Autonome Fahrzeuge

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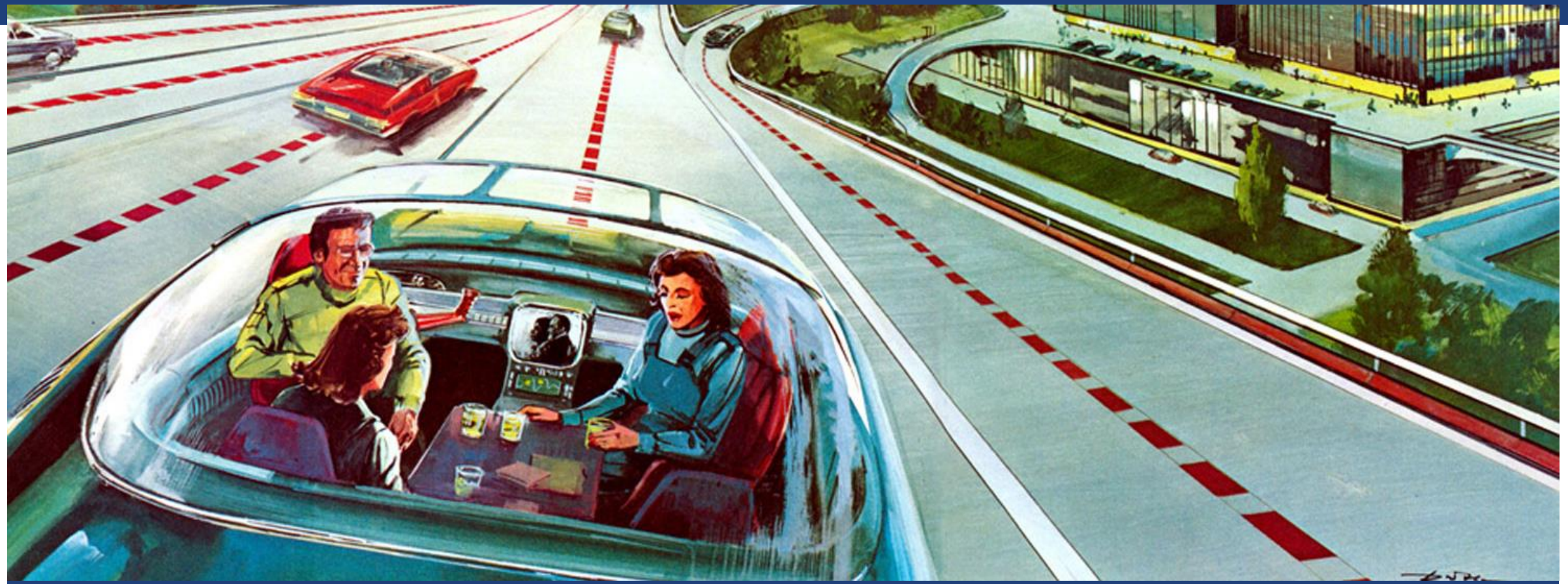
Engelberg, 9.10.2020

About me

- PhD graduate (2019), *at Prof. Dr. Roland Siegwart's Autonomous Systems Lab, ETH Zürich*
  - Visual (Self-)Localization for Autonomous Cars

- 2014-2015: V-Charge (FP7)
- 2016-2019: UP-Drive (H2020)



Autonomous Driving

The Victoria Advocate, March 24th, 1950

Advertisement: Central Power and Light Company

ELECTRICITY MAY BE THE DRIVER. One day your car may speed along an electric super-highway, its speed and steering automatically controlled by electronic devices embedded in the road. Travel will be more enjoyable. It will be made safe — by electricity! No traffic jams . . . no collisions . . . no driver fatigue.

