly relevant skills in what is a strong competitive technical field, where the Alliance is one of the world leaders. Groupe Renault thereby continues to support French innovation and economic development in France,” said Carlos Ghosn, Chairman and Chief Executive Officer of Renault.

ALEXANDRE CORJON
ALLIANCE GLOBAL VICE PRESIDENT
RENAULT-NISSAN, FRANCE
260 passionated SW designers ready to build in house innovations for Connected cars in Toulouse
Joint venture **AVS SAS** on driving simulators

Visit OKTAL at Booth 7000 at Autonomous Vehicle Technology World Expo Stuttgart 2017, 21th – 22th June at Stuttgart

**Les simulateurs jouent un rôle déterminant dans le développement de nouveaux véhicules.**
TEF810X Fully-Integrated 77 GHz Radar Transceiver TEF8102

Toulouse AUTOMOTIVE IC design and application center support ADAS & automatized Driving

- Microwave radar Chip set
  11 years experience
  3rd Monolithic generation ready for market

- ADAS Application center
- V TO X Connectivity
- Ethernet in Automotive
- Vehicle control computing platform:
- MEMS Smart sensor
Continental engineering services provide an open door to the group

**Highlight Topics**

**AUTOMATED DRIVING**

Our strong system competence allows us to develop comprehensive technical concepts, which have our single systems ideally interact and accompany you on the way to automated driving...

Read More

**ELECTRIC DRIVING**

We realize effective solutions and high-performance powertrain systems...

Read More

**TECHNOLOGY TRANSFER**

With our automotive experience we offer you technological solutions in any of your industries...

Read More

**BIG DATA**

Due to increasingly networked vehicles, more and more data is generated. When appropriately used, a variety of new functions and applications follow.

Read More
Dr Boverie: ADAS engineering competence center in Toulouse

- **Driver Monitoring**
  - Image Processing
  - Driver Modelling
  - Human Machine Cooperation

- **Environment Modelling**
  - Radar, Lidar, Camera
  - eHorizon
  - Sensor fusion

- **Vehicle Control**
  - Vehicle Modelling
  - ADAS Functions
  - Brake & Steering Control

- **System Engineering**
  - System Architecture
  - Safety Concept
  - Tests & Validation
150 Passionated designers connecting cars with the Cloud @ Continental Digital Services Toulouse
Robotique autonome
Le guidage des navettes autonomes

Michel DHOME
06 700 150 71
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EASYMILE : Autonomous Shuttle as Toulouse lighthouse
R&D workforce with LAAS inside

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Years</th>
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<tbody>
<tr>
<td>Pierre Guglielminotti</td>
<td>Internship</td>
<td>2017</td>
</tr>
<tr>
<td>Olivier Lefebvre</td>
<td>PhD</td>
<td>2003-2006</td>
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<tr>
<td>Quentin Gaudel</td>
<td>PhD</td>
<td>2013-2016</td>
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<td>Laurent Denarie</td>
<td>PhD</td>
<td>2013-2017</td>
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<td>Arnaud Degroote</td>
<td>PhD</td>
<td>2007-2013</td>
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<td>Pierrick Koch</td>
<td>PhD</td>
<td>2012-2016</td>
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<tr>
<td>Cyril Roussillon</td>
<td>PhD</td>
<td>2008-2013</td>
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<td>Bruno Celariès</td>
<td>Internship</td>
<td>2013</td>
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<td>Alexandre Hamez</td>
<td>Post-doc</td>
<td>2010-2011</td>
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<td>Olivier Roussel</td>
<td>PhD</td>
<td>2012-2015</td>
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<td>Alexandre Ravet</td>
<td>PhD</td>
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<td>Gabriel Bustamante</td>
<td>PhD</td>
<td>2013-2017</td>
</tr>
<tr>
<td>Julien Cornier</td>
<td>Internship</td>
<td>2011/2012</td>
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Happy birthday to all LAAS colleagues
bring more opportunities and synergies

**IVECO**

AUTONOMOUS TECHNOLOGY BROUGHT TO BUS BY EASYMILE

**TLD AND EASYMILE ANNOUNCED A PARTNERSHIP TO DEVELOP TRACTEASY, THE FIRST AUTONOMOUS BAGGAGE TRACTOR**
Off-road leader and founder of RobAgri
The voice of **Ethics** is well received from Toulouse TSE

• Jean-François Bonnefon (Ph.D., cognitive psychology) is a Research Director at the French **Centre National de la Recherche Scientifique.** He works at the **Toulouse School of Economics,** His work deals with decision-making, reasoning, and moral preferences.

• **He is currently interested in the kind of ethics people want for self-driving cars** and other machines.
The planets are aligned
Régional Automotive cluster : intelligent transportation systems architect
Francazal: Robotic Village and R&D integration & test center for Autonomous Transport of the future
A New Living lab for Autonomous and Connected vehicles with 36,000 potential users in Toulouse university campus.
Bouderyless innovation center for academia, industry, high schools and citizens end users.
Interdisciplinary Know how capitalization
Multimodal transport interfaces
Links with Toulouse public transport
Toulouse is ready for more Automotive Attractiveness

• the power of irresistible attraction
  allure, animal magnetism, appeal, captivation, charisma, charm, enchantment, fascination, force field, glamour, magic, magnetism, oomph, pizzazz, seductiveness, witchery
Thank you for your attention & to Marise for inviting to « COME TOGETHER »

Listen to Road Abbey tube: https://www.youtube.com/watch?v=_HONxwhwmGU
Jean-Luc Maté, président et fondateur de JLM Conseil « from ideas to money »
Président du Conseil de prospective de Toulouse Tech
ex Vice Président Stratégie & Business Développement de Continental Engineering Services France & Espagne
Fondateur et ancien vice-président de la plateforme Européenne de Recherche sur le Transport terrestre : ERTRAC.
Fondateur et Président d'honneur du Cluster régional de la filière automobile en Occitanie AUTOMOTECH en charge de la stratégie et du développement international.
Fondateur et président d'honneur du Cluster R&D Européen EUREKA EURIPIDES sur les systèmes électroniques intelligents.
Administrateur de la société française des ingénieurs de l'automobile SIA

Jean-Luc Maté est un des pionnier de l'électronique automobile moderne qui a vu le jour à Toulouse par la localisation de la filiale électronique de Renault et de Bendix : Renix en 1979. Il a personnellement contribué en entrepreneur passionné depuis plus de 38 ans à l'International d'innovations majeures dans tous les domaines du véhicule automobile moderne.