Autonomous Trucks

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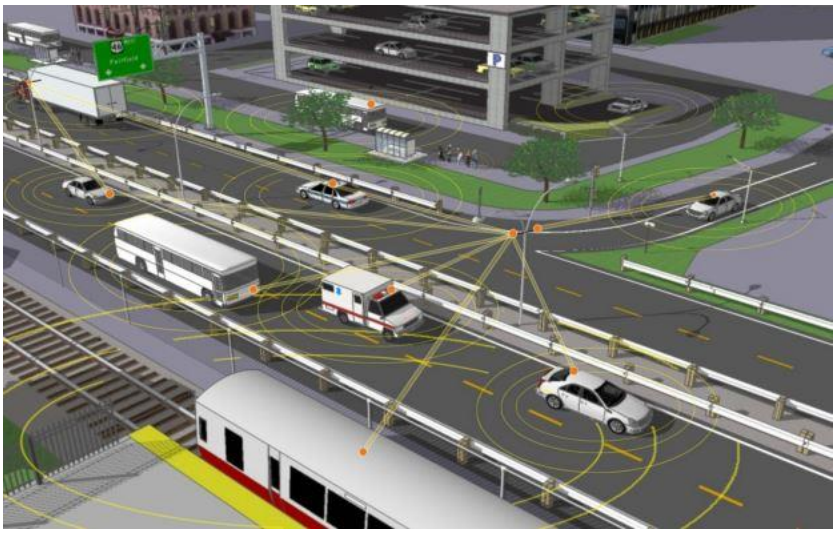

Résumé

La plupart des gens sont au courant que les entreprises technologiques telles que Google et Uber sont en train de développer des véhicules autonomes (conduite automatisée, "self-driving") et que de nombreux constructeurs automobiles ont l'intention de les commercialiser dans un avenir proche. Mais que passera-t-il avec les véhicules lourds? Est-ce que les technologies autonomes joueront un rôle chez les grands camions?

Most people will be familiar with the fact that technology companies such as Google and Uber are in the process of developing autonomous (self-driving) cars, and that many mainstream automobile manufacturers have plans to bring such vehicles to market at some point in the future. But what about heavy trucks? Do self-driving technologies have a role to play in "big rigs"?

There is certainly much interest in the transportation industry in the possible implementation of autonomous trucks. Some of the potential benefits include fuel savings and lower exhaust emissions that would doubtless result from robotic operation; the potential to mitigate against a projected future shortfall in skilled truck drivers; enhanced safety by removing the human element from the driving task; and, of course, cost savings through the elimination of the need to pay human drivers.

Because of the nature of long-haul trucking, this mode of transportation may prove to be a viable real-world laboratory to test and further develop the technologies underpinning autonomous vehicle operation. Consider, for example, a transportation company that routinely carries goods between two warehousing operations in major cities several hundred kilometres apart. Typically, the majority of the route will be on access-controlled freeways. Such roads generally offer a relatively-simple driving environment, with unidirectional traffic, gentle curves, a fixed speed limit, and specific locations for access and egress, with

acceleration and deceleration lanes to facilitate merging and diverging traffic. Consequently, it may well be possible to have the truck undertake the majority of such a journey on "auto-pilot".

Indeed, several truck manufacturers are developing systems that will accomplish such tasks. For example, Freightliner's Inspiration Truck (https://tinyurl.com/InspirationTruck) is already approved for autonomous driving on public highways in Nevada. The truck uses the so-called Highway Pilot system that is designed to operate much like the auto-pilot system on an aircraft.

The truck's driver operates the vehicle normally up to the point where the truck is travelling along a freeway. The driver then engages the truck's autonomous mode of operation. The Highway Pilot system maintains a set speed, observing the speed limit, while keeping a minimum headway between itself and any vehicle ahead; and steering a course such as to stay in the roadway's driving lane. The automatic driving system does not initiate any overtaking manoeuvres. Any lane changes, and the process of leaving the highway, are undertaken by the driver.