Power companies build for your new electric living

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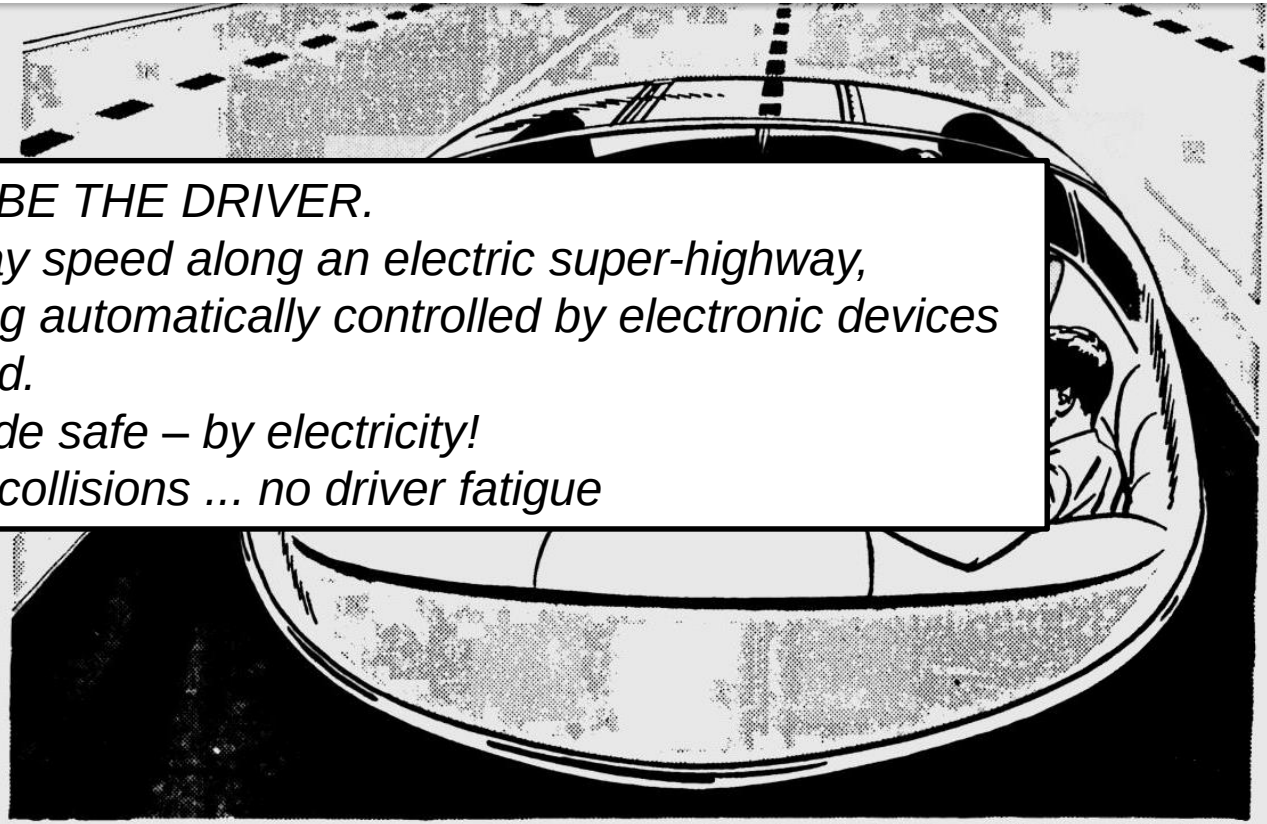

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Early 1960ties…

The Self-Driving Car is an Autonomous Mobile Robot

The three fundamental questions in autonomous mobile robotics:

- Where am I?

- Where do I want to go?

- How to I get there?

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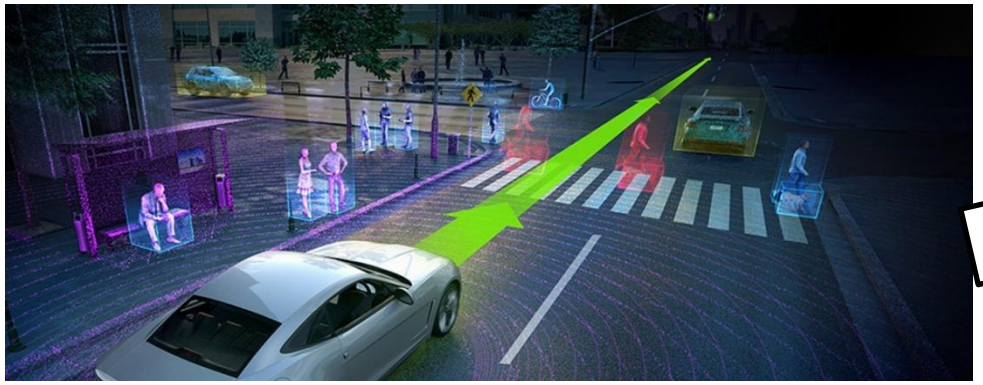
The three fundamental questions in autonomous mobile robotics:

