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Le développement technique des véhicules autonomes

Renaud Dubé, Roland Siegwart, ETH Zurich
www.asl.ethz.ch
www.wysszurich.ch

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- Potential Impact

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Mobility | at the pulse of our society

- Cities and especially Mega Cities are suffering from disastrous traffic situations and air pollution.
- Up to 40% of the city traffic is due to search of parking spots.

lauraliebtbuenosaires.wordpress.com

- Thus, new, more sustainable and efficient mobility concepts are needed.
- Intelligent and autonomous cars can contribute to these pressing societal problems.

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Technologies Disrupting Services | digitalization / industry 4.0

- Microelectronics / Computing — Microsoft, Apple
- Internet / Information — Google, amazon, Facebook, YouTube, airbnb
- Mobile Devices / Connectivity — Apple, WhatsApp, UBER
- Robotics / Autonomous Mobility — Apple, Google, amazon, UBER

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Technologies Disrupting Services | digitalization / industry 4.0

- Microelectronics / Com
- Internet / Infor
- Mobile Devices / C
- Robotics / Autonomous Mobility

Physically Interacting Machines
→ exponential increase of complexity

irbnb
WhatsApp
UBER
Apple
Google
amazon
UBER

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Robotics today (Tesla)

https://www.youtube.com/watch?v=8_lfxPI5ObM

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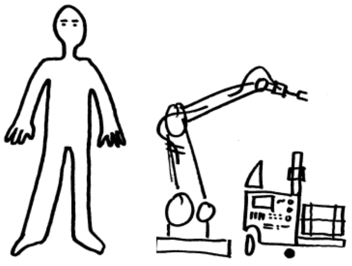
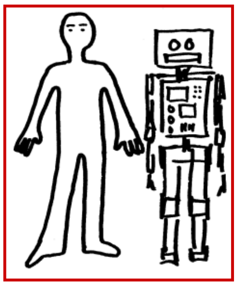
Next generation of Robots
| mobile, smart, connected, adaptive and closer to humans



Industrial Robots



Service and Personal Robots

Cyborgs

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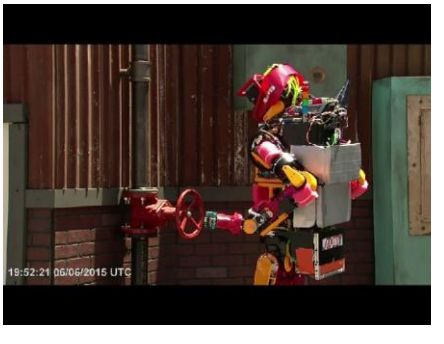
Fascinating Robotics

- Complex machines with high added value

OceanOne | Humanoid Underwater Robot
https://www.youtube.com/watch?v=p1HmgP9l4VY

Spot | hydraulic quadruped
https://www.youtube.com/watch?v=M8YjvHYbZ9w



DARPA Robotics Challenge
07.06.2015,
Team NEDO-JSK, Japan
12 x original speed!!
https://www.youtube.com/watch?v=8P9geWwi9e0

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The Challenge of Autonomous Driving

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Autonomous mobile robots | the key questions

- The three key questions in Mobile Robotics
  - Where am I ?
  - Where am I going ?
  - How do I get there ?
- To answer these questions the robot has to
  - have a model of the environment (given or autonomously built)
  - perceive and analyze the environment
  - find its position/situation within the environment
  - plan and execute the movement

Autonomous mobile robots | challenges and technology drivers

- The challenges
  - ***Seeing***, ***feeling*** and ***understanding*** the world
  - Dealing with ***uncertain*** and only ***partially available*** information
  - ***Act*** appropriately onto the environment
- Technology drivers
  | *technology evolutions enable robotics revolutions*
  - Laser time-of-flight sensors
  - Cameras and IMUs combined with required calculation power
  - Calculation power
  - Control, artificial intelligence and learning