The driver can manually override the automatic system and take full control of the truck at any time. Indeed, the system will hand over control to the driver should it be unable to detect important aspects of its surroundings.

For example, this might occur on a section of the road where there are no lane markings, complex roadwork environments, or adverse weather conditions.

While such trucks may best-described as semi-autonomous, they are using advanced driver assistance systems that will ultimately be incorporated into fully-autonomous vehicles. Multiple sensing systems and devices, such as radar, lidar, and digital video cameras, provide real-time data that are analyzed by powerful microprocessors and provide inputs to a variety of control systems. Sophisticated GPS units and high-resolution, three-dimensional maps provide additional spatial information. In addition to the basic needs to manage speed, braking, and direction through actuators in the vehicle's throttle, brake and steering systems, there are many on-board safety systems that utilize portions of the data stream. Examples are: Forward Collision Warning and Mitigation, Adaptive Cruise Control, Lane Departure Warning/Lane Keeping Assist, and Automatic Emergency Braking systems.

While all of the above-noted features provide some indication of the future of long-distance trucking (and possibly passenger transportation), there is clearly some way yet to go in terms of implementing fully-autonomous solutions.

There is currently a need to have a human driver in the truck's cab who is available to take control in certain circumstances, including driving the truck to and from the warehouses and the freeway. Some research is being undertaken on this aspect of the process where a skilled, human driver would operate the truck by remote control (http://starsky.io/). Aimed primarily at "last-mile operations", human operators would be available to take control of vehicles for the journey to or from a freeway, with the trucks travelling autonomously – and unmanned – for the portion of the trip along the highway.

Fully-autonomous operation will require much more sophisticated sensing and control systems for trucks to be able to navigate normal city traffic and street environments, and to avoid additional hazards such as cross traffic, pedestrians and cyclists. Even the "simple" freeway journey will have its challenges. Will the truck's sensing systems be able to

differentiate between a hitch-hiker and a flagman and take the appropriate action? Will the control systems bring the vehicle to a stop in a safe location should some incident, such as a collision with road debris or another vehicle, cause significant damage to a wheel or steering axle?

Nevertheless, the somewhat simplistic routing scenario envisaged, that of a journey from Warehouse A to Warehouse B, may still offer a useful test environment for fully-autonomous operations. Typically, there will be one specific route that is most efficient and, an autonomous truck could be "taught" the basic details required for the journey as a whole. Thus, while the autonomous vehicle would still need to adapt to the traffic environment applicable at any given time, including any unforeseen hazards, the pre-existing "travel plan" may well provide an important foundation on which to build the system's capabilities.

Further technological advances will doubtless provide additional safety enhancements. For example, vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications systems will provide equipped vehicles with detailed information on such things as the speed and travel paths of nearby vehicles, roadway speed limits, and the future status of traffic light signals.

Already, short-range radio communications are proposed to connect a number of tractor-trailer units travelling along a highway as a "platoon". The lead vehicle is driven normally, while following vehicles use cooperative adaptive cruise control to maintain vehicle spacing, and V2V communications to provide almost instantaneous braking where necessary. This allows for close inter-truck spacing and consequent reductions in fuel consumption and engine emissions. (See: *Truck Platooning Research in Canada* elsewhere in this issue.)

Self-driving technologies hold the promise of more efficient and safer transportation systems. While, we still have a long road to travel in this regard, there is an abundance of technologies, and much research activity, aimed at reaching the ultimate goals. This is likely to be an interesting journey!

Image courtesy of *The Volvo Group*

The Volvo Group has developed an autonomous truck for use in garbage collection in built-up areas. The route is pre-programmed and the truck reverses from one wheelie-bin to the next. Multiple sensors continuously monitor the vehicle's surroundings. The truck will steer around parked vehicles but will stop immediately if an obstacle (such as a child) suddenly appears in its path. The driver, who walks ahead of the reversing vehicle, can focus on refuse collection and does not have to climb into and out of the cab every time the truck moves to a new bin.

https://tinyurl.com/AutonomousGarbageTruck