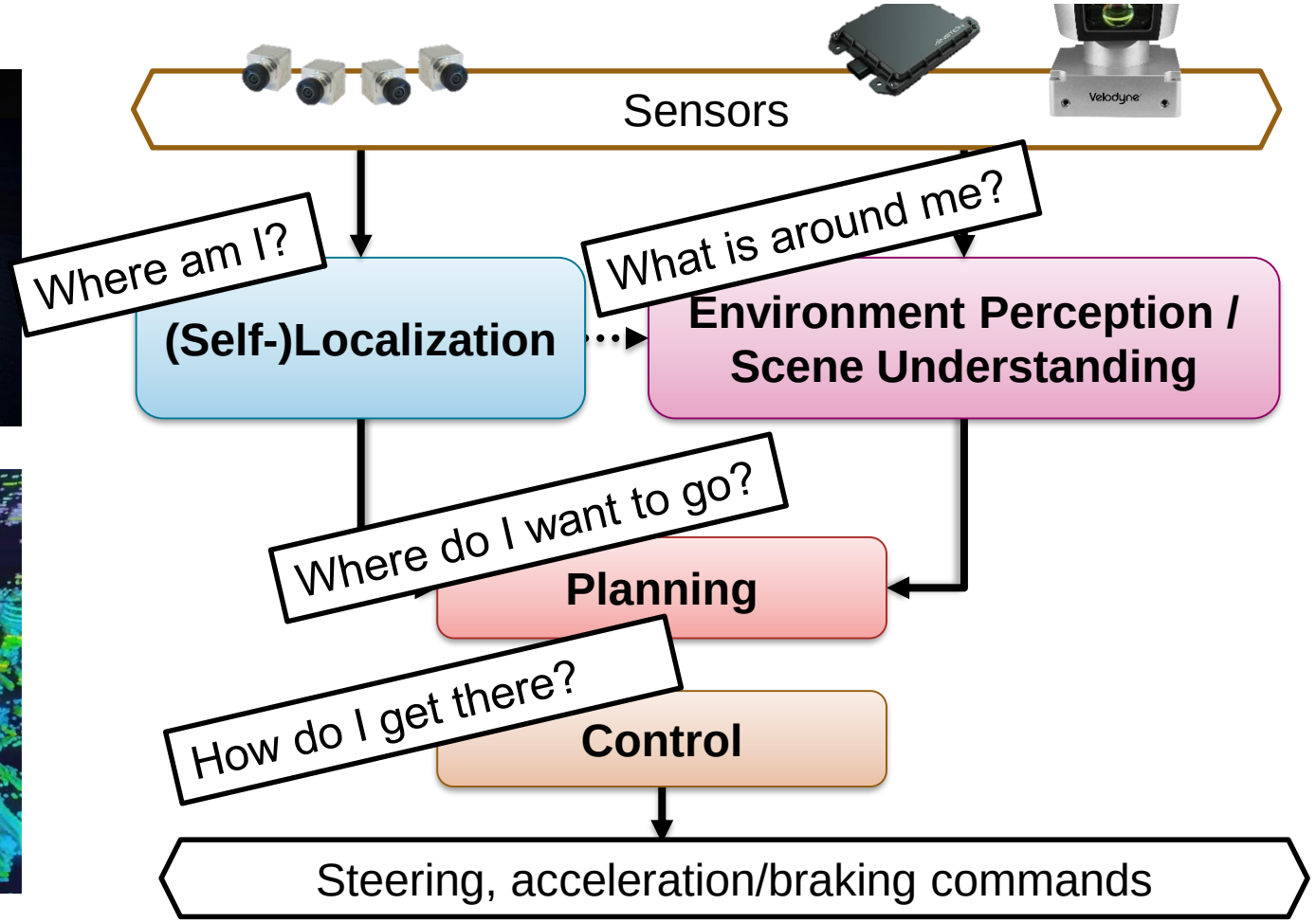
- Where am I?

- Where do I want to go?

