Benefits of Autonomously Driven Vehicles

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Abstract The vehicles with high grades have the embedded systems which are essential for the operation of a vehicle with higher standard of safety. This way road transport can significantly closer to the safety of rail and air transport because the error of driver is the main cause of the accident. The expected benefits of autonomous vehicles are their ability to observe small distances between the vehicles. Based on the information from stationary sources and vehicles running near adjust their route and speed of travel so as to minimize delays in congestions. This ensures greater continuity of driving, reducing consumption of vehicles and therefore the production of greenhouse gases from road transport. If the vehicles are capable of autonomous driving is achieved higher average speed and they have been removed the mandatory brakes within driving. It achieves the higher performance of individual vehicles and thus fewer number of vehicles on the roads and less traffic congestion.

Keywords: Accident, parking, vehicle assistant, brakes

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1. Introduction

Autonomous vehicles are clearly near future of road transport. The rapid development of computers, their ability to communicate with each other using Wifi connections, various sensors allow this trend. In the following we approach the possible benefits for the company from their gradual implementation on practice.

2. Fewer accidents

If you look at statistics on traffic accidents, almost always is the cause of accident person. Whether it is due to incorrect assessment of the traffic situation, the laws of physic, the revaluation of the ability itself or the vehicle. Table 1 shows that a technical problem occurs only insignificantly.

Based on this we can assume that autonomous vehicles bring a significant reduction in the number of fatalities in road accidents. Already are the vehicles dealt in a system which responds around to the situation. For example: ABS Anti-block system (Anti-lock Braking System). This system is already compulsory equipment new registered vehicles. It can keep the wheels braked at the optimum slip 10 – 30%. Especially on the few adhesive surfaces ensures that the braked wheel moves in the area of maximum transmission of braking forces while the wheel is also able to pass a large enough force in the transverse direction. The system consists of a sensor which detects deceleration of the wheel, control unit, which based on the size of the wheel deceleration gives the command to change the pressure in the periphery of the braked wheel and thus the change of brake force. If each wheel is operated in this way independently, the result is a shorter braking distance and maintaining control of the vehicle direction at any moment within braking. This system is the cornerstone which can be built more sophisticated systems.

**ACC – Adaptive Cruise control.** This system helps to limit the risk of accident the vehicles running in columns. Company Volvo launched it in 2003 and was part of the offer for trucks manufactured by the company. It helps the driver maintain a safe distance from the vehicle in front and easily keep pace with the flow of traffic. ACC not keep a fixed rate, but to set a fixed time to the vehicle ahead. System keeps a distance through automatic control of acceleration, engine brake and auxiliary brake.

| Year | Traffic accidents | Killed in road accident | Traffic accidents | Killed in road accident |
|------|------------------|------------------------|------------------|------------------------|
| 2014 | 11783            | 259                    | 46               | 1                      |
| 2015 | 13547            | 274                    | Don’t enter      | Don’t enter            |

Table 1. Traffic accidents in Slovakia [1]
If the vehicle in front decreases its speed, reduces the speed a vehicle equipped with ACC. If control vehicle accelerates again, increases speed the vehicle with ACC until the default value. ACC can be deactivated by simply pressing the ACC control or by pressing the brake of clutch pedal. In situations where the auxiliary brakes are not able to keep distance, if the vehicle in front brakes suddenly, the driver is notifying by the alarm sound and light on the speedometer. Then the driver must use the service brakes. The control unit decides on the basis of information from the radar which operates in the frame 11 degrees ahead of the vehicle. The drive of this field divided into two categories – captured vehicle (up to 12 units). It selected one target vehicle by which regulates the driving speed. Vehicles in adjacent lanes are captured vehicles and do not affect advancing of the trailer. If such a vehicle changes lane and deflects before the trailer, it becomes a target vehicle. Based on the size of the lateral acceleration, the system recognizes that the car moves around a corner. It maintains speed even though the radar lost contact with the selected target vehicle.

