The bumpy road towards automated vehicles: Can we smooth the path?

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Abstract

Autonomous vehicles and driver assist technologies are seen as the next-big-thing for road safety. Many authoritative organisations are predicting benefits of up to 95% reductions in crashes; levels never achieved before. Unfortunately, these forecasts are at best optimistic and at worst misleading as they are based on the false ideas that driver error is at the heart of all road safety problems and new technology is infallible. This presentation will summarise the main issues with the introduction of autonomous vehicles and explain why we need to act now to ensure that we maximize the road safety benefits from these vehicles.

The Problem

Autonomous vehicles are widely proclaimed to be the answer to many road safety problems, with estimates that they will produce 90-95% reductions in crashes. Some vehicle manufacturers are forecasting that autonomous vehicles will be available on our roads within the next five to ten years. The problem is that most of these projections are based on shaky foundations and they overlook some significant issues with many new technologies already in use. The estimates of reductions in crashes are based on the premise that since 90-95% of crashes involve driver error, taking the driver out of the transport task will eliminate these crashes. This premise is faulty as a significant proportion of the behaviours seen as driver errors occur because of poorly designed vehicles, roads and road system rules, regulations and enforcement. There are many examples of poorly usable features of the road system including: poor vision from vehicles so drivers miss important information in the driving environment, in-vehicle tools that distract drivers or require them to take eyes off road, and red light cameras that make drivers stop too quickly. Issues relating to the usability of the vehicle and the road system are unlikely to be overcome by partial or even fully automated vehicles. We have a history of inadequate and unsophisticated technologies being included in vehicles. It is unlikely that we will do better when the whole task of driving is automated. Unreliable and/or annoying features of automated technologies are still likely to be a problem. If the technologies we are currently using in vehicles are not sufficiently sophisticated and can cause errors and failures in the system, why do we think they will be perfect, or even good enough when we let the technologies take over most, or all, of the driving task?

Furthermore, vehicles touted as fully automated, that require drivers to do nothing but wait until required to take over, will present greater problems for road safety. We already know that drivers do not do well when they are not alert due to fatigue or not paying active attention (Williamson et al., 2013). Assistive technologies that simply require the driver to maintain passive attention until they are required to take-over again will always be working against the human response to find something else to do and even to fall asleep when there is not much going on (Dunn and Williamson, 2012). There is good evidence that leaving the driver 'out of the loop' when technology is in control leads to significant performance impairment when the driver is asked to resume control which seems to increase with higher levels of automation (Omnasch et al., 2014). The limited research that had been done on how long it takes drivers to resume control of an automated vehicle shows that around 8 seconds are needed: too long for safety (Gold, et al., 2013). Many of the existing driver assist technologies are unsophisticated, poorly designed and fail to address driver needs. For example, a number of studies have demonstrated that cruise control, which is becoming a standard addition to many vehicles, significantly slows driver reaction times especially in emergency situations when it is most needed (eg., Vollrath, Schleicher and Gelau, 2011; Pauwelussen and

Feenstra, 2010). More concerning, the US Insurance Institute for Highway Safety evaluated the effectiveness of forward collision avoidance systems, adaptive headlights and lane departure warnings in vehicles through tracking insurance claim frequency for vehicles containing each of these devices (IIHS, 2012, Seabaugh, 2012). While the first two devices showed some reductions in crash frequency, claim frequency for vehicles with lane departure warnings increased. Contrary to expectations that warning drivers of imminent lane departures would reduce crashes, it was associated with higher claim rates. There is a considerable literature on the consequences of inappropriately occurring warnings (Sullivan, Tsimhoni and Bogard, 2008; Navarro, Mars and Hoc, 2007) which might have discouraged, or at least modified this type of technology before it was implemented. It would clearly be preferable to determine the usability and road safety impact of in-vehicle technologies and how they interact with one another before they are introduced to the driving public rather than waiting for crashes to occur. These examples highlight the fact there has been little or no research on what functions in vehicles *should* be automated in order to assist drivers and reduce crashes nor how best to automate.

This presentation will discuss some of the major issues with driver assist technologies and automated driving systems that will need to be overcome. These include:

1. The amount of passive control required of ‘drivers’
2. Who drives – when?
3. Transitions between automation and driver
4. Poor design of new technology in vehicles
5. Track record of ‘selling’ unsophisticated systems in vehicles
6. Issues of trust and acceptance of the technology

Overcoming these problems requires that we first acknowledge their existence, and then take action to ensure that technology is fully developed and usability is tested before being allowed on-road. Most importantly, we need to remember that vehicles are tools for people to use. We need to change focus from the current vehicle-centred approach of simply adding new technologies to vehicles because we can, to finding the best ways of assisting the driver and making the driving task easier and more efficient. This will require more research on usability of new technologies, but we already know a considerable amount about some of the major pitfalls in automation to benefit system safety and efficiency and these lessons must be incorporated into developing cases for allowing increasingly automated vehicles onto our roads. This will require systematic and concerted action, but with the current deluge of new technologies entering our road system, we need to do it now.

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