Advanced Driver Assistance Systems (ADAS)

By Alan German

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Résumé

Il y a eu beaucoup de discussions, ces dernières années, autour des véhicules autonomes. Toutefois, bien qu'ils sont actuellement en développement et, dans certains cas, soient soumis à des tests routiers, le potentiel des véhicules autonomes reste à exploiter. Il faut également reconnaître qu'un certain nombre de technologies a déjà fait son apparition dans le parc de véhicules. Commercialisés sous l'appellation ADAS (Advanced Driver Assistance Systems), les systèmes avancés d'aide à la conduite font partie intégrante de plusieurs véhicules de série.

There has been much discussion in recent years on the topic of autonomous vehicles; however, while these are under active development and even, in some cases, are on the road as limited test fleets, their full potential has yet to be exploited. Nevertheless, a number of the underlying technologies and sub-systems are making their way into the current vehicle fleet. Marketed as Advanced Driver Assistance Systems (ADAS), many current production vehicles are equipped with a variety of such high-tech systems.

The process of automating the driving task with a view to making vehicle travel safer has been in progress for a number of years. We are now familiar with the availability of in-vehicle safety systems such as anti-lock brakes (ABS) and electronic stability control (ESC) and, indeed, these technologies are standard equipment in all new passenger vehicles. In recent years there has been an industry-wide trend to equip vehicles with a range of similar technologies, all aimed to further assist vehicle operators with the driving task.

Commonly available systems in current production vehicles include adaptive cruise control, forward collision warning, pedestrian detection, automatic emergency braking, backup cameras, blind spot monitoring, lane departure warning and lane keeping assistance systems. Often, several such systems are bundled in optional packages, or included as increasing levels of standard equipment in the more expensive models for any given vehicle platform. The output of these systems varies with the specific device and vehicle manufacturer and can involve one or more of audio or visual warning signals, hepatic feedback, and automatic activation of vehicle control systems.

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Adaptive Cruise Control

The essence of Adaptive Cruise Control (ACC) is for the vehicle to maintain a set distance between itself and any vehicle ahead. The vehicle driver sets the desired speed that is to be maintained as is the case for regular cruise control. The ACC system then monitors the road ahead, typically using radar or laser-based ranging (LIDAR) sensors and/or front-facing cameras, to detect the presence of other vehicles. Should any such vehicle be moving more slowly than the subject vehicle, the ACC system will adjust the throttle and/or apply the brakes in order to match the other vehicle's speed and maintain the set headway.

Should the other vehicle accelerate, or turn off the roadway, such that the path ahead is clear, the ACC will automatically bring the subject vehicle back up to the set speed. Some systems take this technology to another level by providing a "stop-and-go" feature for use in dense traffic. These systems are capable of following slow-moving traffic, including bringing the vehicle to a complete stop if necessary, and then continuing ahead when the traffic begins to flow again.

Forward Collision Warning/Automatic Emergency Braking

These active safety systems build on the technology underlying ACC. The vehicle's forward-looking sensors and their control system determine relative speed and headway and identify if there is potential for a collision with a vehicle ahead. For example, the lead vehicle may be forced into a hard-braking situation, due to some sort of hazard, and slow down very rapidly. If the Forward Collision Warning (FCW) system on the subject vehicle considers that a collision is imminent it will warn the driver to apply the brakes. An extension of this is to include Automatic Emergency Braking (AEB) to apply the vehicle's brakes automatically. Depending on the system, this may be at a level sufficient to bring the vehicle to a halt or, at a minimum, enough to reduce the impact speed and hence the collision severity.

Pedestrian Detection

Pedestrian detection systems are yet another extension of the above-noted technologies. Forward-looking radar or LIDAR sensors may be combined with on-board digital cameras and image-processing systems.

The image-processing system identifies external road users, typically pedestrians and cyclists, tracks their motion in real time, and predicts potential conflicts.

In particular, should the system determine that a pedestrian or cyclist is in the vehicle's path of travel, it will issue an alert to the vehicle driver and, if necessary, will apply the vehicle's brakes in an attempt to avoid impact.

Backup Cameras

As of May 2018, every new light-duty vehicle in Canada must be equipped with a Rear Visibility System (RVS). Commonly known as a backup camera, the system uses a video camera mounted at the rear of the vehicle that is activated automatically when the driver engages reverse gear.

Backup camera in-dash display

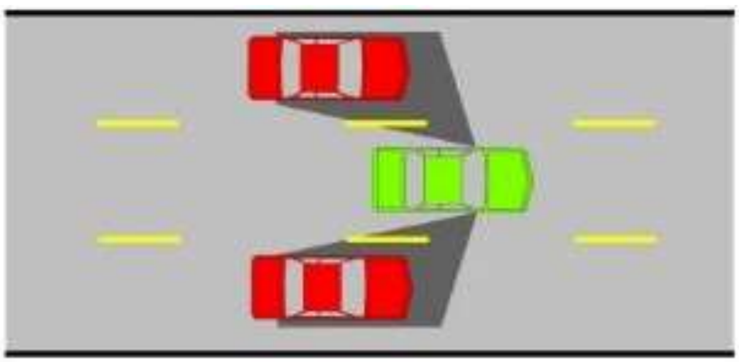
The camera provides a wide-angle view to the rear of the vehicle, with the image being displayed either on a video screen mounted in the dashboard (which may form part of the vehicle's information system) or in a small display in the rear view mirror.

The view to the rear assists the driver when backing up and, in particular, helps to avoid impacts with any individuals (notably small children) or objects in the vehicle's path.

Blind Spot Monitoring

Even with properly adjusted side mirrors, an overtaking vehicle may enter a region outside of the driver's view to the side and rear of the vehicle. Termed a "blind spot", electronic sensors are typically employed to automatically identify objects in such locations and issue a warning.

Blind spot detection systems normally use either radar or rear-looking video cameras to detect vehicles in the driver's blind spot. Detectors are located on both sides of the vehicle to facilitate safe lane change manoeuvres. The system only identifies objects in close proximity to the vehicle, and may only activate if the driver uses a turn signal when another vehicle is in a blind spot..


Vehicles in the driver of the green car's blind spot are detected and the driver alerted that it is not safe to change lanes

Generally, the system will illuminate a warning light, often located on the appropriate side mirror, to advise the driver of the presence of the adjacent vehicle. Other systems vibrate the steering wheel or seat if the driver attempts to initiate an unsafe passing manoeuvre.

Some systems extend blind spot detection to provide rear cross-traffic alerts. Side-facing sensors at the rear of the vehicle are used to detect vehicles travelling essentially at right angles to a vehicle that is reversing. The driver is alerted to the presence of such cross traffic in order to avoid any potential collision.

Lane Departure Warning and Lane Keeping Assistance Systems

Lane departure warning systems usually employ a forward-facing camera to monitor the roadway ahead. An image-processing system attempts to identify roadway markings and road edge delineators and so define the vehicle's travel lane. Should the vehicle's predicted path be such that it would leave the current travel lane, when the driver has not activated a turn signal, a warning signal is issued. Some systems also vibrate the steering wheel.

Lane keeping assistance systems extend the above approach by automatically taking some measure of corrective action. Typically, the system applies gentle steering inputs, as necessary, to maintain the vehicle's path down the centre of the intended travel lane.

Note that, while ADAS can help with the driving task, users must be aware of the limitations imposed by such issues as inclement weather, darkness, glare, a lack of clear lane markings, etc.