Sensing and Perception

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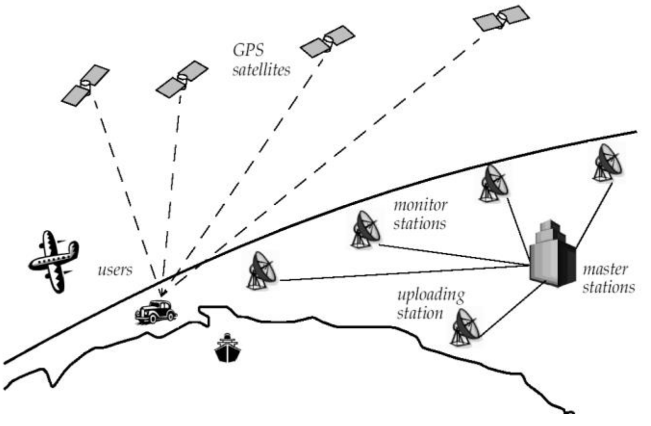
Key Sensors for Autonomous Driving

- Speed, steering angle, …
- 3D Laser
  - 3D and light independent
  - Expensive and bulky
- Cameras
  - Very rich information
  - Error prone (blurry, light sensitive, …)
  - 3D to 2D
  - Cheap
- GPS / D-GPS
  - Limited resolution
  - No link to local environment
  - Unreliable in city environments
  - Cheap



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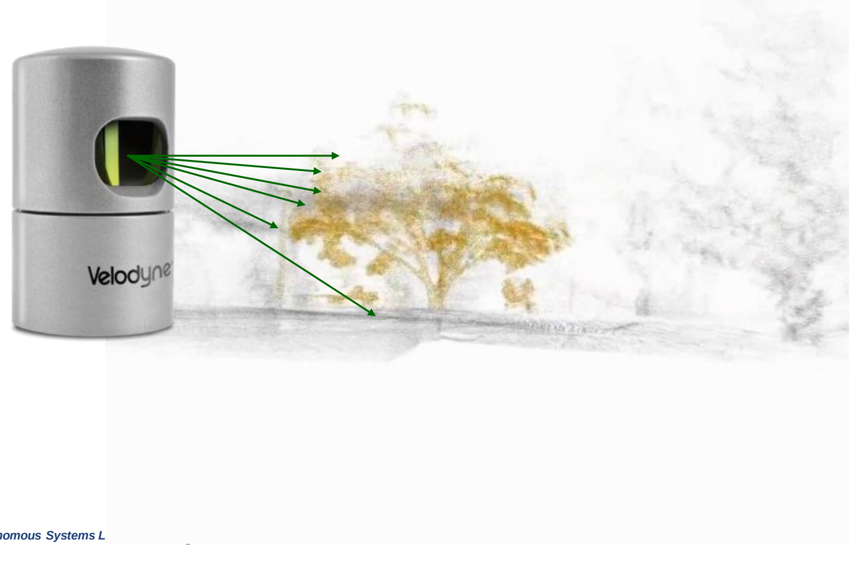
"Seeing" | Laser-based 3D mapping



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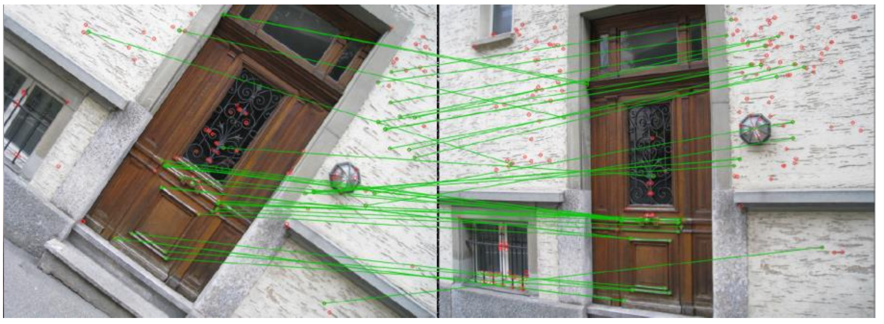
"Seeing" | Visual-Inertial Motion Estimation