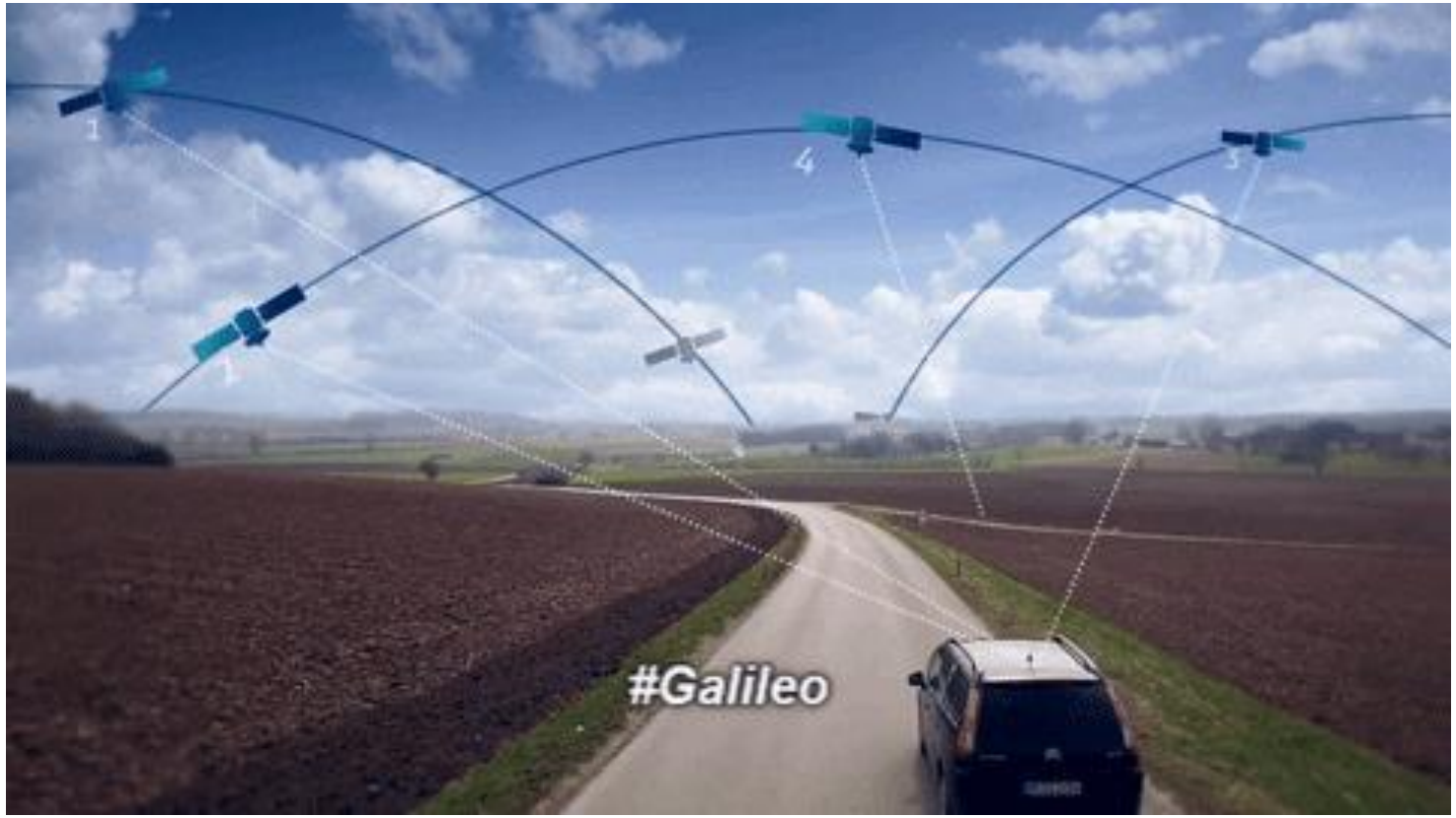
- How to I get there?
- What is around me?

