SELF-DRIVING CARS Łukasz Dzwoniarek

AUTOMATION LEVELS OF AUTONOMOUS CARS

LEVEL 0



There are no autonomous features.

LEVEL 1



These cars can handle one task at a time, like automatic braking.

LEVEL 2



These cars would have at least two automated functions.

LEVEL 3



These cars handle "dynamic driving tasks" but might still need intervention.

LEVEL 4



These cars are officially driverless in certain environments.

LEVEL 5



These cars can operate entirely on their own without any driver presence.

LEVEL I

- 1992: Mitsubishi was the first to offer system warning the driver, without influencing throttle, brakes or gear-shifting.
- I995: Mitsubishi introduced syste m controlling speed through throttle control and downshifting, not by applying the brakes.
- 2000: Toyota refined their laser ACC system by adding "brake control", that also applies brakes.



COLLISION MITIGATION BRAKE SYSTEM

2003: Honda introduced an autonomous braking front collision avoidance system, using a radar-based system to monitor the situation ahead. The Honda system was the first production system to provide automatic braking. When activated, the CMBS has three warning stages.

- I. Audible and visual warnings to brake.
- 2. E-Pretensioner's tugging on the shoulder portion of the seat belt two to three times as an additional tactile warning to the driver to take action.
- 3. CMBS predicts that a collision is unavoidable, includes full seat belt slack takeup by the E-Pretensioner for more effective seat belt protection and automatic application of the brakes to lessen the severity of the predicted crash.





- In the Mojave Desert, a 240 km route.
- None of the robot vehicles finished the route.
- Carnegie Mellon University's Red Team and car Sandstorm (a converted Humvee) traveled the farthest distance, completing 11.78 km of the course before getting hung up on a rock after making a switchback turn.



Vehicle	Team Home	Time Taken (h:m)
Stanley	Stanford University, Palo Alto, California	6:54
Sandstorm	Carnegie Mellon	7:05
H1ghlander	University, Pittsburgh, Pennsylvania	7:14
Kat-5	The Gray Insurance Company, Metairie, Louisiana	7:30
TerraMax	Oshkosh Truck Corporation, Oshkosh, Wisconsin	12:51









2007 URBAN CHALLENGE

Vehicle	Team Home	Time Taken (h:m:s)
Boss	Carnegie Mellon University, Pittsburgh, Pennsylvania	4:10:20
Junior	Stanford University, Palo Alto, California	4:29:28
Odin	Virginia Tech, Blacksburg, Virginia	4:36:38
Talos	MIT, Cambridge, Massachusetts	Approx. 6 hours
Little Ben	University of Pennsylvania, Lehigh University, Philadelphia, Pennsylvania	No official time.
Skynet	Cornell University, Ithaca, New York	No official time.



2007 URBAN CHALLENGE

Team	Language(s)	OS	Hardware
Tartan Racing (winner)	C++	Linux	
Stanford Racing	C, C++	Linux	Pentium M computers
VictorTango	a mixture of C++ and LabVIEW	Windows, Linux	
МІТ	С	Linux	cluster with 40 cores
Team Ben Franklin	MATLAB		
Cornell	C, C++, C#	Windows XP	17 dual-core servers
Insight Racing		Linux	Mac Mini
Team Case	Mostly LabVIEW, some C++ and MATLAB	Windows XP	5 Mac Minis, 2 NI PXI's, CompactRIO
Team Gray			GrayMatter, Inc. AVS.
Sting Racing	Java	Linux	
Team Gator Nation (CIMAR)	C, C++, and C#	Windows, Linux (Fedora)	
Austin Robot Technology	C++		
Team LUX		Windows XP	
Team Jefferson	Java	Solaris (Java RTS), Linux (Java SE)	micro-controllers and Sun SPOT (Java ME)









Vehicle applies brakes unnecessarily



- Started in 2009 by Google
- Car cost: 150 000 USD, including 70 000 USD LIDAR
- In August 2012, the team announced that they have completed over 500,000 km autonomousdriving accident-free





























ruise















GOOGLE & WAYMO WAYMO



GOOGLE & WAYMO

- In June 2015, the team announced that their vehicles have now driven over 1,600,000 km
- Test cars have been involved in 14 collisions, of which human drivers were at fault 13 times.
- On February 14, 2016 a Google selfdriving car attempted to avoid sandbags blocking its path. During the maneuver it struck a bus. Google addressed the crash, saying "In this case, we clearly bear some responsibility, because if our car hadn't moved there wouldn't have been a collision".