Google Project Tango



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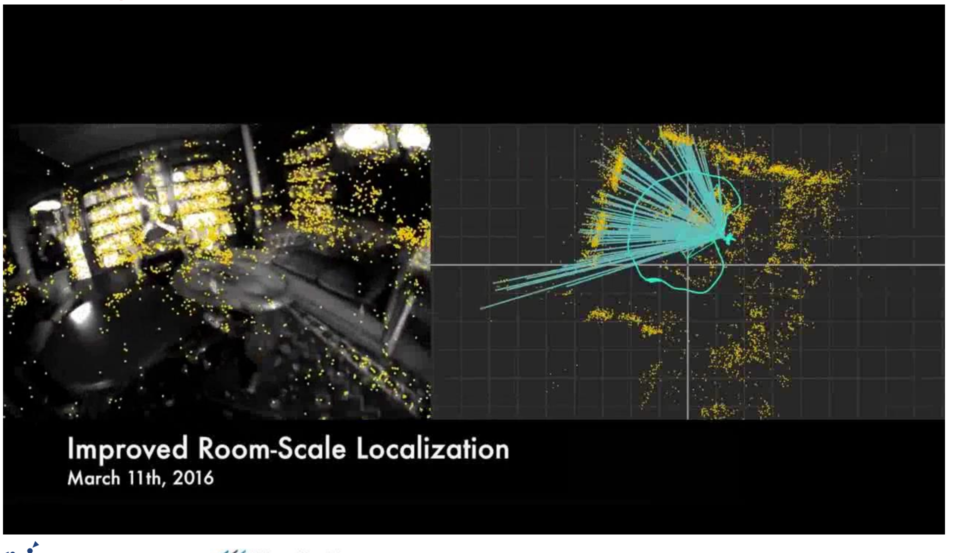
"Intelligent Smartphone" | perceiving and understanding the environment

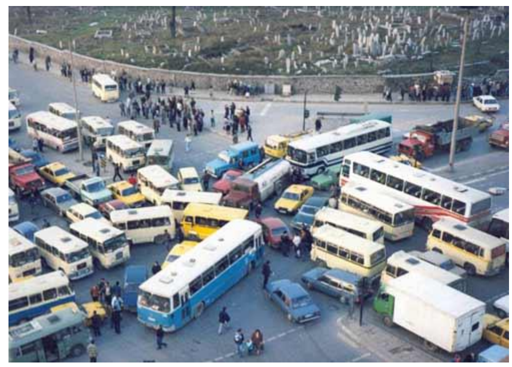


Google Project Tango

https://www.youtube.com/watch?v=yvgPrZNp4So

“**Understanding**” the world

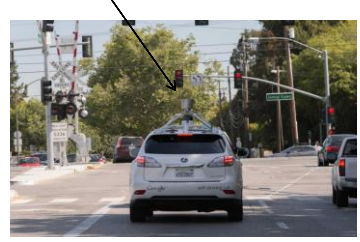
- Humans are unbeatable
  in taking decisions in complex situations and negotiate with other traffic participants