Software Modules





Localization | GPS is not sufficient outdoors



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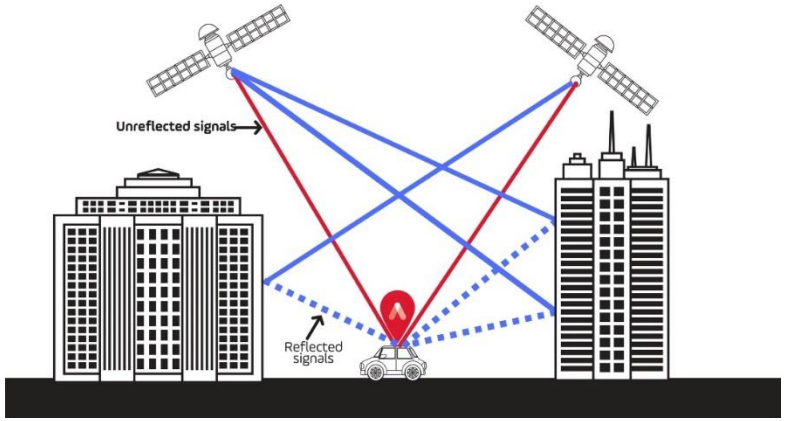
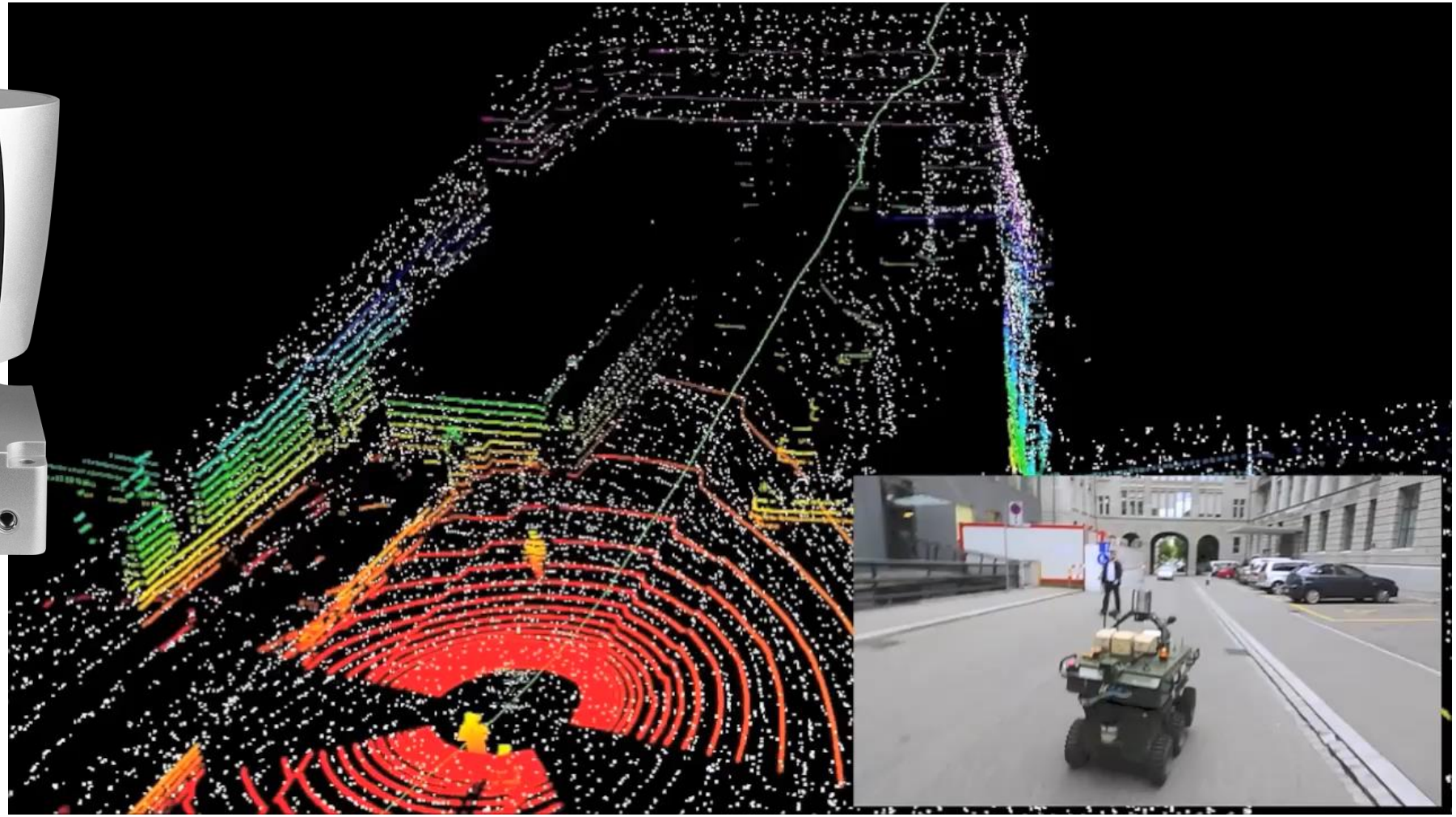


