Influence of ADAS on driver behavior

Prof. D. Vangi*, A. Virga*, M. Conigliaro*, Prof. H. Steffan**, E. Tomasch**
* University of Florence , Department of Industrial Engineering, via di Santa Marta, 3 - 50 139 Firenze, Italy
+390552758782
** TU-Graz, VSI - Vehicle Safety Institute, Inffeldgasse 23/I, A-8010 Graz, Austria
Corresponding author: Prof. D. Vangi dario.vangi@unifi.it

Autonomous driving is one of the main subjects of investigation as regards road vehicles. SAE 3 level represents a transition period towards full-automation in which safety in the interaction between human driving logics and automation logics is one of the issues. Since automation logic is developed without human-like characteristics, solutions could result to be dangerous in terms of interaction with drivers. Duly conceived and developed HMIs (human machine interface) can strongly help in this transition, but human-likeness of automation is a requisite to be appropriately taken into account. Human-likeness of automation ensures more natural and safe interaction with automation logic,smoothness and effectiveness of such an interaction further increases safety. In this context, to properly design effective HMIs a development of driver models seems the main road to drive the progress towards full automation, placing safety and the user acceptance as fundamental points of this development. Current studies aim to new challenges which have to take in consideration the HMI as well as going over the previous experimentation and findings, in order to reach higher levels of automation. With the aim of addressing these new goals driver's behaviour and the HMI features have always to be considered to obtain the best performance when driving. The diffusion of such devices can influence the drivers behavior, so that taking these aspects into account will be more and more relevant in road accident reconstruction, for instance concerning the possible influence on drivers reaction time and mode.
In the present study, driver behaviour was studied in road accidents involving elderly pedestrians, with different ADAS (Advanced Driver Assistance Systems) HMIs, as a base to develop a driver model in near missing pedestrian accidents. A literature research was conducted with the aim of finding out the main influencing factors, including environment, boundary conditions, configuration of impact, pedestrian and driver information, when pedestrian fatalities occur and an analysis of frequent road accidents was conducted to get more detailed information about the driver's behaviour. A general decrease of road victims has been seen over time, but the absolute sum of deaths is still considerable and the challenge to improve pedestrian safety remains still opened. In order to obtain more detailed information about pedestrian accidents, real road accidents were reconstructed with multibody simulations on PC-Crash and, by the comparison between literature findings and reconstructions, a generic accident scenario was defined. The generic accident scenario was implemented on the driving simulator in use at the Laboratory for Safety and Traffic Accident Analysis (LaSIS, University of Florence, Italy) in order to analyse the driving behaviours of volunteers, also considering the influence of ADAS devices. The research was carried out using a full scale dynamic driving simulator. Forty-five young volunteers were enrolled for this study, resulting in forty valid tests on different testing scenarios. Two different scenarios consisted in driving with or without ADAS in the vehicle. Different kinds of ADAS, acoustic and optical, with different time of intervention were tested in order to study the different reactions of the driver. The tests showed some interesting differences between driver's behaviour when approaching the critical situation. Driver with ADAS reacted earlier, but more slowly, depending also on the type of alarm, and often with double reaction when braking. In fact, the results of the activity showed that with ADAS intervention the time to collision (TTC) increases, but the reaction time and braking modality change:
a) there is a sort of "latency" time between the accelerator pedal release and the brake pressure;
b) the brake pressure is initially less intense. So the driver only partially takes advance from the TTC increase. These differences were valued not only qualitatively, but quantitatively as well.
This work revealed to be useful to improve the knowledge of drivers' behaviour, in order to realize a driver model that can be implemented to help attaining and assessing higher levels of automation through new technology. This work describes the results of the experimental activity, illustrating the driving behaviour observed in different conditions, relating them to the different methods of ADAS intervention and comparing the driver behaviour without ADAS.