Autonomous vs. Automated

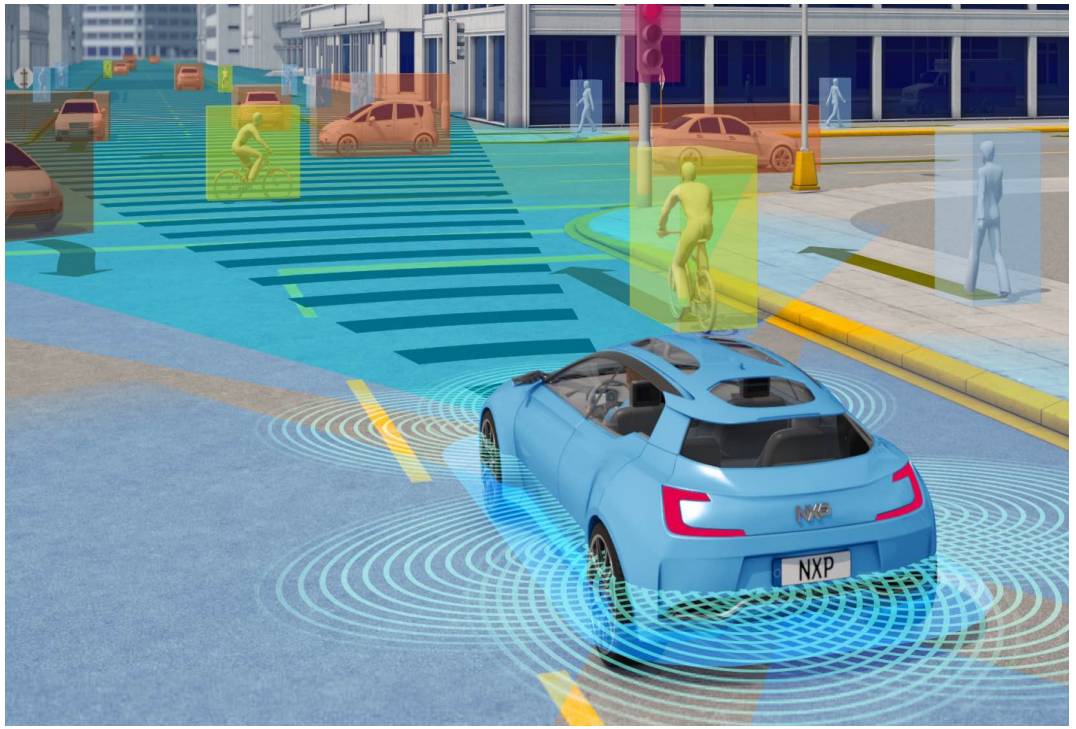
Are autonomous vehicles a blessing or threat

Autonomous vs. Automated

- Wood et al. (2012) first uses the term "autonomous"
- 'Automated' connotes control, while 'autonomous' connotes independently
- *Autonomous* means self-governing.
- Autonomous implies performance under uncertainties and the ability to compensate for system failures
- Earlier projects (i.e. ECT) relying on artificial aids such as inductive or magnetic strips
- Outside influences reduce the level automation, and may require intervention
  - When a driver is required, the term 'automated' would more accurate
  - Autonomous cars do not communicate with other vehicles or with an enveloping management regime

Geospatial world

- Autonomous driving will handle all the driving tasks
- This will have an impact on road safety and mobility for everyone
- Vehicles detect pedestrians, cyclists, vehicles, road work and more in all 360 degrees
- Sensors detect and predict the behavior all the road users
  - 94% of crashes involve human choice or error