THEFT

JTOPILOT













"ATRAGIC LOSS,,

- This is the first known fatality in just over 130 million miles where Autopilot was activated.
- Among all vehicles in the US, there is a fatality every 94 million miles.

Rear View Camera Max distance 50m Ultrasonics Max distance 8m Forward Looking Side Cameras Max distance 80m Radar Max distance 160m

THE

	Drive PX 2 (AutoCruise)
Generation	Second
Introduced	September 2016[18]
Computing	1x Tegra X2 (Parker)
CPU Cores	2x Denver 4x Cortex A57
GPU	1x Parker GPGPU (1x 2 SM <u>Pascal</u> , 256 CUDA cores)
TDP	(Parker SoC only: 10 W)[20]

- Since September 2015, Hotz has been working on his own AI startup called comma.ai.
- Hotz revealed he is building vehicular automation technology based on artificial intelligence algorithms.
- Hotz has built a working selfdriving 2016 Acura ILX, which he demonstrated on the I-280 in a video.

10000

INSIDE HOTZ'S

A 21.5-INCH SCREEN DISPLAYS THE CAR'S AUTONOMOUS TECHNOLOGY (THE OPERATING SYSTEM IS UBUNTU LINUX), ALONG WITH FEEDS FROM THE CAMERAS AND LIDAR SYSTEMS

(A

HOTZ ADDED A JOYSTICK TO THE CAR'S CENTER CONSOLE. A PULL OF THE TRIGGER ENGAGES THE SELF-DRIVING SYSTEM THE GLOVE COMPARTMENT HAS BEEN TURNED INTO A COMPUTING HUB WITH A MINI PC, A NETWORKING SWITCH, AND GPS SENSORS

- On October 27, 2016, the NHTSA informed Hotz that this product was legally required to comply with Federal Motor Vehicle Safety Standards, and requested information that would confirm such compliance. A day later, George Hotz tweeted from Shenzhen that the comma one was cancelled.
- comma.ai open sourced their self driving car software on November 30, 2016, emphasising its intended use for research without any warranty.

AIR FRANCE AIRBUS

US AIRWAYS 1549 AIRBUS A320

- On January 15, 2009, from New York City's LaGuardia Airport to Charlotte Douglas
- All 155 people aboard were rescued by nearby boats and there were few serious injuries.
- The computers impose adjustments and limits of their own to keep the plane stable, which the pilot cannot override even in an emergency. Sullenberger said that these computer-imposed limits also prevented him from achieving the optimum landing flare for the ditching, which would have softened the impact.

QANTAS FLIGHT 72 AIRBUS A330

- Singapore to Perth on October 7, 2008
- Jet plummeted almost 500 meters in total when rogue computer ordered it to dive
- More than 100 passengers were injured in the incident

SECURITY

- "Biggest threat is fleet wide hack; that wold be the end of Tesla"
- "People in the car have hardware override"

SECURITY

SECURITY

- EU plans to fit all cars with speed limiters preventing them from going over 70mph.
- The new measures have been announced by the European Commission's Mobility and Transport Department as a measure to reduce the 30,000 people who die on the roads in Europe every year.

JANOSIK 2.0

HARDWARE "HACKING"

FORD ESCAPE TOYOTA PRIUS

- Local atack via CAN network 2013
- Disabled my brakes, honked the horn, jerked the seat belt, and commandeered the steering wheel

JEEP CHEROKEE HACK

- Remote attack July 2015
- Control over: AC, radio, wipers, transmission, breaks
- Chrysler's patch must be manually implemented via a USB stick or by a dealership mechanic.

HOW TO HACK A TESLA MODEL S

- DEF CON 23 2 december 2015 - Marc Rogers, Kevin Mahaffey
- Control light, power off car while driving
- Physical access required

TESLA FIX

Tesla Motors

Accelerating the world's transition to electric mobility

\$25 - \$10,000 Per Bug.

Program Details Hall of Fame

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Report Bug

Tesla values the work done by security researchers in improving the security of our products ar are committed to working with this community to verify, reproduce, and respond to legitimate n We encourage the community to participate in our responsible reporting process.

For vehicle or product related services, or if you feel that your report is outside the scope of contact vulnerability@tesiamotors.com. Our GPG public key is available here: https://www.tesiamotors.com/sites/default/files/downloads/tesiavulnerabilitypgp.asc

Responsible Disclosure Guidelines

We will investigate legitimate reports and make every effort to quickly correct any vulnerability, responsible reporting, we will not take legal action against you nor ask law enforcement to inve comply with the following Responsible Disclosure Guidelines:

Q&A