A Classification of Driver Assistance Systems

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General Considerations

Driver Assistance Systems seem to have a considerable potential for road safety and traffic efficiency improvement.

Driver Assistance Systems:

**Support** the modification of the driving task by providing:

- information
- advice
- assistance

**Influence** directly and indirectly the behaviour of users of both equipped and non-equipped vehicles.

**Alleviate** accident consequences by in-vehicle intelligent injury reducing systems.
Classification of Driver Assistance Systems

**System oriented approach**
Based on the road safety features examination, where the **distinct phases in the accident process** are utilized.

**User oriented approach**
Based on their functional analysis, these systems are classified according to the **supported levels of driving tasks**
- individual / professional driver
- fleet owner
- elderly drivers
- etc.
Objective

**System** oriented approach

**User** oriented approach

Such classification fails to provide answers on the usefulness of Driver Assistance Systems.

Certain parameters not taken into consideration:
- impact to traffic efficiency
- road safety

**Outline** these two different approaches where **priorities** for future developments can be better identified.
Classification based on Distinct Phases in the Accident Process

Driver Assistance Systems are meant to **improve** road safety by
- influencing traffic exposure
- reducing the probability of crashes
- reducing injury consequences

**Distinct phases in the accident process**
- pre-crash
- crash
- post-crash
Pre-Crash Phase

Driver Assistance Systems mainly focused in the **support** provided to the driver

- information
- perception
- convenience
- driver – vehicle monitoring
Pre-Crash Phase

Navigation Systems

• navigation routing
  • location and route guidance
• integrated navigation
  • additional services (signing, warning, or even intervening in the driving process)
• real time traffic and traveler information
  • combine information available to users of traditional navigation systems with real time travel-related information (road surface condition, work zones, congestion, etc.)
Pre-Crash Phase

Elimination of unnecessary and sometimes dangerous deceleration and acceleration areas

- automated transaction systems (electronic toll collection)
Pre-Crash Phase

Driver Performance Monitoring Systems

• driver health monitoring
  • assess several parameters of the driver's health and combines the results to estimate the current health level of the driver
  • if it appears to be below certain pre-selected "safe" levels the driver and possibly some external entity are notified (e.g. doctor, police)
Pre-Crash Phase

Vehicle Status Monitoring Systems

• tachograph recording
• engine condition information services
  (e.g. oil pressure, tire inflation pressure, etc.)
Crash Phase

Smart Restraint Systems

- vehicle restraint systems (EN1317)
- passive safety of support structures for road equipment (EN 12767)
Post-Crash Phase

Alerting Systems

• alert emergency services (e.g. police, ambulance, fire brigades, highway patrols)
• dedicated support services
  • troubled drivers get connected automatically
Classification based on Supported Levels of Driver Tasks

Tactical
Operational
Tactical Levels of Driver Tasks

Longitudinal Control Systems

• intelligent speed adaptation (ISA)
  • external speed recommendations
  • automatic speed reduction function
    (directly, or indirectly by managing signalization)
• adaptive cruise control (ACC)
  • senses the presence and relative speed of moving vehicles ahead and adjusts the vehicle’s speed accordingly
Tactical Levels of Driver Tasks

Lateral Control Systems

- road and lane departure collision avoidance
  - warning and control assistance to the driver
    (through lane or road edge tracking and by determining the safe speed for the road geometry in front)
- lane change and merge collision avoidance
  - detect and warn the driver of vehicles and objects in adjacent lanes
  - particular valuable during lane change or merging maneuvers
Tactical Levels of Driver Tasks

General Vehicle Control Systems

- automatic stop-and-go
  - significant safety benefits in hazardous situations or frequent stop-and-go conditions (e.g. congestion)
- platooning
  - lower level of maturity
  - each vehicle travels keeping a constant headway from the preceding
Tactical Levels of Driver Tasks

Collision Avoidance Systems

- rear end collision avoidance
  - senses the presence and speed of vehicles and objects in the vehicle's lane of travel and provides to minimise the risk of collisions
- obstacle and pedestrian detection
  - warning of driver when pedestrians or obstacles are in close proximity to the driver's path
- intersection collision warning
  - utilize a cooperation of vehicle and infrastructure
  - mostly beneficial at railway crossing areas
Augment Driver’s Perception

- vision enhancement systems
  - headlight design
  - blind spot detection
  - parking aids
  - etc.
- road surface condition info
  - collect and analyze data using vehicle-mounted or fixed infrastructure road sensors
Operational Levels of Driver Tasks

Driver Convenience Systems

- driver identification
  - adjust seat, steering wheel, mirrors, etc.
- hands-free interfaces and remote controls
Conclusions

The specific contribution of driver assistance systems is still under consideration and research:

- some systems present a net potential for road safety improvement
- some others have an effect mainly on traffic efficiency improvement

There is a need for "intelligent" roads that will support and cooperate with the "intelligent" vehicles.

More and more systems tend to connect and collaborate with external systems.

In every case the safety of the driver as well as the vehicle passengers is the overall goal.
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