- Technology is better in *simple but fast decisions (ABS, ESP, …)*

Today | 3D laser sensors

Expensive, complex and cumbersome



- Google Self-Driving Car Project (status summer 2015)
  - > 20 vehicles in use
  - > 2,7 mio km, 1.5 mio km in autonomous mode
  - > 11 accidents
    - No people insured
    - Non of them caused by car control algorithm

https://www.youtube.com/watch?v=eJCR2TaeSFc

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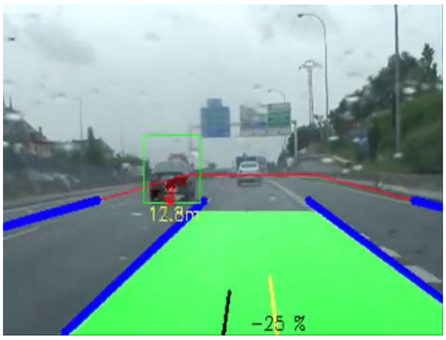
Today | cameras (lane tracking, …)



https://www.youtube.com/watch?v=JmxDIuCIlcg

https://www.youtube.com/watch?v=aGW4nRzx8Iw

- Detection and tracking of
  - Lanes
  - Street signs
  - Other cars
  - …

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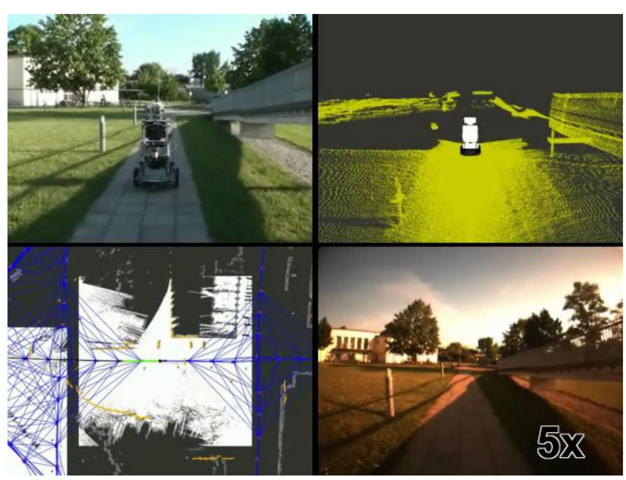
Today | cameras and laser

EUROPA - European Robotic Pedestrian Assistant

- In collaboration with
  - University of Freiburg,
  - Univ. of Oxford
  - KU Leuven
  - RWTH Aachen
  - BlueBotics



https://www.youtube.com/watch?v=HE0NK7rFfpk

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V-CHARGE

ETH zürich · University of Oxford · BOSCH · VOLKSWAGEN · Università degli Studi di Parma · Technische Universität Braunschweig

The V-Charge Examples

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V-CHARGE

V-Charge | Automated Valet Parking and Charging for e-Mobility

- V-Charge Vision
  - Seamless integration of individual and public transportation.
  - Autonomous valet parking of electric cars
    - Train stations, airports, company and university campuses, …
- Approach
  - Fully autonomous navigation using close-to-market sensors.
- Main Challenges
  - Visual perception and localization
  - Dynamic path planning
  - Communication, …
- Benefits
  - User comfort
  - High density parking possible

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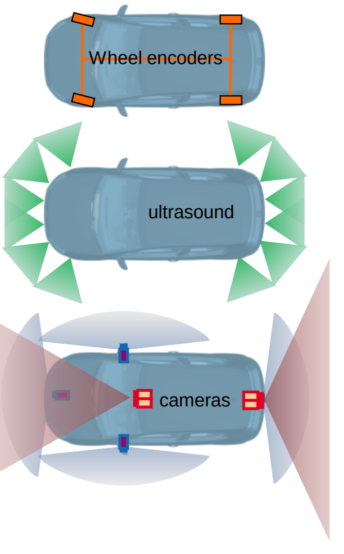
V-CHARGE