Multi-path: Errors > 5m

Obstructed skies

Need other sensors for localization

Localization | LiDARs



Localization | LiDARs

- ✚ High precision
- ✚ Invariant to changing weather and lighting conditions

- ━ Expensive

Localization | Cameras

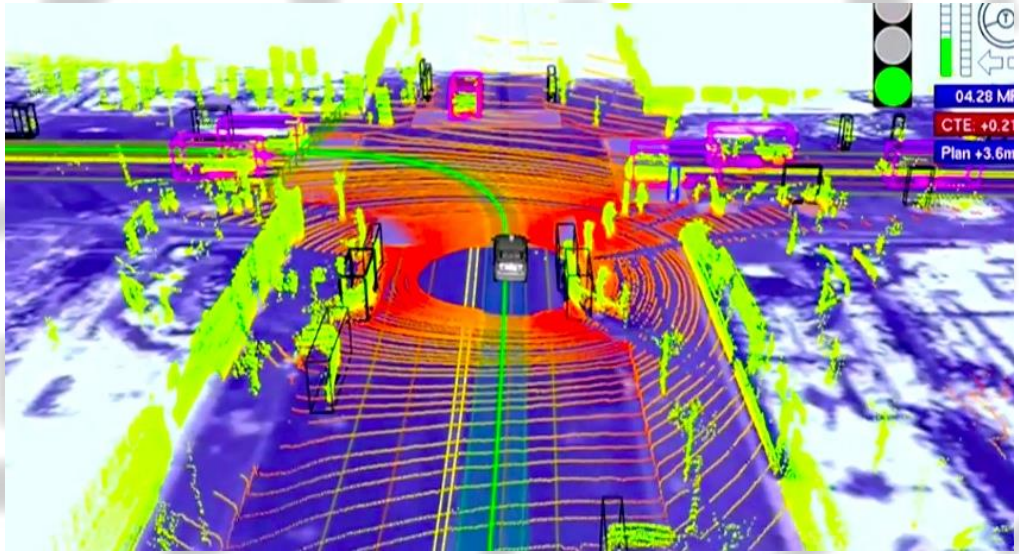
+ Affordable

− Sensitive to changing weather and lighting conditions

Sunny, summer *Cloudy, winter* *Snow, winter* *Sunny, winter*

Environment Perception / Scene Understanding

- What is around me?
  - Where are **other traffic participants**? What is their driving speed and direction?
  - Are there any **traffic signs** or **road markings** of my concern?
  - Where are **pedestrians**, obstacles, etc.?
  - Where are the **road lanes**?
  - Where is the **free** driving **space**?
  - Where can I **stop**? Where do I park?
  - …



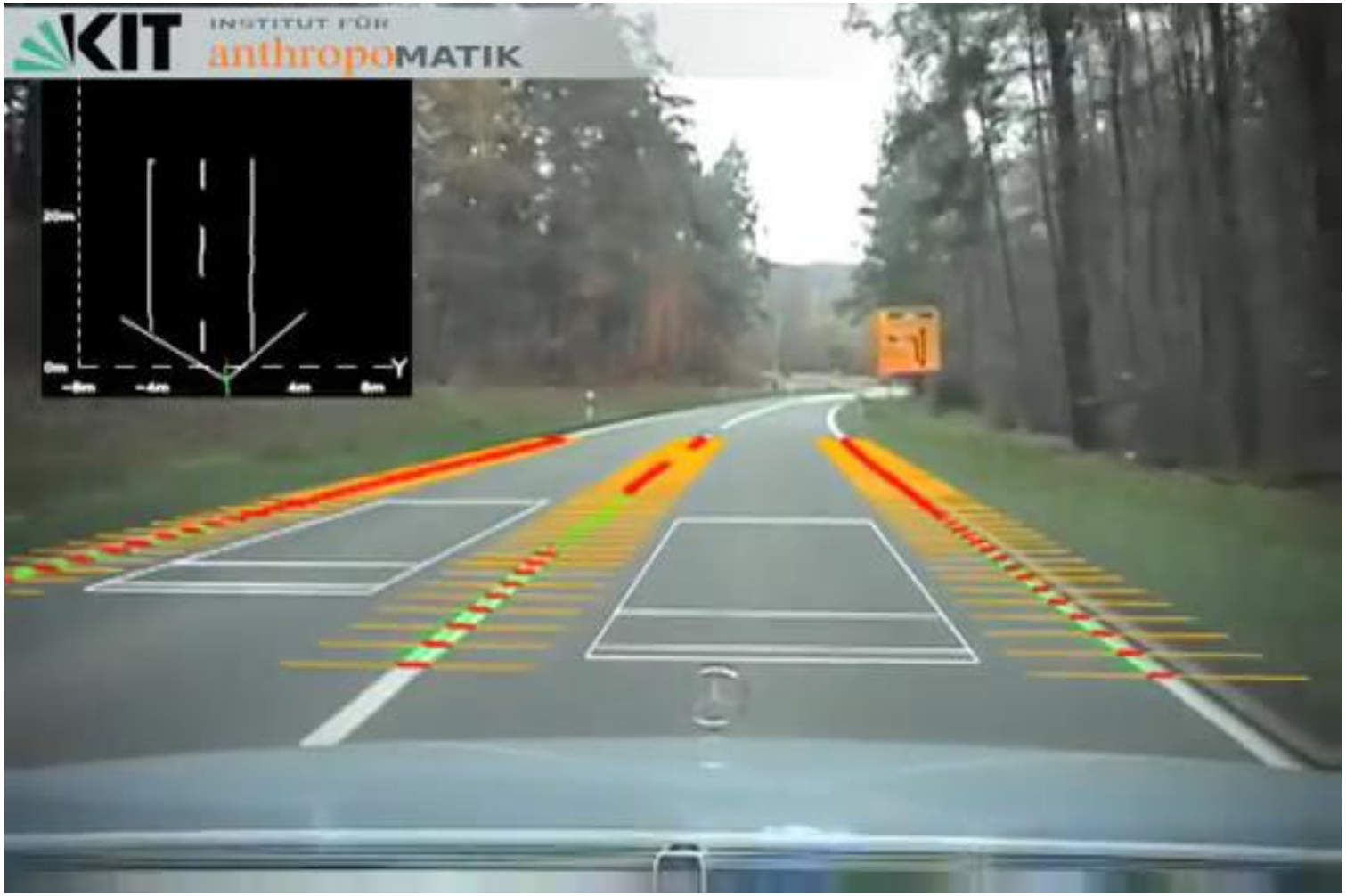
Environment Perception / Scene Understanding