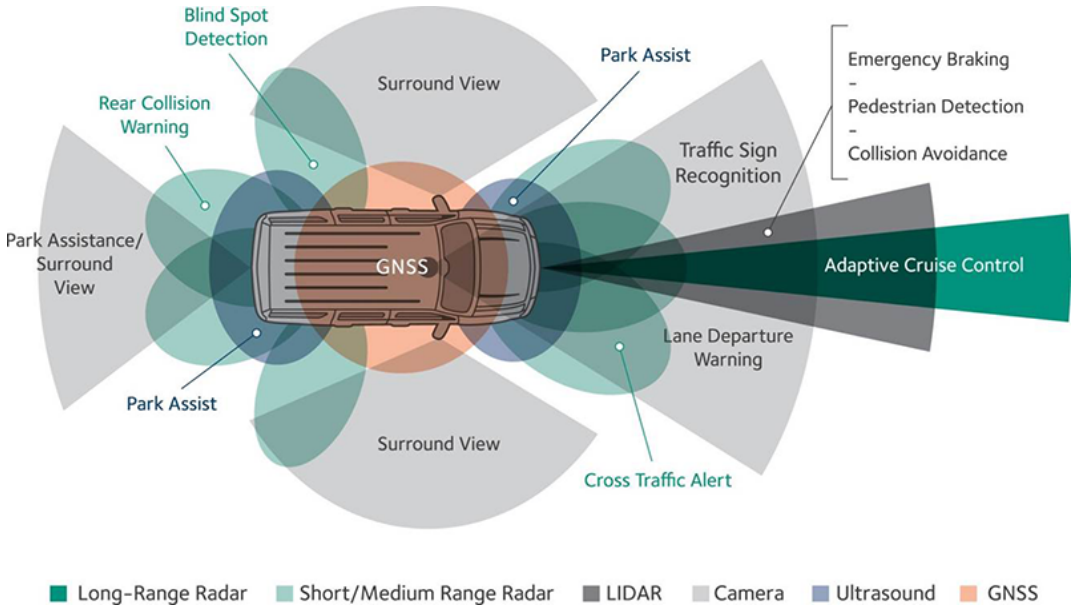
SAE's "driving modes"

- Level 0: Automated system issues warnings and may momentarily intervene but has no sustained vehicle control.
- Level 1 ("hands on"): The driver and the system share control
- Level 2 ("hands off"): The automated system takes full control. The driver must be prepared to intervene if the system fails.
- Level 3 ("eyes off"): The driver need no attention for the driving tasks, The vehicle will handle situations that call for an immediate response. The driver must still be prepared to intervene within some time
- Level 4 ("mind off"): No driver attention is ever required for driving.
- Level 5 ("steering wheel optional"): No human intervention is ever required

- note he shift from 2 to 3: the human driver no longer has to monitor the environment

