

6 IMPACTS OF AUTOMATION ON THE DRIVING ACTIVITY

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In terms of road safety, autonomous vehicles chiefly rest their case on their ability to reduce the number of road accidents. Indeed, the engineers' central idea is that by removing the human driver from the loop and thereby the human-factor related risks too, systems will perform better than with human intervention.

This argument however should not be taken for granted as many problems remain to be evaluated. For instance, full automation (SAE level 5³) is not yet available for light vehicles. A transition phase should therefore be provided between the manual (vehicle driven by the human driver) and autonomous (vehicle driven by means of its automatic onboard control systems) modes. Depending on the various levels of automation (as suggested by SAE³), expectations vis-à-vis the drivers will differ, and accordingly the problems they might be faced with.

In this framework, Ifsttar is working on the anthropocentric design⁴ of driver assistance systems, the identification of critical scenarios, the monitoring of drivers to adapt man-machine interactions and on the virtual design of assistance systems.

Driver assistance

The first level is currently being deployed with the advent of various control systems that are only active on part of the driving functions. This allows the driver to momentarily resort to occasional assistance (acceleration, braking, etc.) and correspondingly diminishes the amount of attention required to handle the

driving task. If such reduction can be beneficial in highly complex situations, it may inversely entail dangerous side effects. Thus, inattention phenomena resulting from excessive lack of activity (e.g. drop in vigilance levels, wandering thoughts, etc.), or mind being distracted by other asks (e.g., phone calls, eating, etc.), could be observed. These phenomena basically result in problems with the intake of information pertaining to the road environment.

The role of driver-supervisor

In the level-2 case, the system takes on board new functions but the driver, who controls his/her environment, should be able to resume control on the vehicle at all times. But then, the risk related to the above-mentioned phenomena may be compounded by the fact that the driver no longer has any active driving task when all longitudinal and lateral controls are taken over by the system. This level would however still require the driver to be attentive to his/her environment to be capable of resuming control at all times. This rather worrying obligation means that in terms of road safety nothing ensures that the human driver is indeed in a supervision posture, from a cognitive point of view, even if his/her physical position is indeed correct.

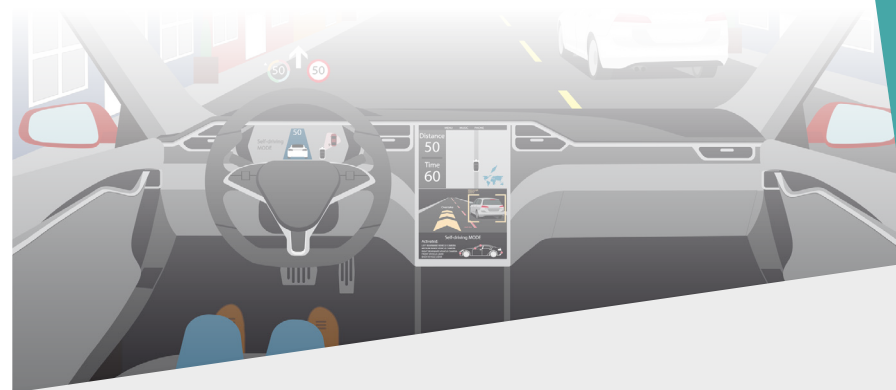
From supervisor to passenger status

For levels 3 and 4, the driver is authorised to execute other tasks during the driving delegation phases. S/he must however remain in a capacity to resume control at the system's request. If the driver fails to resume control, it is provided the vehicle may be called to a halt (level 3) or parked to safety (e.g. on an emergency stopping lane for level 4). In both cases, transition phases are quite critical.

Indeed, when the driver delegates his/her driving task to the autonomous system (manual transition to self-driving), the system must be ready to take over control. Should the system not be able to ensure self-driving, it is important that the driver fully understands that the vehicle cannot do so. The same observation applies for phases of control resumption by the driver (self-driving transition to manual). It must be ascertained that the driver is in such physical and attentional condition that s/he may resume control and be well aware that the vehicle no longer is in self-driving mode.

Whatever the level of automation, the need for the driver to take into account the system's status is a well-known issue in cases of man-machine cooperation. It is nevertheless of even greater importance in the case of automated vehicles where mistakes can be fatal.

1. LESCOT: Laboratory Ergonomics and Cognitive Sciences applied to Transport
2. TS2: Transport, health, safety Department
3. SAE International is a worldwide association of over 128,000 engineers and technical experts working together with the aerospace, automotive and commercial vehicles industries. <https://www.sae.org/>
4. Human centered



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