- Image segmentation

Environment Perception / Scene Understanding

- Object detection & classification

Environment Perception / Scene Understanding



Environment Perception / Scene Understanding

Amnon Shashua, MobileEye

ETH zürich | UNIVERSITY OF OXFORD | BOSCH | VOLKSWAGEN AKTIENGESELLSCHAFT | UNIVERSITÀ DEGLI STUDI DI PARMA | Technische Universität Braunschweig

The V-Charge Project

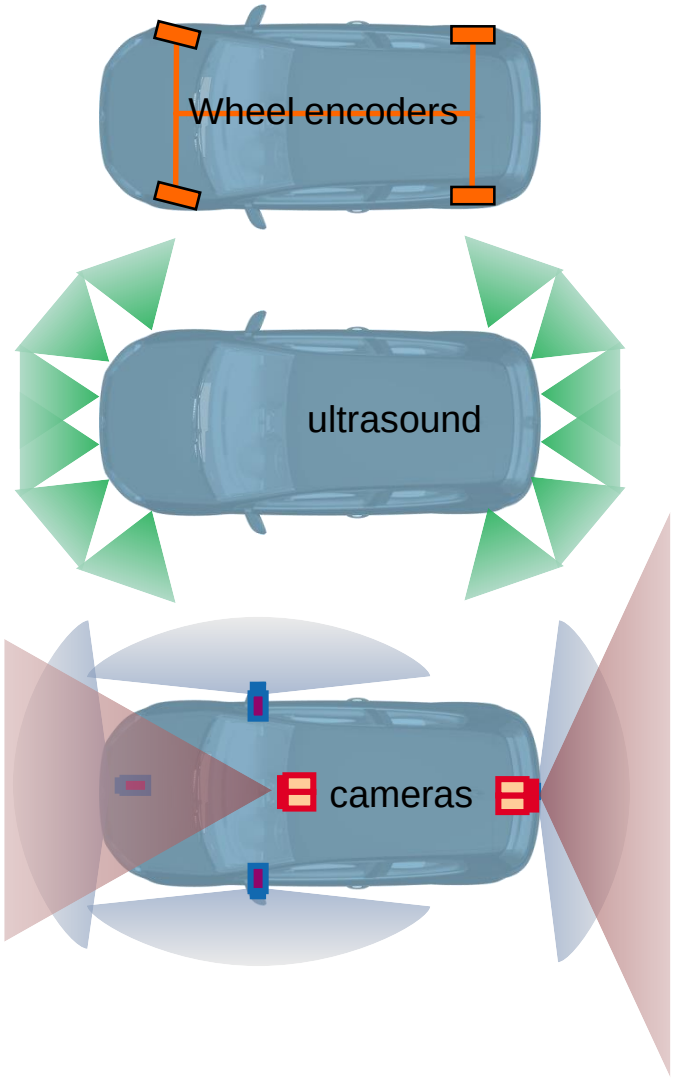
2012 - 2015

V-Charge | Vision

- V-Charge Vision
  - Seamless integration of individual and public transportation.
  - Autonomous valet parking of electric cars

