Transport and Communications, 2016; Vol. II.
ISSN: 1339-5130
DOI: 10.26552/tac.C.2016.2.4

Benefits of Autonomously Driven Vehicles

Vladimír Rievaj[1], Lenka Mokričková[1], František Synák[1]

[1] Faculty of Operation and Economics of Transport and Communications – Zilina, University of Zilina, Slovakia

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

JEL R41

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.

Table 1. Traffic accidents in Slovakia [1]

Year	Completely		Including technical reasons	
	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

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.

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 or backs away. Such a situation is risk because it can cause an accident. The system helps the driver so that when parking brake is released after releasing the brake pedal, brake are released with two-second delay, which gives the driver time to bring it to the wheels of a sufficient driving force and the vehicle didn't back.

Electronic stability program (ESP, DSC,ESC,VDC,DSTC). It is mandatory to newly registered vehicles. It should actively prevent uncontrolled skidding of the vehicle and helps the driver stabilize it if it gets to skidding. It direct cooperates with ABS and ASR. It compares the behaviour of the vehicle with the calculated values. It is checking the desired travel direction based on the steering angle, the actual speed based on the speed of the wheel. It compares the later acceleration and the vehicle rotation around the vertical axis with the calculated values.
The control unit automatically adjusts the torque of the engine and where appropriate brakes the wheel, which can help to balance over steer or under steer skid of the vehicle. The Federal Statistical Office of Germany has registered more than 42% decrease of an accident rate of vehicles equipped with ESP system approximately 3 years after its serial installation.
A traction control system (ASR, TSC, ETC, T C S). It helps wheels not to rotate on the spot when moving off on slippery surfaces. For that, it uses reduction of engine power. If one of the wheels slows down the slipping wheel on the slippery surface, a wheel on the fixed ground has a larger torque.

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). Autonomous 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

DOI: 10.26552/tac.C.2016.2.4

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 drug coefficient. The consumption savings will be even higher. [4]
The regular trainings will be not required for autonomous vehicles and they will not take a holiday and income. Taking into consideration such personnel costs, the transportation will be significantly faster, cheaper and more punctual. This personnel advantage lies also in fact, that there is a lack of drivers seen in current practice.
Between autonomous vehicles will be communication so there will be no problem to create so called automobile trains when more vehicles driving in close proximity. Such driving will lead to further reduction of driving resistance and fuel consumption.

4. Parking

The complete implementation of autonomous vehicles should be also seen in the ownership of personal vehicles. There will be no need for owning a personal vehicle and paying depreciations, reparations, insurances and parking fees. The vehicles will be parked in parking lots and if somebody wants to get from place A to place B, there is a simple possibility of ordering a vehicle. The computer will choose a vehicle corresponding with a number of people and load transported as well as distance. The savings will be seen as a result of utilising electro mobiles for short distances and vehicles with required range for longer distances.
Being aware of a relative small number of personal vehicles that are driving and those vehicles that are taking up parking areas, the autonomous vehicles can also seem to be favourable in lesser demand on infrastructure space. [3]

5. Conclusions

This paper endeavours to point out the possibilities of autonomous vehicles and their contributions to higher road safety, faster goods transportation, delivery accuracy, higher utilization of car park, and last but not least in lower fuel consumption and thus in reduction of greenhouse gases. The autonomous vehicles may be seen in diminution in demand of parking areas, too and what is more, they could bring popularity to city transport since there could be vehicles driving with lesser number of seats. The passengers would be transported "from door to door" and their routes would be able to be connected, optimized and thus resulting in time shortening.

ACKNOWLEDGEMENTS

VEGA Project č. 1/0331/2014 -ŠULGAN, M. a kol.: The modelling of distribution logistics system could lead to solving problem of distribution of the existing or new projecting of distribution logistics system in company, , ŽU in Žilina, FPEDAS, 2014-2016.

REFERENCES

[1] www.minv.sk

[2] http://www.opel.sk/

[3] ČTK | 01.07.2016 06:39

[4] The diagnostic support tool - quality function deployment and its implementation possibilities to urban public transport quality management / Ivana Andriskova, Mariana Strenitzerova. In: Communications : scientific letters of the University of Žilina. - ISSN 1335-4205. - Vol. 16, no. 2 (2014), s. 63-69.

[5] EU Transport in figures – Statistical pocket book 2015, Luxembourg: Publications Office of the European Union, 2015, ISBN 978-92-79-43914-8