**Brake assist.** A lot of drivers don’t action on the brakes sufficient force when braking in danger which means that the braking distance of the vehicle is longer compared to the path which the vehicle was able to stop. Brake assist on the basis of a sharp and strong brake pedal automatically applies maximum braking force such as brake valve control braking it considered at risk. If the driver keeps the pressure to control, the vehicle brakes with maximum effect. Releasing the pressure on the driver brakes, the maximum braking force is automatically reduced as well. [5]

**Hill-start assistant.** Many drivers have problems when starting uphill. Their vehicle before starting stops the engine. Hill-start assistant braking force is automatically reduced as well. Then the driver must use the service brakes. The control unit decides on the basis of information from the radar which operates in the frame 11 degrees ahead of the vehicle. The vehicle before the obstacle up to 15 km/h speed and from vehicle before the obstacle up to 15 km/h speed and from 15 up to 30 km/h speed according to the roadway surface.

**Distance Alert (DA).** It uses for its operation an adaptive cruise control. If the distance from vehicle driving at the front falls to critical value, it alerts the driver by red flashing light. Some systems will slow down automatically to increase the distance at the safe level.

**Advanced Emergency Braking System (AEBS), Autonom ous Emergency Braking (AEB).** 75% of car accidents happen up to 30 km/h speed. The system uses a camera which monitors 10 m space before vehicle. It warns drivers visually and acoustically if there is an obstacle in front of them. When there is no or inadequate reaction from driver, the system is able to activate brakes individually. It can stop vehicle before the obstacle up to 15 km/h speed and from 15 up to 30 km/h speed according to the roadway surface.

**Line Departure Warning (LDW).** It can detect the traffic lanes on the roadway. It is being activated at the speed above 60 km/h. If drivers attempt to change the traffic lane without signalling a change of direction, it warns them or slightly rotates wheels of the vehicle so that vehicle will not leave the current traffic lane.

**Roll Stability Control (RSC).** It uses information about lateral acceleration of vehicle and controls its stability against rollover. If there is a risk recognized, it reduces engine power and slows down vehicle wheels which can maintain vehicle stability. Rear wheels of semitrailer, for instance. All of these systems will in the case of cooperation be able to drive a vehicle by utilising GPS even without driver. However, the current legislative allows such autonomous vehicles to be driven only in some countries (USA). In the EU, the testing of autonomous vehicles may only be performed outside the public transport. [2]

The statement that autonomous vehicles will bring a lower accident rate has been seen in the introduction. However, it should be stated that American authorities have started to investigate the first fatal accident in which a man died in a self-driving vehicle of Tesla Motors Company. The driver had an activated autopilot when he crashed with a lorry on one of Florida’s roads on May. The cause of the accident was that the driver of oncoming tanker turned left on crossroads. Neither autopilot, nor driver saw the white side of tanker towards harsh sunlight, so the brake was not activated and the crash was unavoidable. Tesla Company states that it is the first known case of fatal accident after more than 200 million kilometres driven without directly human driving. Let us compare such defined safety of autonomous vehicles with vehicles driven by humans. An
average vehicle occupation is 1.6 people so Tesla vehicle carried out more than 320 million people (killed people) per kilometre. In 2014, there were killed 53 people per 10 billion kilometres in the EU. That means one killed person per 189 million kilometres. Autonomous Tesla vehicle is thus two times safer and in the future, vehicles will inform other vehicles about their position, so the probability of an accident will be significantly lower. [2]

3. Drivers will not be needed for vehicle driving

If vehicles are driving without a need of drivers, it means that they will be constructed only for replenishing working fluids and realising important maintenance. The safety breaks for drives will not be necessary and a limitation of working hours will not be in force. So, the vehicles could transport more goods and could be faster than with people. Mutual information about vehicle position can serve control unit to be able to choose the roadway that is less jammed so that vehicles will drive more fluently than with people. Even today the use of cruise control can reduce consumption about app. 5 %. If vehicles are aware of their position, they can optimise not only a route but also a driving speed. Computers have not a need to overtake slower vehicles and since safety breaks for drivers will not be required, they will be able to drive at lower speed. If today drivers may drive for 4 and half an hour and then can take a 45 minutes' rest, at the stable speed of 90 km/h they overcome the distance of 405 kilometres. The autonomous vehicle will be able to drive at the speed of 77 km/h and it will overcome the same distance. Vehicle combinations with 40 tons of weight will be expected to have a reduced consumption about 4.1 litres per 100 km. Only a change of speed was considered while estimating. However, the autonomous vehicles will not need a cab and thus can obtain a space for better shape of vehicle and a reduction of air drag coefficient. The consumption savings will be even higher. [4]

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