- Benefits
  - User comfort
  - High density parking possible

V-Charge | Close-to-market sensors



UP-Drive
Automated Urban Parking and Driving

VOLKSWAGEN AKTIENGESELLSCHAFT

ETH zürich

IBM

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

CZECH TECHNICAL UNIVERSITY IN PRAGUE

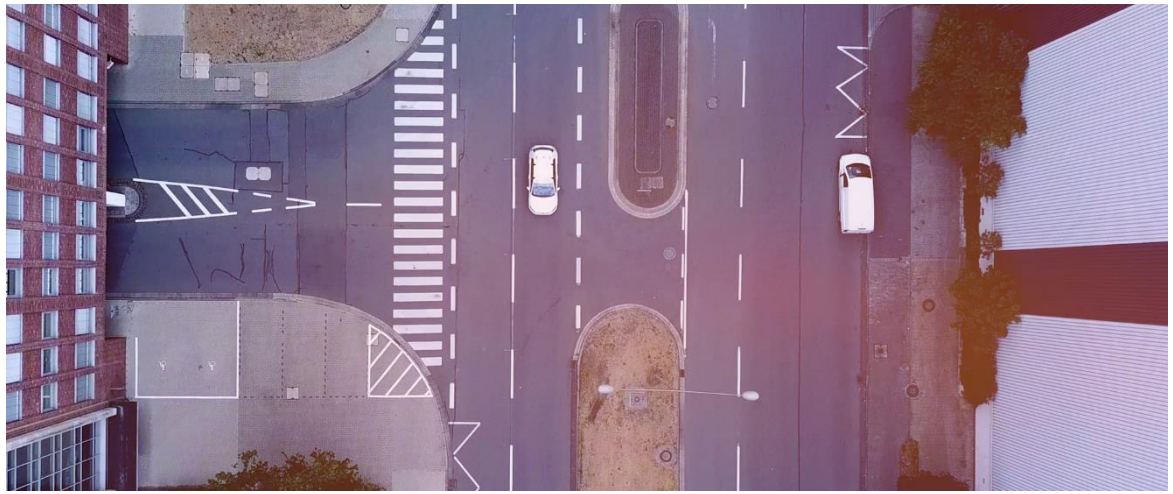
UP-Drive
Urban Parking and Driving

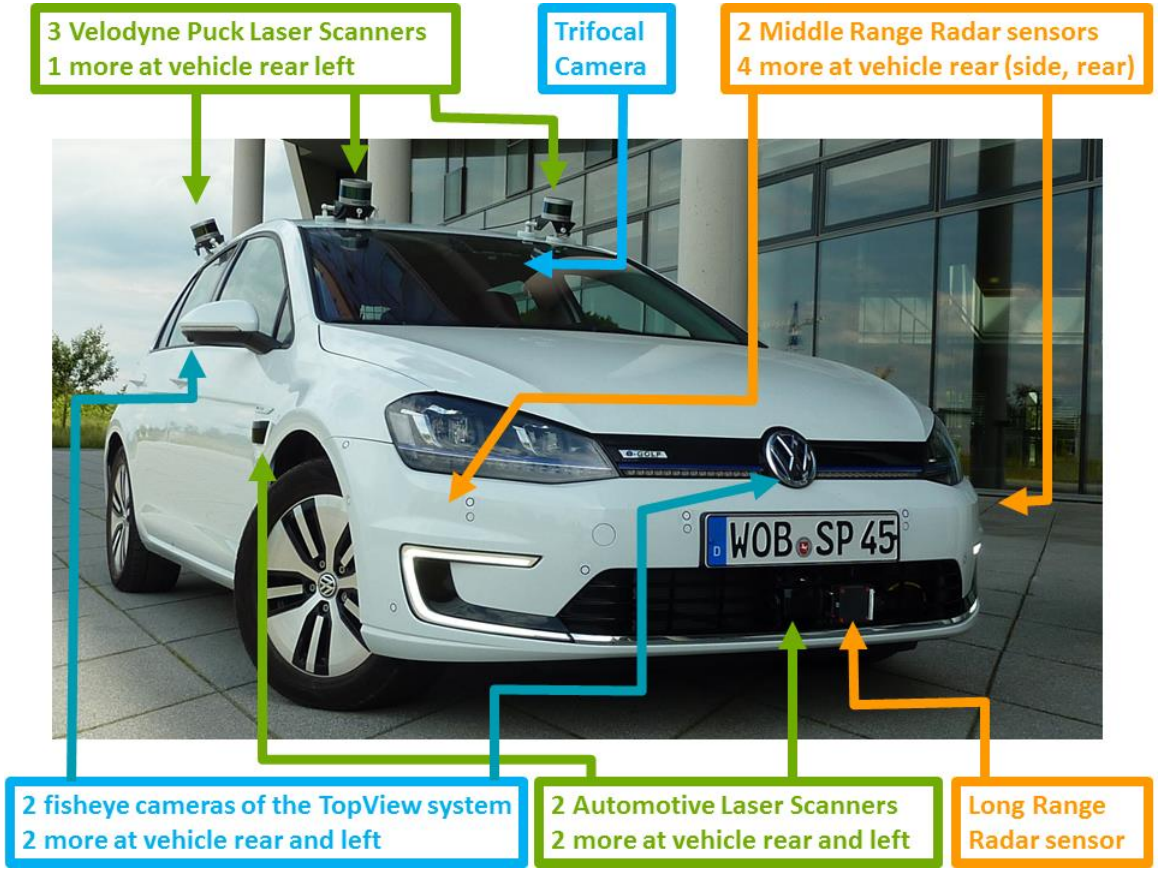
2016 - 2019

UP-Drive

- Autonomous Valet Parking in **Urban Environments**
- Multiple vehicles:
  Vehicle ⟷ cloud communication

➡ **Level 4 Urban Autonomous Driving**





Thank you for your attention!

Questions?