V-Charge | using close-to-market sensors



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V-CHARGE

V-Charge | Vision and Results

https://www.youtube.com/watch?v=7xQfKTAtyNU

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Potential Impact

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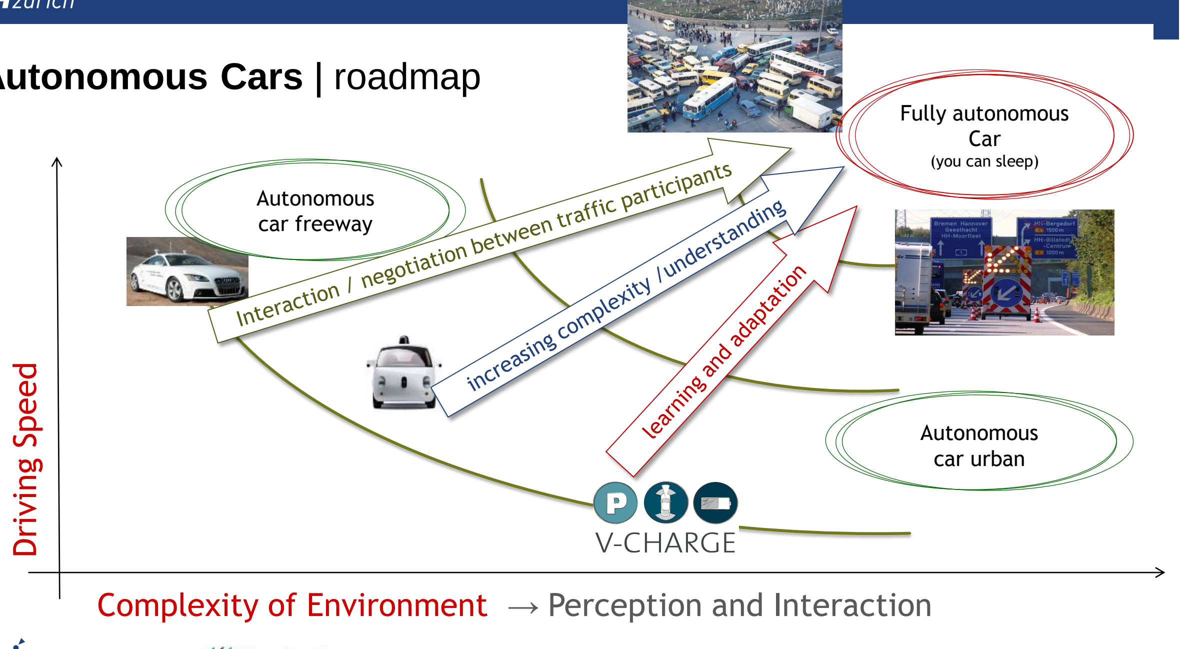
Autonomous Cars | roadmap



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Mobility of the Future | technology disrupting services

- Seamless integration of public and individual transportation
  - Uber & Autonomous cars
    - Cheep, efficient and on-demand
  - On-demand last mile "public" transportation with autonomous e-cars
    - Potentially cheaper than local buses
      - No driver
      - E-Cars: low running and maintenance costs

UBER

- Personal Airplanes
  - Conquer the third dimension
    - Personal commute airplanes (highly automated, lightweight)
    - Electric might become feasible for distances up to some hundred km.

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Urban Mobility System Upgrade | How shared self-driving cars could change city traffic

International Transport Forum

- TaxiBot
  - Self-driving cars that can be shared simultaneously by several passengers
  - Model City: Lisbon

→ Nearly the same mobility can be delivered by *10% of the cars*

→ In combination with high-capacity public transportation *65% fewer vehicles* are needed during peak hours

→ No need for on-street parking *freeing up around 20% of the kerb-to-kerb street space*

→ However, managing the transition will be challenging

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Conclusion

- Huge progress in autonomous in the last years
  - Systems cost are still an important issues
- Today
  - Low speed in somewhat complex environments (urban, structured)
  - High speed in structured environments (freeway)
- Missing technologies
  - Situation understanding
  - Interaction / negotiation between traffic participants
    - car-to-car
    - car-to-pedestrian
- Opportunities
  - Technologies coming out of R&D on autonomous vehicles make our road safer, already today
  - Autonomous vehicles will offer novel mobility concepts

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Autonomous Cars | a bright future without traffic jams