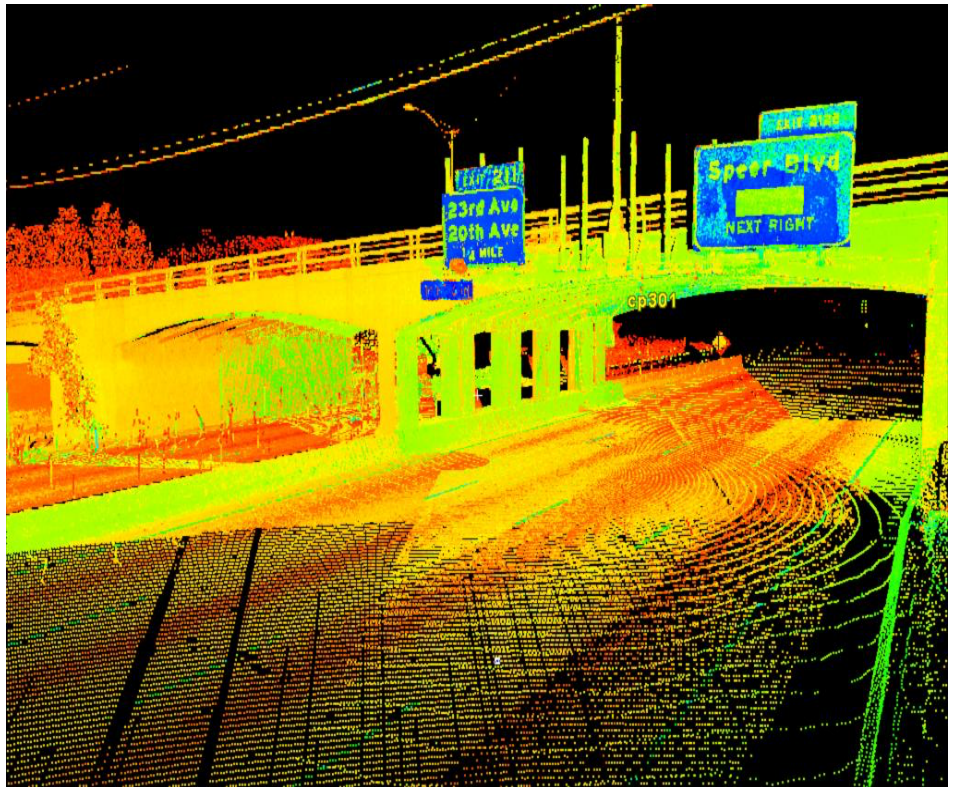
The increasing complexity

- The complexity of autonomous cars is increasing, with some 250 applications (e.g. navigation controls, weather sensors)
- The big challenge is to optimize that and let all of those vendors work



Making a map of the World

- Today, advanced robots are popping up everywhere thanks to: sensors, actuators, Machine Learning and AI
- Sensors:
  - Autonomous vehicles can only navigate with Lidar, which spews lasers to build a map of the world.
  - Algorithms pick landmarks and objects

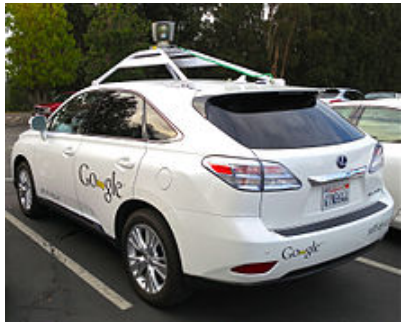


Robot platforms

- In autonomous driving, there exists a layer between the operating system running on the car and the algorithms
- ROS is an open-source for robotics, prototyping
- AWare OS, is designed for Level 4 autonomous driving
- Vertical vs horizontal approach in partnering with others

A self-driving car with the previous Google branding

Tesla Model S Autopilot is only suitable for limited-access highways, not for urban driving



A Lexus RX450h retrofitted by Google for its self-driving car project

Impact of autonomous driving

- Cities must rebalance budgets brought in by cars (taxes, fees, tickets and parking revenues)
- Driverless cars don't need these things
- The likelihood of widespread adoption is still unclear, but a number of unresolved questions will pop-up
  - A new look at how infrastructure is to be built
  - Infrastructure improvements must be beneficial to both human drivers and automated vehicles
  - Self-driving vans will make home deliveries significantly cheaper and transform retail
  - What is the effect on travel behavior?
  - Will car ownership and car use increase because it is easier to use them?
  - Will car-sharing decrease the total usage, and make cars more efficient?

Challenges

- The challenge is to produce sensory data in order to provide accurate detection
- Self-driving cars use algorithms, which fuse data from multiple sensors and estimates map updates
- Sensors detect and tracks of other moving objects, such as cars and pedestrians
- Typical sensors include Lidar, Vision, GPS
- Sensor fusion integrates information from a variety of sensors to produce a consistent, accurate, and view of the environment
- Driverless vehicles are being developed with neural architecture, in which neurons are simulated from the environment
- The neural network depends on an extensive amount of data extracted from real-life driving scenarios, enabling network to "learn"

Deep Learning

- Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms
- DL have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, where they have produced results superior to human experts
- DL is vaguely inspired by patterns in biological systems but have various differences from properties of biological brains, which make them incompatible with neuroscience evidences